1977

Cadillac



SERVICE MANUAL

DAVE GRAHAM
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QUICK REFERENCE INDEX. To use, move either the hand or selection tool directly over the section you desire to reference. Simply click once with the mouse button and the manual will automatically jump to that section.

1977 CADILLAC SERVICE MANUAL

FOREWORD

This service manual has been prepared by the Service Department of the Cadillac Motor Car Division to aid in servicing 1977 model Cadillac automobiles. It is intended primarily for servicemen who are familiar with earlier model Cadillacs. It includes complete information on service procedures and specifications specific to 1977 Cadillac cars except body service information which is covered in the body service manual.

All information, illustrations and specifications contained in this manual are based on the latest product information available at time of publication. The right is reserved to make changes at any time without notice. Refer to the Cadillac Serviceman for updated information.

When reference is made in this manual to a brand name, number or specific tool, an equivalent product may be used in place of the recommended item.

CAUTION

1977 vehicles contain many parts dimensioned in the metric system. Most fasteners are metric and many are very close in dimension to familiar customary measurements in the inch system. However, it is important to note that, during any vehicle maintenance procedures, replacement fasteners must have the same measurements and strength as those removed, whether metric or customary. Mismatched or incorrect fasteners can result in vehicle damage or malfunction, or possibly personal injury. Therefore, fasteners removed from the vehicle should be saved for re-use whenever possible. Where the fasteners are not satisfactory for re-use, care should be taken to select a replacement that matches the original. The symbol (M) on some illustrations in this manual indicates metric fasteners.

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Detroit, Michigan 48232

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TABLE OF CONTENTS

GENERAL INFORMATION A. General Information B. Maintenance & Lubrication	0.
AIR CONDITIONING	1.
BODY, FRAME AND BUMPERS A. Frame and Body Mounts B. Bumpers C. Chassis Sheet Metal	2.
STEERING, SUSPENSION, WHEELS AND TIRES A. Front End Alignment B. Steering C. Front Suspension D. Rear Suspension E. Wheels and Tires	3.
DRIVE AXLE AND PROPELLER SHAFT A. Propeller Shaft B. Rear Axle C. Front Wheel Drive	4.
BRAKES	5.
ENGINE A. Mechanical B. Cooling C. Fuel Systems D. Electrical E. Emission Controls F. Exhaust System	6.
TRANSMISSION A. 400 Transmission B. 425 Transmission	7.
CHASSIS AND BODY ELECTRICAL	8.
ACCESSORIES	9.
APPENDIX — METRIC TABLES	10.
ALAPHABETICAL INDEX	11.
ELECTRICAL/VACUUM CIRCUIT DIAGRAMS	INSIDE BACK COVER

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IMPORTANT SAFETY NOTICE

Proper service and repair is important to the safe, reliable operation of all motor vehicles. The service procedures recommended by Cadillac and described in this service manual are effective methods of performing service operations. Some of these service operations require the use of tools specially designed for the purpose. The special tools should be used when and as recommended.

It is important to note that this manual contains various Warnings, and Cautions which should be carefully read in order to minimize the risk of personal injury to service personnel or the possibility that improper service methods will be followed which may damage the vehicle or render it unsafe. It also is important to understand that these Warnings, and Cautions are not exhaustive. Cadillac could not possibly know, evaluate and advise the service trade of all conceivable ways in which service might be done or the possible hazardous consequences of each way. Consequently, Cadillac has not undertaken any such broad evaluation. Accordingly, anyone who uses a service procedure or tool which is not recommended by Cadillac must first satisfy himself thoroughly that neither his safety nor vehicle safety will be jeopardized by the service method he selects.

SECTION 0A

ARRANGEMENT OF THE MANUAL

The title page contains a rapid reference section index with headings corresponding to the page tabs at the beginning of each section. A table of contents is provided at the beginning of each section. A complete Alphabetical Index is located at the back of the manual.

The individual sections include a general description and diagnosis at the beginning of each section followed by on car service and unit repair procedures. An illustrated list of special tools, a torque requirement chart, and specifications are provided as required at the end of each section.

Service information pertaining only to those features that are exclusive to the Eldorado or Seville is provided at the back of the individual sections in the manual. For Eldorado and Seville procedures and recommendations not listed, refer to the forward part of the appropriate section, as these service procedures are similar to those on other 1977 Cadillac models.

GENERAL INFORMATION

VEHICLE IDENTIFICATION NUMBER

Each 1977 Cadillac automobile or commercial chassis carries a 13 digit vehicle identification number used for license and insurance identification and in general reference to the automobile. The number is located on the forward lower edge of the windshield frame below the instrument panel cover on the driver's side of the car where it is visible through the windshield. The Cadillac identification number is decoded in Fig. 0A-1.

The last six digits of the number determine the sequence in which the car was built. Assembly lines are assigned specific sequence numbers as follows:

100001 Through 400000 Detroit Built "C" series and Eldorados.

600001 Through 690000 Linden Built "C" series.

450001 Through 550000 Detroit Built "K" series.

The series and body type (2nd, 3rd, and 4th digits) of the vehicle identification number may be further decoded using Fig. 0A-3. The letter designates the car series (B = Brougham; D = DeVille; F = Fleetwood, etc.). The two numbers designate whether the body style has 2-doors or 4-doors. For the Limousine, the numbers determine whether the vehicle is equipped with a center partition. For the Commercial Chassis, the number represents the name of a

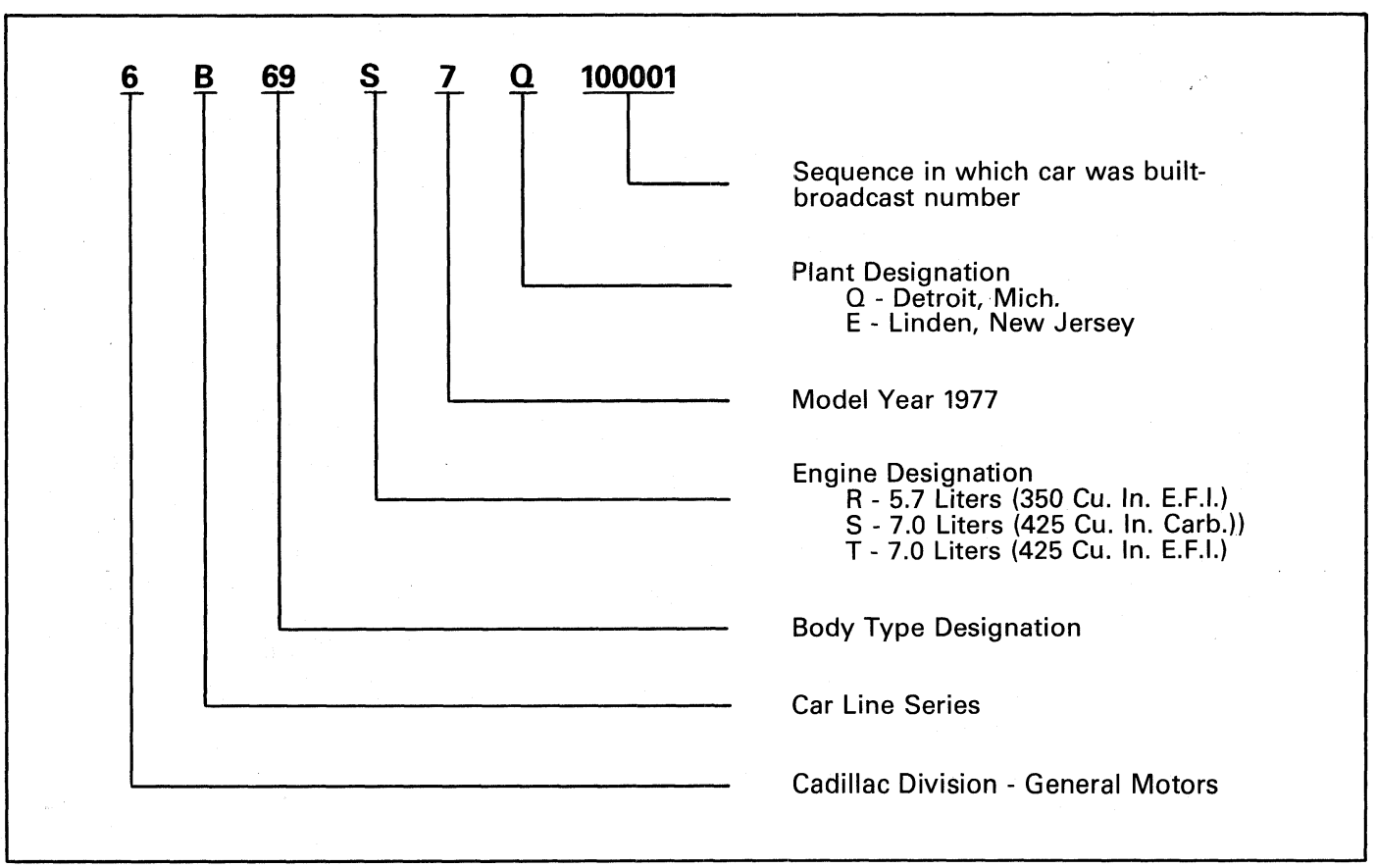
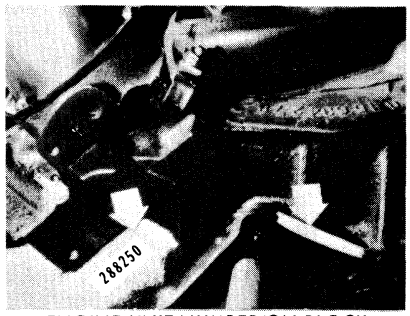
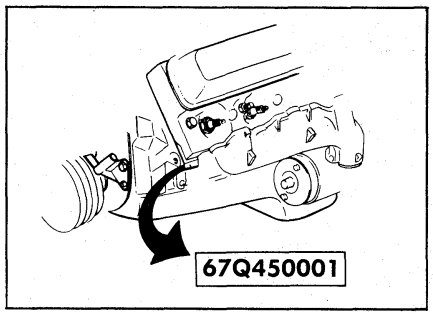


Fig. 0A-1 Vehicle Identification Number



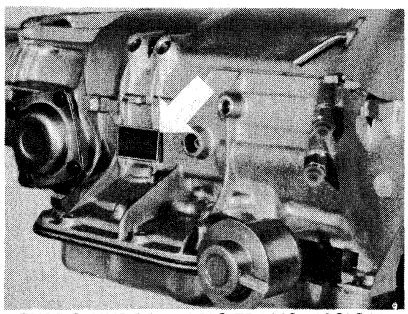
ENGINE UNIT NUMBER ON BLOCK BEHIND LEFT CYLINDER HEAD; V. I. N. DERIVATIVE ON BLOCK BEHIND INTACK MANIFOLD (EXCEPT SEVILLE).



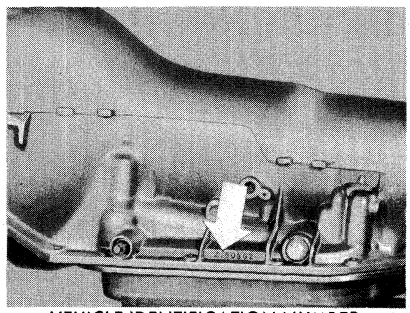
ENGINE IDENTIFICATION NUMBER LOCATED ON LEFT HAND SIDE OF CYLINDER BLOCK AT FRONT BELOW CYLINDER HEAD (SEVILLE ONLY)



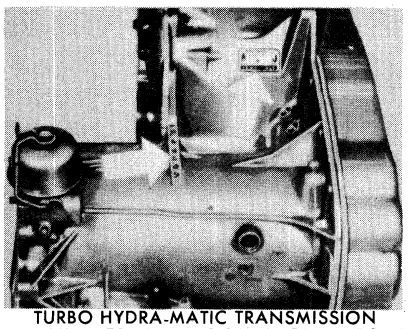
VEHICLE IDENTIFICATION NUMBER LOCATED ON PLATE RIVETED TO COWL BAR IN THE LOWER LEFT HAND CORNER OF THE WINDSHIELD



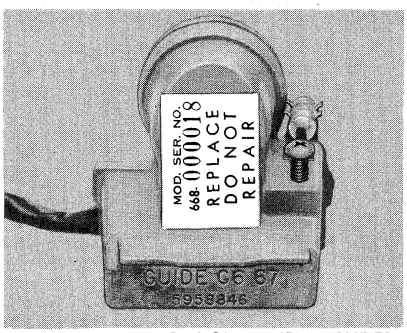
TURBO HYDRA-MATIC TRANSMISSION UNIT NUMBER PLATE LOCATED ON RIGHT SIDE OF CASE (EXCEPT ELDORADO)



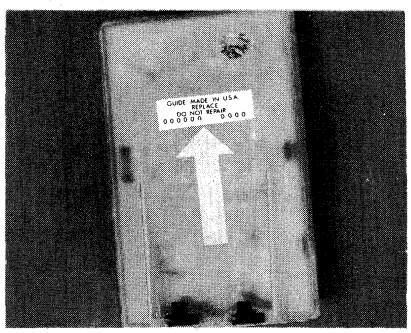
VEHICLE IDENTIFICATION NUMBER DERIVATIVE LOCATED ON LEFT SIDE OF TRANSMISSION CASE (EXCEPT ELBORADO)



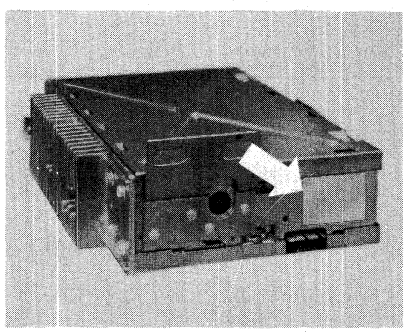
TURBO HYDRA-MATIC TRANSMISSION UNIT NUMBER PLATE LOCATED ON LEFT SIDE OF CONVERTER HOUSING. VEHICLE IDENTIFICATION NUMBER DERIVATIVE LOCATED ON VERTICAL SUPPORT PAD ON LEFT OF TRANSMISSION (ELDORADO).



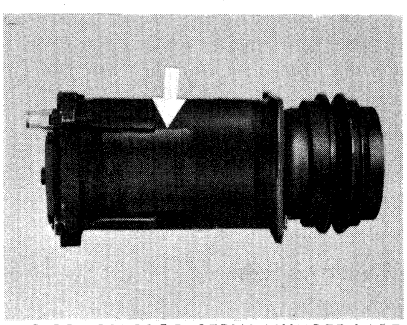
GUIDE-MATIC PHOTOCELL AND AMPLIFIER SERIAL NUMBER LABEL LOCATED ON BACK OF UNIT



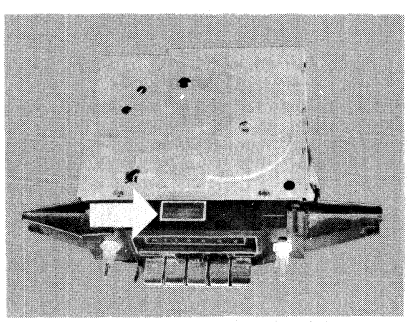
TWILIGHT SENTINEL AMPLIFIER SERIAL NUMBER LABEL LOCATED ON COVER OF UNIT.



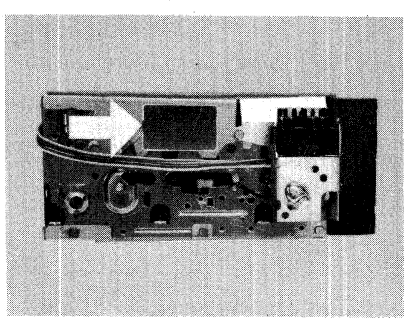
ELECTRONIC CONTROL UNIT SERIAL NUMBER TAG LOCATED ON RIGHT SIDE OF UNIT.



A/C COMPRESSOR SERIAL NUMBER LABEL LOCATED ON REAR PORTION OF COMPRESSOR HOUSING



RADIO SERIAL NUMBER TAG LOCATED ON THE TOP FRONT OF RADIO (EXCEPT ELDORADO AND SEVILLE).



RADIO SERIAL NUMBER TAG LOCATED ON BACK SIDE OF RADIO. (ELDORADO AND SEVILLE ONLY)

Fig. 0A-2 Unit Location

DESCRIPTION	MODEL DESIGNATION NUMBER	BODY TYPE	SHIPPING WEIGHT (LESS OPTIONS) KG	SHIPPING WEIGHT (LESS OPTIONS) LB	WHEELBASE MM	WHEELBASE IN.	OVERALL LENGTH MM	OVERALL LENGTH IN.	OVERALL HEIGHT MM	OVERALL HEIGHT IN.	MAXIMUM WIDTH MM	MAXIMUM WIDTH IN	TREAD WIDTH FRONT MM	TREAD WIDTH FRONT IN.	TREAD WIDTH REAR MM	TREAD WIDTH REAR IN.
FLEETWOOD BROUGHAM	B69	4-Door Pillar Sedan	1969	4340	3085	121.5	5618	221.2	1441	56.7	1942	76.4	1568	61.7	1542	60.7
SEDAN DE VILLE	D69	4-Door Pillar Sedan	1915	4222	3085	121.5	5618	221.2	1404	55.3	1942	76.4	1568	61.7	1542	60.7
COUPE DE VILLE	D47	2-Door Coupe	1899	4186	3085	121.5	5618	221.2	1381	54.4	1942	76.4	1568	61.7	1542	60.7
ELDORADO COUPE	L47	2-Door Hardtop Coupe	2248	4955	3208	126.3	5692	224.0	1376	54.2	2027	79.8	1618	63.7	1615	63.6
SEVILLE	S69	4-Door Pillar Sedan	1900	4190	2903	114.3	5182	204.0	1386	54.6	1824	71.8	1557	61.3	1499	59.0
FLEETWOOD LIMOUSINE	F23	4-Door Auxiliary Seat Sedan	2149	4738	3670	144.5	6203	244.2	1446	56.9	1942	76.4	1568	61.7	1542	60.7
FLEETWOOD FORMAL LIMOUSINE	F33	4-Door Auxiliary Seat Sedan With Center Partition	2180	4806	3670	144.5	6203	244.2	1446	56.9	1942	76.4	1568	61.7	1542	60.7
COMMERCIAL CHASSIS	Z90	—	—	—	3670	144.5	—	—	—	—	—	—	1568	61.7	1542	60.7

Fig. 0A-3 General Description and Specifications

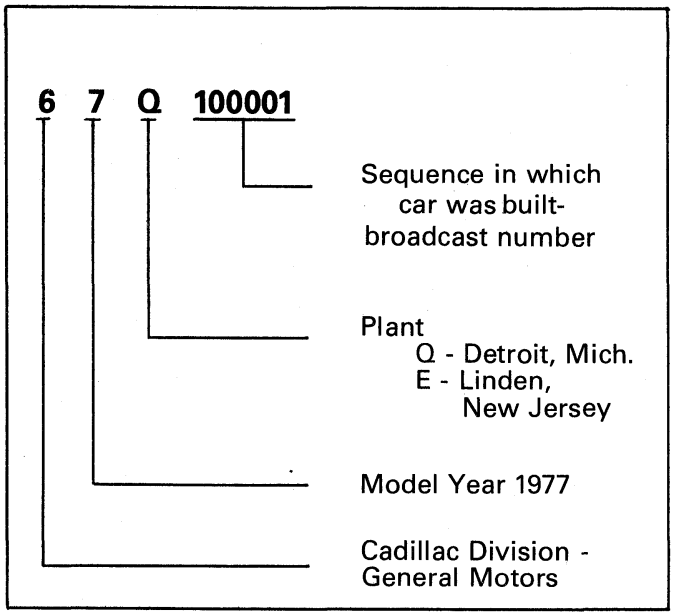


Fig. 0A-4 Vehicle Identification Number Derivative

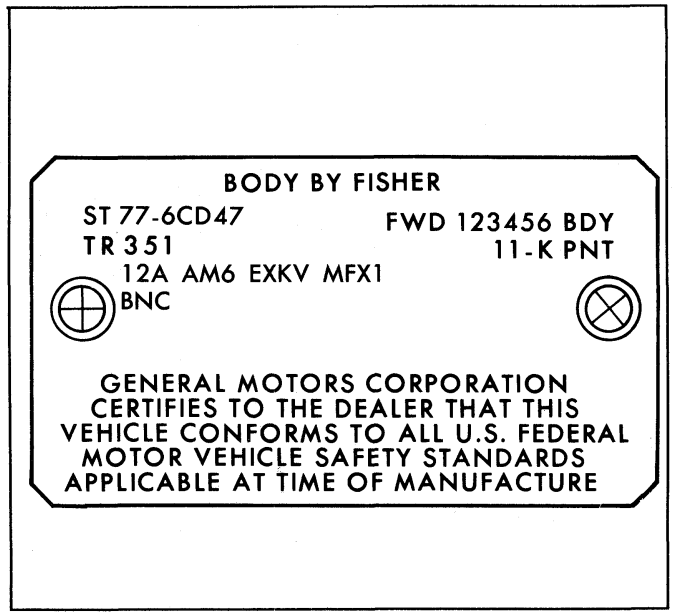


Fig. 0A-5 Body Identification Plate

commercial body builder.

A nine-digit derivative of the vehicle identification number is applied to the engine and transmission at the locations shown in Fig. 0A-2. This derivative is used for in-plant control of these assemblies and may be used by law enforcement or other officials to identify proper engine-chassis combinations. This number should contain the same numbers and letters as the vehicle identification number but in the condensed form shown in Fig. 0A-4.

IDENTIFICATION NUMBERS

Location of identification numbers on various units are shown in Fig. 0A-2. The identification number on the unit should always appear on product report forms sent to the Central Office such as PIR's, Claim Tags, Pre-Delivery Reports and, when required, on Warranty Claims. The 13 digit Vehicle Identification Number is necessary when reporting product information on any vehicle.

BODY IDENTIFICATION PLATE

The body identification plate, Fig. 0A-5, carries the style number, trim number, body number, and paint number in the areas indicated by ST, TR, BDY, and PNT.

The first two digits of the style number (ST) indicate the model year while the remaining five digits indicate the model designation.

The numbers following the trim number (TR) indicate the interior trim color and seat type.

The body number (BDY) consists of three letters indicating the assembly plant and six digits indicating the sequence in which the body was built.

The first two digits of the paint number (PNT) indicate color of the body; the letter indicates the color of the vinyl top.

The number-letter code at the left below trim indicates date of assembly (month-01 through 12, week A through E).

Number-letter codes following the date of assembly indicate Fisher Body options and accessories installed at the factory.

For body identification plate locations, refer to Fig. 0A-6.

TIRE PRESSURE

When inflated as recommended on the tire pressure placard, located on the inside surface of the glove compartment door, Fig. 0A-8, the tires originally installed will operate satisfactorily at all normal highway loads and

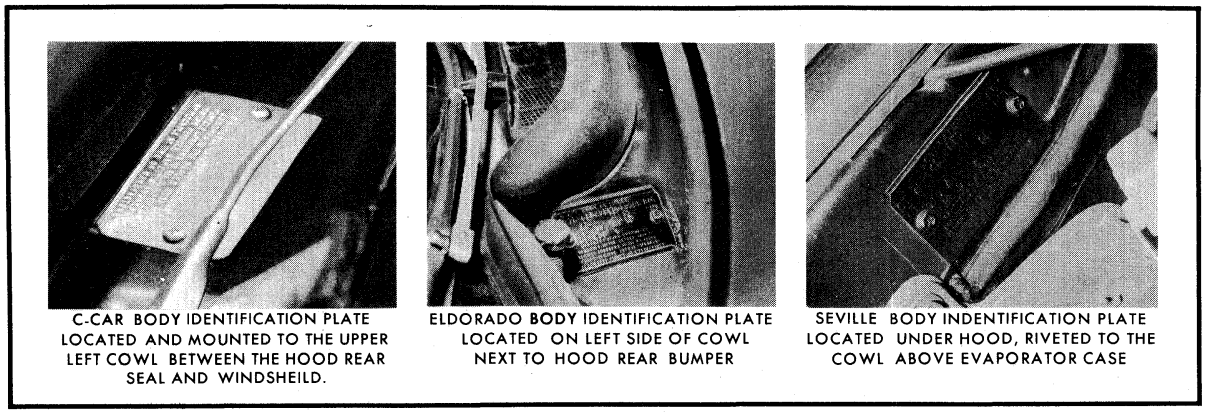


Fig. 0A-6 Body Identification Plate Location

TIRE PRESSURE CHART

Vehicle Capacity — Plus 91kg (200 lbs) Trunk Load

Brougham, DeVille Sedan and Coupe, Eldorado — 6 Occupants
Fleetwood Limousine — 8 Occupants
Fleetwood Formal Limousine — 7 Occupants
Seville — 5 Occupants

	Up to Vehicle Capacity		Up to Five Occupants (Four-Seville)	
Car Series	Front kPa — psi	Rear kPa — psi	Front kPa — psi	Rear kPa — psi
Brougham	166 — 24	207 — 30	166 — 24	166 — 24
DeVille	193 — 28	221 — 32	179 — 26	179 — 26
Eldorado	193 — 28	166 — 24	186 — 27	138 — 20
Limousine	207 — 30	248 — 36	186 — 27	186 — 27
Seville	166 — 24	193 — 28	166 — 24	166 — 24
Commercial	345 — 50	517 — 75	—	—

Fig. 0A-7 Tire Pressure Chart

speeds. Do not load your vehicle beyond the capacity (total kilograms or pounds) shown on the tire placard. This represents the design capacity of the vehicle, not merely of the tires. For tire pressure specifications, refer to Fig. 0A-7.

KEYS

All 1977 Cadillacs use TWO specific keys.

1. Square head - used for ignition switch ONLY.
2. Oval head - used for doors, glove box and trunk.

A third specific oval head key is used on the right rear door of the Fleetwood Limousine and Fleetwood Formal Limousine.

Key blank code letters are "A" for square head and "B" for oval head.

TOWING INSTRUCTIONS

Refer to the General Motors 1977 Passenger Car and Light Truck Towing Instructions Manual.

PUSHING OR PULLING CAR TO START ENGINE

CAUTION: *Vehicle must not be pushed or towed to start.*

Since there is no direct mechanical link from the engine to the drive wheels, any attempt to start the engine by pushing the car will be unsuccessful. Should the battery become discharged, it will be necessary to use an auxiliary battery

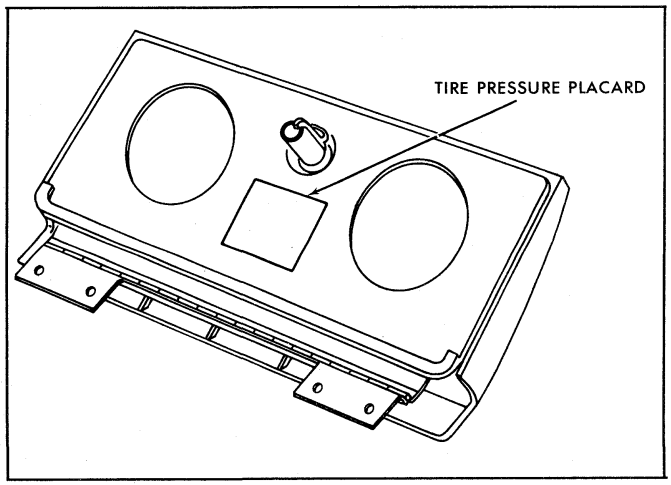


Fig. 0A-8 Tire Placard Location

JUMP STARTING WITH AUXILIARY (BOOSTER) BATTERY

WARNING: THE FOLLOWING JUMP START PROCEDURE IS FOR USE ONLY UNDER THE FOLLOWING CONDITIONS. DEPARTURE FROM THESE CONDITIONS AND PROCEDURES COULD RESULT IN: (1) PERSONAL INJURY CAUSED BY ELECTROLYTE SQUIRTING OUT THE BATTERY VENT, (2) PERSONAL INJURY OR PROPERTY DAMAGE DUE TO BATTERY EXPLOSION, (3) DAMAGE TO THE CHARGING SYSTEM OF THE BOOSTER VEHICLE OR THE IMMOBILIZED VEHICLE. IF ALL THE CONDITIONS CANNOT BE MET, OR IF YOU ARE UNCERTAIN ABOUT THEM, WE STRONGLY RECOMMEND FOR YOUR SAFETY AND THAT OF THE CAR THAT JUMP STARTING BE DONE ONLY BY A COMPETENT MECHANIC.

The battery in the other vehicle must be 12 volts and negatively grounded. The nominal voltage and grounding of the vehicle's battery may be determined by checking the specifications in the owner's manual. Use of a booster battery of a higher nominal voltage, or which is positively grounded may result in serious personal injury or property damage.

WARNING: NEVER EXPOSE BATTERY TO OPEN FLAME OR ELECTRIC SPARK — BATTERY ACTION GENERATES HYDROGEN GAS WHICH IS FLAMMABLE AND HYDROGEN GAS WHICH IS FLAMMABLE AND EXPLOSIVE. DO NOT ALLOW BATTERY FLUID TO CONTACT EYES, SKIN, FABRICS, OR PAINTED SURFACES — FLUID IS A CORROSIVE SULFURIC ACID SOLUTION WHICH COULD CAUSE SERIOUS PERSONAL INJURY OR PROPERTY DAMAGE. FLUSH ANY CONTACTED AREA IMMEDIATELY WITH WATER. WEAR EYE PROTECTION SUCH AS INDUSTRIAL SAFETY SPECTACLES OR GOGGLES WHEN WORKING ON OR NEAR BATTERY. REMOVE RINGS, METAL WATCH BANDS AND OTHER METAL JEWELRY BEFORE JUMP STARTING OR WORKING AROUND A BATTERY. BE CAREFUL IN USING METAL TOOLS AND EQUIPMENT. IF SUCH METAL SHOULD CONTACT THE POSITIVE BATTERY TERMINAL (OR METAL IN CONTACT WITH IT) AND ANY OTHER METAL ON THE CAR, A SHORT CIRCUIT MAY OCCUR WHICH COULD CAUSE PERSONAL INJURY. BATTERIES AND ACID SHOULD ALWAYS BE KEPT OUT OF REACH OF CHILDREN.

The battery, called a freedom battery, is a sealed-type battery that does not have filler openings or caps. If the car contains a replacement battery other than a sealed type, refer to jump starting instructions provided by the manufacturer of the battery.

JUMP START PROCEDURE:

1. Set parking brake and place automatic transmission in "Park" position. Turn off lights, heater, and other electrical loads.

WARNING: CHECK BATTERY CHARGE INDICATOR. IF INDICATOR IS LIGHT (ALL CLEAR), REPLACE BATTERY. DO NOT ATTEMPT JUMP STARTING WHEN INDICATOR IS LIGHT, AS THIS COULD CAUSE AN EXPLOSION.

2. Attach the end of one jumper cable to the positive terminal of the booster battery and the other end of the same cable to the positive terminal of the discharged battery. DO NOT PERMIT vehicles to touch each other as this could cause a ground connection and counter act the benefits of this procedure.

3. Attach one end of the remaining negative cable to the negative terminal of the booster battery, and the other end to a solid engine ground (such as A/C or alternator mounting bracket) at least 12 inches from the battery of the vehicle being started. (DO NOT CONNECT DIRECTLY TO THE NEGATIVE POST OF THE DEAD BATTERY.)

4. Reverse this sequence exactly when removing the jumper cables.

Hoist Recommendations (Except Eldorado)

CAUTION: *Failure to follow the recommendations outlined below may result in unsatisfactory vehicle performance, or a decreased durability which may result in loss of control of the vehicle.*

The preferred type of hoists for lifting Cadillacs is one that engages the front suspension and rear axle (twin post type), or all four wheels.

When using a twin post hoist, the front hoist saddle should be positioned under the suspension lower control arm as shown in Fig. 0A-9. Extend the saddle arms outward as far as possible without contacting either the lower spherical joint or the tie rod end. The rear hoist saddle should be positioned directly under the rear axle and stabilizer bar, if vehicle is so equipped, Fig. 0A-10.

CAUTION: *The rear lower control arms should never be used as a lift point.*

If a frame-engaging hoist is used, lift only in the areas shown in Fig. 0A-11.

CAUTION: *When raising the side of the vehicle with a floor jack or similar device, do not position the jack under the frame side rail at the mid-car area on coupes or center pillar area on sedans or any other portion of the center rail that is unboxed as this may bend the frame side rail.*

For Seville only, Fig. 0A-12, lift frame between the No. 2 body mount and the transmission rear support crossmember. The rear should be lifted on the horizontal body reinforcements inboard of the leaf spring and support.

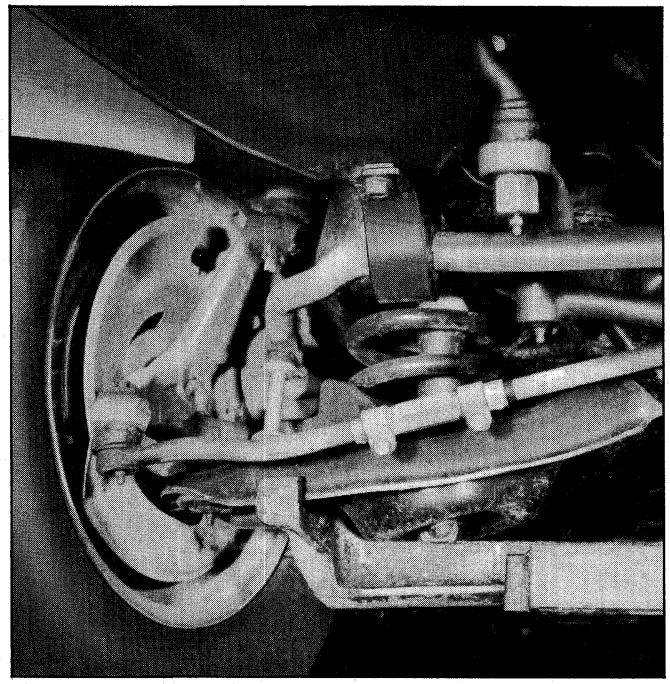


Fig. 0A-9 Front Hoist Saddle Position (Exc. Eldorado)

CAUTION: *Supports must be positioned so as to distribute load and support vehicle in a stable manner. Care must be exercised to insure that placement of hoist supports does not damage brake lines, fuel lines, exhaust system, park brake cable or rear leaf springs.*

CAUTION: *The shock absorbers act as rebound stops for the rear suspension. Under no circumstances should the rear end of car be raised so that rear suspension is in rebound position while disconnecting shock absorbers.*

Hoist Recommendations (Eldorado Only)

CAUTION: *Failure to follow the recommendations outlined below may result in unsatisfactory vehicle performance, or decreased durability which may result in loss of control of the vehicle.*

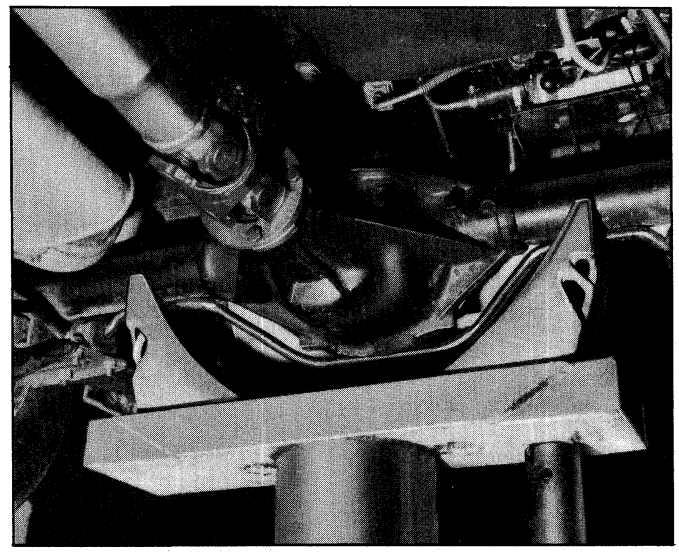


Fig. 0A-10 Rear Hoist Saddle Position

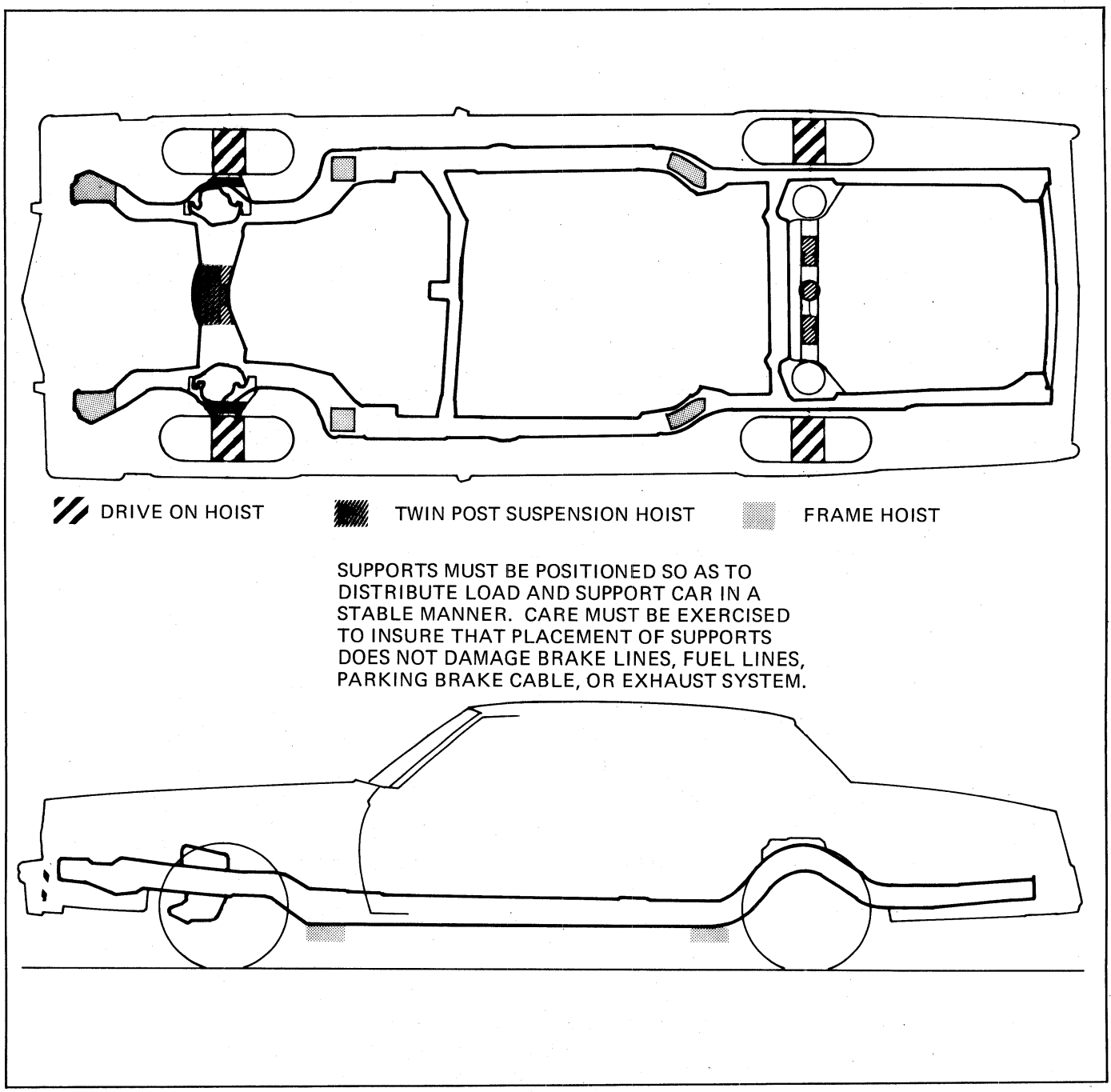


Fig. 0A-11 Lifting Location (C-Car)

The preferred type of hoist for lifting the Eldorado is one that engages the front suspension and rear axle or all four wheels.

Use of a suspension-engaging hoist requires that certain procedures be observed.

Be sure front hoist saddle adapters engage lower suspension arm just inboard of stabilizer linkage (both sides), Fig. 0A-13, to prevent damage to steering linkage.

When using a suspension engaging hoist place "saddles" of hoist in the maximum "inward" position and under the rear axle to prevent damage to Automatic Level Control overtravel lever bracket, fuel lines, and brake lines. Continue to raise the hoist slowly until contact with the rear axle. Complete lifting operations.

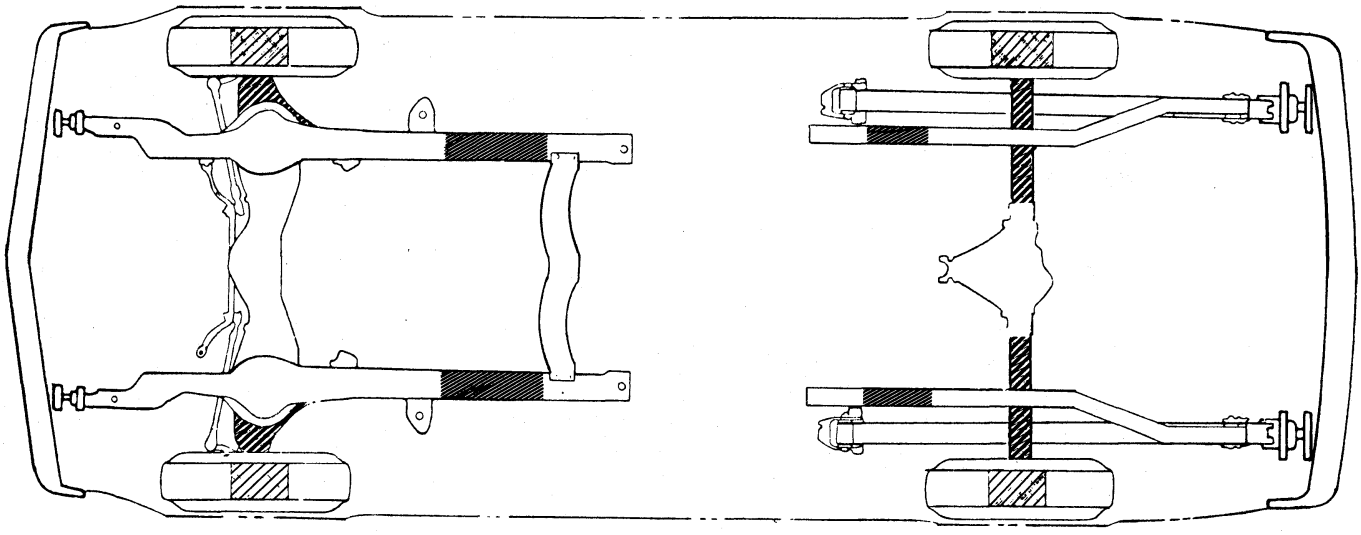
CAUTION: *The rear lower control arm should never be used as a lift point. Doing so could result in damage to the rear suspension and non-standard vehicle performance.*

If a frame engaging hoist is used, certain precautions must also be observed.

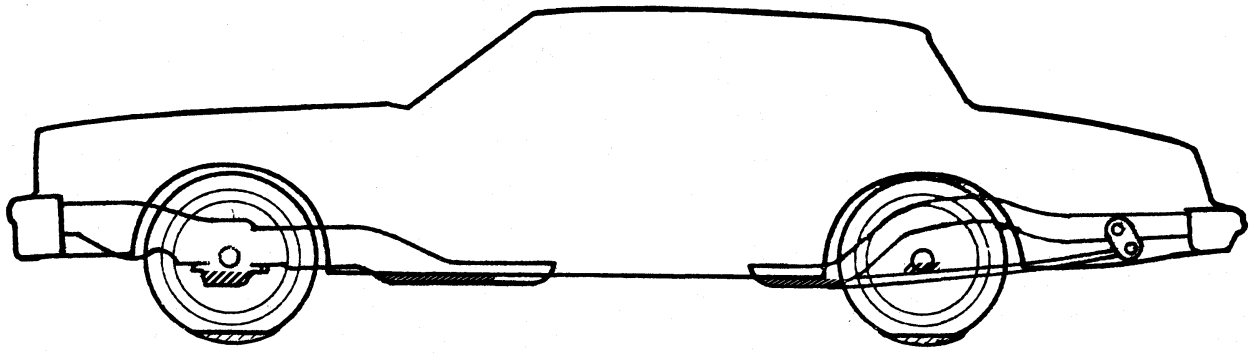
Make sure that hoist adapters and "tabs" are in lowered position before driving on or off the lift.

Position hoist adapter "tabs" in raised position to obtain maximum possible height between frame and hoist.

Be sure to position adapter tabs in exact locations shown in the shaded areas of Fig. 0A-14 and make sure the centerline of the door is behind the centerline of the lift post for proper weight distribution.



DRIVE ON HOIST TWIN POST SUSPENSION HOIST FRAME HOIST



SUPPORTS MUST BE POSITIONED SO AS TO DISTRIBUTE LOAD AND SUPPORT CAR IN A STABLE MANNER. CARE MUST BE EXERCISED TO INSURE THAT PLACEMENT OF SUPPORTS DOES NOT DAMAGE BRAKE LINES, FUEL LINES, PARING BRAKE CABLE, REAR LEAF SPRINGS OR EXHAUST SYSTEM.

Fig. 0A-12 Lifting Locations (Seville)

NOTE: Certain cars are equipped at these locations with special brackets used for rail shipment. If such a situation is encountered, be sure to engage bracket fully rather than at the edges.

An additional precaution of using two floor stands under the front frame crossmember of the Eldorado is recommended when heavy mechanical operations are to be performed. Be sure to remove these stands before attempting to lower the vehicle.

If a drive-on hoist is used, be sure the center line relationship as stated above is also applied, Fig. 0A-14.

When supporting the Eldorado with a floor jack or jack stands, the supports should be placed at the suspension lift points or the frame contact lift points. The Eldorado should never be supported at the extreme ends of the frame or at the center of the frame side rail or lifted at the front or rear bumper with anything other than the bumper jack provided with the car.

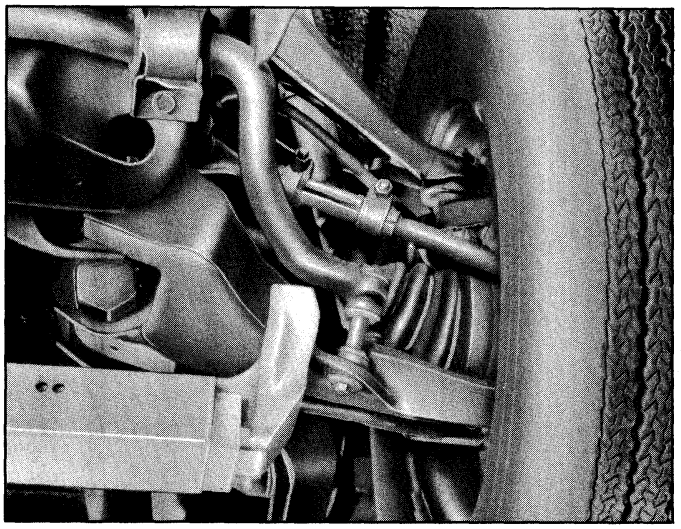


Fig. 0A-13 Front Hoist Saddle Position (Eldorado)

VIBRATION COMPLAINTS AND CORRECTION

NOTE: Before proceeding with the vibration correction procedure, make certain any and all performance problems are completely resolved.

There are several excitation sources and many responding systems which may cause an annoying vibration. The first step is to identify individual vibration complaints by systematically classifying them, during a road test, into one or more of the following categories: (1) car speed sensitive, (2) engine speed sensitive, (3) torque (throttle) sensitive, or (4) jounce sensitive. Since each of these categories has specific vibrations associated with it, this classification will give direction to the proper area for analysis of the problem. This will eliminate many components that cannot be the cause, and will focus attention on only those items that can contribute to the specific condition encountered.

1. Road Test

Prior to the initial road test, check and adjust the tire pressures and install an engine tachometer. Next, ride the car with the owner driving and have him point out the disturbance with which he is concerned.

NOTE: The importance of riding in the car with the owner cannot be over-emphasized.

If the condition is normal, and no corrective work is needed, the owner should be told immediately. This normalcy can be demonstrated with other vehicles, pointing out that similar vehicles have the same condition.

2. Sensitivity Classification

Having verified that a vibration problem does exist, the first step in correcting the problem is to classify it in terms of one or more of the following sensitivity categories.

a. Car Speed Sensitive

Most vibration complaints will be found to be car speed sensitive, i.e., the frequency of the excitation depends only on the speed of the vehicle. To determine if a given problem is car speed sensitive:

(1) Drive the car in "Drive Left" and record the car speed and the engine RPM at which the problem occurs.

(2) Shift the car into "Drive Right" and again record the car speed and the engine RPM at which the problem occurs.

(3) If the problem occurs at the same **car speed** as when the car was in "Drive Left", the vibration is car speed sensitive.

NOTE: It is possible that two problems could occur at the same car speed. Decelerate the engine to the RPM obtained in Step 1 and check to see that problem has disappeared. If it has not, there are two problems: one of which occurs at the **car** speed determined in Step 1, while the second occurs at the **engine** speed determined in Step 1.

b. Engine Speed Sensitive

Another group of vibration complaints will be found to be engine speed sensitive, i.e., the frequency of the excitation depends only on the speed of the engine, independent of the speed of the vehicle. To determine if a given problem is engine speed sensitive:

(1) Drive the car in "Drive Left" and locate the vibration problem. Record the car speed and the engine RPM at which the problem occurs.

(2) Shift the car into "Drive Right" and again locate the vibration problem. Record the car speed and the engine RPM at which the problem occurs.

(3) If the problem occurs at the same **engine speed** as when the car was in "Drive Left", the vibration is engine speed sensitive.

c. Torque Sensitive

A torque sensitive problem is one which increases in intensity as the torque (power) output of the engine increases, i.e., the intensity of the vibration increases a the throttle opening is increased. To determine if a given problem is torque sensitive:

(1) Drive the car in "Drive Left" and record the car speed and engine RPM at which the problem occurs.

(2) Observe the condition while varying the throttle position. Drive the car with steady throttle, slowly increasing to heavy throttle by going up hill or applying the brakes while increasing the throttle opening, and slowly decreasing to minimum throttle by coasting through the vibration speed.

(3) If the condition becomes more severe as the throttle opening is increased, the vibration is torque sensitive.

d. Jounce (or Load) Sensitive

A jounce (or load) sensitive problem is one which varies in intensity as the height of the car changes with respect to the surface of the road, i.e., the intensity varies as the rear springs are extended or compressed. To determine if a given problem is jounce (or load) sensitive:

(1) Drive the car and observe the condition with varying passenger load.

(2) Alternately, drive the car over a road that dips in such a way that it causes the rear of the car to move up and down relative to the surface of the road. Keeping a constant throttle, observe the condition.

(3) If the condition varies depending on the passenger load (or varies as the rear of the car moves up and down), the problem is jounce (or load) sensitive.

e. Multiple Classification

In the process of classifying vibration problems in terms of these four sensitivity categories, you will find that many problems fit more than one of the categories. Combining these categories into their possible combinations, the majority of all vibration problems will fall into one of the following "cases" of categories:

(1) Engine speed sensitive only

(2) Car speed sensitive only

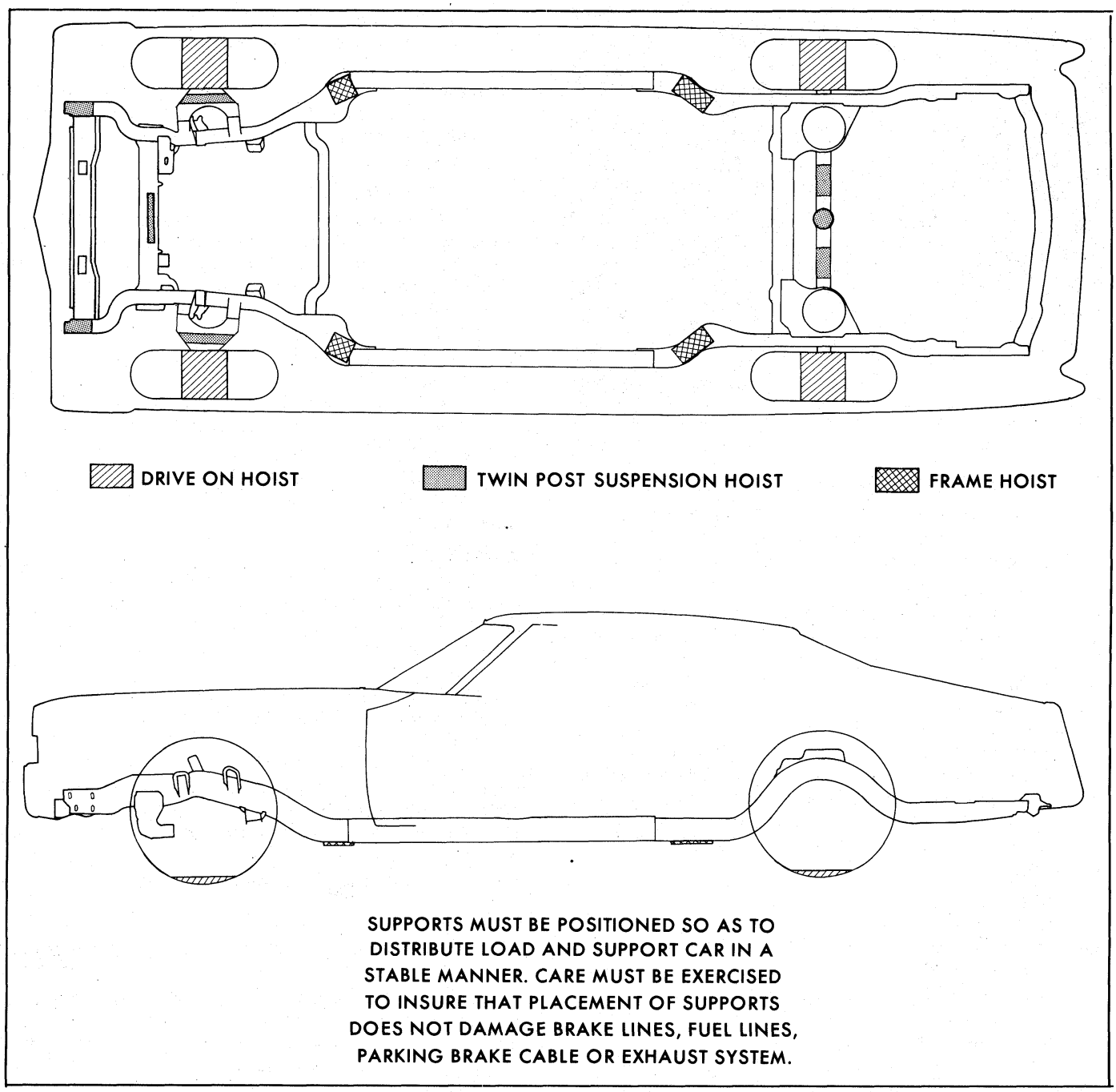


Fig. 0A-14 Lifting Locations (Eldorado)

(3) Torque sensitive and car speed sensitive
(4) Torque sensitive and engine speed sensitive

3. Engine Speed Sensitive Only

Problems in this class may be duplicated with the car stopped and the transmission in neutral by running the engine at the RPM at which the disturbance was felt durint the road test. All additional appraisals can thus be made under this "free engine" condition.

"Free engine" problems can be due to belts or engine driven accessories (power steering pump, generator, air conditioning compressor, fan, etc.). To isolate the offending component, first check the torque on all accessory mounting bracket bolts. Also, check the condition and tension of all accessory drive belts. If any abnormal conditions are found, correct and retest for the vibration problem.

Air conditioning compressor problems can be diagnosed by turning compressor off and on while the vibration problem is being experienced.

If tightening the accessory mounting bolts and adjusting the drive belt tensions fails to correct the disturbance, remove accessory drive belts, one at a time, tighten the accessory mounting bolts, and retest for the problem. Continue to remove the belts one at a time until the offending component is located.

CAUTION: *With the water pump drive belt removed, the engine may overheat rapidly resulting in possible engine damage; hence, this appraisal must be made very quickly.*

4. Car Speed Sensitive Only

All tire problems are sensitive to car speed only. Driveline unbalance or runout is sensitive to car speed at the rate of one vibration per revolution (First Order). Driveline vibrations at the rate of two or more vibrations per revolution, on either "C" cars or Eldorado, are sensitive to both car speed and torque, and should not be considered as "car speed sensitive only".

a. Suspension Hop and Tramp (Tire Balance)

In order to verify suspension hop and tramp as excited by tire balance and/or runout, proceed as described in Section 3E.

b. Balancing Wheels, Tires, and Brake Drums

Many wheel balancers will adequately balance the wheel-tire-brake drum assembly; however, it is the skill of the operator that really is important. The operator must be well trained on the equipment used.

c. Checking Tire, Wheel Brake Rotor and Rear Axle Runout

Excessive runout will cause a vibration which is exactly like unbalanced wheels and tires. After balancing tires, if a first order tire disturbance still exists, check runout as follows:

1. Wheel and Tire Runout

Follow procedure described in Section 3E. If the runout cannot be reduced to acceptable values by repositioning the tire and wheel, replace the parts at fault. Re-test on the road.

2. Brake Rotor and Axle Shaft Runout

a. If after checking wheel runout (radial and lateral), it is determined that excessive runout is present, check brake rotor or axle shaft for runout with a dial indicator before replacing wheel. Refer to Section 5 for specifications on rotor runout.

b. If lateral (in-out) wheel runout (wobble) is behond specifications, check hub and rotor to wheel pads (front end) or axle flange (rear end) for lateral runout. The dial indicator stem should contact the axle flange or hub and rotor pads as close as possible to the outboard side of the studs.

d. Tire Radial Force Variation

If the disturbance is still present, the problem is due to a non-uniformity in one or more of the tires. This fault is inherent in the tire and often cannot be corrected by any means other than replacement. The problem which remains at this point, however, is to isolate the offending tire(s). This may be accomplished by using a machine capable of measuring loaded radial runout. See Section 3E.

5. Torque Sensitive and Car Speed Sensitive

The only excitation which is both car speed sensitive and torque sensitive is 2nd Order driveline (two vibrations per revolution) on the "C" and "K" car or 3rd Order Driveline (three vibrations per revolution) on the Eldorado. These problems are caused by improper drive shaft angles which are a result of wrong standing height or faulty joints. Refer to Section 3A to check standing height. Drive axle joint replacement is described in Section 4C. Constant velocity universal joint repair is described in Section 4B.

6. Torque Sensitive and Engine Speed Sensitive

The only excitation which is both engine speed sensitive and torque sensitive is the "firing order" excitation (that is, 4th Order for an eight cylinder engine). The problems likely to be encountered in this class are as follows:

a. An engine-driven accessory (power steering pump, generator, air conditioning compressor, etc.) excited by 4th Order Engine.

Engine driven accessories generally do **not** present a problem if all attachment bolts are torqued to specifications and all drive belts are adjusted to the proper tension. In order to verify that an engine-driven accessory is not the cause of a vibration complaint:

(1) Check installation torques on all attachment bolts securing either an accessory to its mounting or the mounting to the engine.

(2) Check all drive belts for correct tension. Also check the physical condition of the belts.

(3) Visually inspect each accessory to ensure that the brackets installed are complete and properly assembled.

The checks outlined above should be performed and any irregularities corrected before proceeding.

b. Power Plant "bending" as excited by 4th Order Engine.

Loosen the top four bolts which attach the transmission to the engine, and reappraise the problem. If this is the actual cause of the complaint, the problem should now occur at a much lower engine speed than it did originally, or be completely eliminated. Retorque bolts before proceeding.

Having thus verified that this is the actual cause of the complaint, the following procedures are suggested as a means of correction:

(1) Inspect the vehicle to be sure the entire engine-transmission assembly and the exhaust system are not in contact with the frame or body.

(2) Inspect the engine and transmission mounts to be sure they have not sagged, or deteriorated.

(3) Check the initial spark advance setting.

(4) If these inspection procedures reveal any irregularities, correct and re-test on the road.

c. Exhaust system "bending" as excited by 4th Order Engine. (This may include either the crossover pipe, exhaust pipe, or tailpipe).

CAUTION: *It is often convenient to test for exhaust system vibrations by stalling the engine in Drive with the brakes applied. However, a car should NEVER be stalled at engine speeds greater than 1200-1300 RPM and NEVER for extended periods of time, since the transmission may overheat. When this method of testing is used, it is best done on a hoist, permitting the driveline and rear axle to rotate after each appraisal to circulate transmission oil. DO NOT USE THIS TEST METHOD FOR ANY PROBLEM OCCURING ABOVE 1300 RPM.*

When a particular component of the exhaust system, such as the exhaust pipe or tailpipe, is suspected of causing a vibration problem, it may be verified by the following procedure:

(1) Put the car on a hoist with a helper behind the wheel and all doors and windows closed. Next, stall the vehicle in "Drive" as described above in the problem RPM range, while pressing a metal object (such as a wrench or screwdriver) lightly against the suspected component. If this component is the cause, it will "buzz" or "rattle" against the wrench or screwdriver due to its vibratory motion.

(2) To further verify that the suspected component is the

cause, pull down rather heavily on that component while the driver evaluates the problem RPM range for any reduction in the level of the disturbance. This method of verification may also be applied on a road test by clamping a 5-10 pound metal weight securely to the suspected component. Such a weight will change the resonant frequency of the component in question, and will change the problem speed if it is actually the cause.

(3) To verify disturbances produced by exhaust system components which resonate beyond 1300 RPM (such as the exhaust crossover), the stall technique cannot be used. In these cases, it is best to use the weight-and-clamp method together with a road test.

Having verified that some component of the exhaust system is the cause of the problem, the following procedures should be used to correct the disturbance.

(a) Since the majority of exhaust system problems are due to "bound up" conditions, loosen all joints in the entire system, and let the pipes rest on floor stands while each clamp and bolt is torqued to specification. Refer to Section 6F.

(b) Visually inspect the entire system for sufficient clearance of all points (at least 1/2" in all direction) especially those in the direction of engine roll under acceleration.

(c) Visually inspect all exhaust system hangers to ensure that there is no metal-to-metal contact.

(d) Ensure that the end of the tailpipe is not directed at the inside surface of the rear bumper, but below it.

(e) After these procedures have been performed and any irregularities corrected, re-test on the road.

CAR STORAGE PREPARATION

Certain precautions must be taken when placing a car in storage for extended periods of time. Should an owner decide to store a car for 30 days or less, or, for a period of 30 days to 12 months, the following steps are recommended:

a. 30 Days or Less

1. Wash car and inflate tires to 276 kPa (40 psi).
2. Provide proper cooling system protection. At least -40°C (-40°F).
3. Run engine until completely warmed up; then drain and refill with fresh oil which, according to the label on the can, is intended for service "SE".
4. Run engine again with fresh oil until completely warmed up; drive car to place of shelter for storage and park. Do not restart again until end of storage period.
5. Be sure parking brake is in released position and car is on level surface.
6. If car is to be stored in a hot area, the fuel tank, lines, pump, filter and carburetor or injectors, if equipped with EFI should be drained.
7. Disconnect battery and prevent battery from discharging or freezing by keeping it fully charged.

b. 30 Days to 12 Months

1. Wash car.
2. Run engine until completely warmed up; then drain and refill with fresh oil which, according to the label on the can, is intended for service "SE".
3. Run engine again with fresh oil until completely warmed up; drive car to place of shelter for storage and park. Run engine at 2,000 RPM in neutral and slowly pour engine oil into carburetor or both throttle body bores in the case of EFI. After about a pint has been added, pour oil fast enough to stall engine.
4. Be sure parking brake is in released position and car is on level surface.
5. Siphon gasoline from fuel tank.
6. Disconnect all fuel lines, blow out, and reconnect.
7. Remove carburetor, clean thoroughly, and store in plastic bag.
8. Remove fuel pump, clean, and store with carburetor.

NOTE: Tape fuel pump, carburetor, and gas line openings closed with masking tape.

9. On Electronic fuel injection use following procedure.

a. Disconnect fuel lines from EFI fuel rail fitting rearward including in-line pump and filter.

b. Remove filter assembly and discard. Blow fuel from fuel lines and filter.

c. Reconnect fuel lines, fuel pump and filter housing.

d. Remove fuel pump fuse.

e. Crank engine approximately 20 seconds to remove fuel from injectors. Install fuel pump fuse.

10. Drain coolant from radiator, cylinder block, and heater cores.
11. Lower windows 1/2 inch to stop humidity "sweat" and mold.
12. Remove battery from car, and have charge maintained during period car is stored.
13. Put car on chassis stands so that tires are off the floor. Position stands under front lower control arms and rear axle as shown in Figures 0A-9 (0A-13 if Eldorado) and 0A-10.
14. Apply 10W engine oil to exterior bright surfaces.
15. When car is taken out of storage, install a new fuel filter element, check brake system for leaks, and bleed brakes. Clean spark plugs and regap. Install carburetor, fuel pump, and battery, and refill cooling system.

Special consideration should be given when conditions of high humidity, high temperature, or outdoor storage are encountered. Local experience will dictate the additional protection measures in each particular case.

SECTION 0B

1977 CADILLAC MAINTENANCE SCHEDULES I AND II

To retain the safety, dependability and emission control performance originally built into Cadillacs, it is essential that they receive periodic inspections, maintenance and service parts replacements.

This section contains a complete schedule of the maintenance required by the vehicles.

These inspection and maintenance services are those which experience and testing have shown to be the most likely needed services at that particular mileage or time interval for an average owner. However, the Cadillac serviceman should also recommend additional items of maintenance based on driving habits, driving conditions, geographical locations, climatic conditions, and factory service bulletins.

BODY LUBRICATION

Mechanical parts having contacting surfaces in relative motion with other body parts are lubricated during assembly. To maintain ease of operation, it is recommended that the following parts be lubricated at the basic service intervals shown in the Vehicle Maintenance Schedule with lubricants as follows:

All door hinges are to be lubricated with engine oil (30 weight preferred). Apply lubricant to roller and hinge pin bushings but do not lubricate hold open link and roller contacting surfaces.

External locks (door, rear compartment lid), rear compartment lid hinges and torque rod to hinge surfaces are to be lubricated with Auto-Lube "A", Part No. 1050110, Spray-Lube "A", Part No. 1050520, 3 M Lithium Spray Lube No. 8915, or equivalent.

Lubricate lock cylinders with WD-40, 3M 4-way or equivalent spray lubricant.

The lubrication requirements for seat mechanism, door hardware, sun roof and windshield wipers are covered in specific sections of the body service manual.

EXPLANATION OF COMPLETE 1977 VEHICLE MAINTENANCE SCHEDULE I AND II

Presented below is a brief explanation of each of the services listed in the preceding Complete Vehicle Maintenance Schedules.

Vehicle Maintenance Schedule I is applicable to all Cadillac engines which do not contain the letter "U" in the engine identification code (which begins with the number "7") shown in the upper left corner of the underhood "Vehicle Emission Control Information" label. (Example: 760JO.)

Vehicle Maintenance Schedule II is applicable to all Cadillac engines which contain the letter "U" in the engine identification code. (Example: 760JOU.)

Normal Vehicle Use - The owner's maintenance instructions contained in this maintenance schedule are based on the assumption that the car will be used as designed:

- to carry passengers and cargo within the limitations indicated on the vehicle tire placard affixed to the inside surface of the glove box door,
- on reasonable road surfaces within legal operating limits,
- on a daily basis, as a general rule, for at least several miles, and
- on unleaded fuel.

Unusual operating conditions will require more frequent vehicle maintenance as specified in the respective sections included below.

SECTION A
LUBE & GENERAL MAINTENANCE

ITEM NO. — **SERVICES**

A-1 CHASSIS●– Lubricate all grease fittings in front suspension, and steering linkage and constant velocity universal joints. Lubricate transmission shift linkage, primary and secondary hood latch, door and hood hinges. Lubricate parking brake cable guides, underbody contact points and linkage.

A-2 FLUID LEVELS●*– Check level of fluid in brake master cylinder, power steering pump, engine, axle, transmission and windshield washer. Engine coolant should be checked for proper level and freeze protection to at least -40°C. (-40°F.) or to the lowest temperature expected during the period of vehicle operation. Proper engine coolant also provides corrosion protection.

Any significant fluid loss in any of these systems or units could mean that a malfunction is developing and corrective action should be taken immediately. A low fluid level in the brake master cylinder front reservoir could also be an indicator that the disc brake pads need to be replaced.

A-3 ENGINE OIL*– Change each 12 months or 7,500 miles, whichever occurs first under normal driving conditions, or each 3 months or 3,000 miles when the vehicle is operated under the following conditions: (a) driving in dusty conditions, (b) trailer pulling, (c) extensive idling or (d) short-trip operation at freezing temperatures (with engine not thoroughly warmed-up). See the Owner's Manual for additional details on engine oil.

A-4 ENGINE OIL FILTER*– Replace at the first oil change and every other oil change thereafter, if mileage (7,500) is the determining factor. If time (12 months) is the determining factor, then change oil filter with every oil change.

A-5 TIRES– Steel belted radial tires should be rotated at first 7,500 miles and then at every 15,000 miles thereafter. To equalize wear, rotate tires as illustrated in Owner's Manual and adjust tire pressures as shown on tire placard on glove box door.

A-6 REAR AXLE– Change lubricant every 15,000 miles on standard type rear axles or final drives when using vehicle to tow a trailer. Change lubricant at first 15,000 miles on controlled differential axles.

●Also a Safety Service
*Also an Emission Control Service

1977 CADILLAC — COMPLETE VEHICLE MAINTENANCE SCHEDULE I

This Maintenance Schedule is applicable to all Cadillac engines which do not contain the letter "U" in the Engine Identification Code (which begins with the number "7") shown in the upper left corner of the underhood "Vehicle Emission Control Information" label. (Example: 760J0.)

When To Perform Services (Months or Miles whichever occurs first)	Item No.	Services (For Details, See Numbered Paragraphs)	Mileage When Service Is To Be Performed					
			7.5	15.0	22.5	30.0	37.5	45.0
Section A — Lubrication and General Maintenance								
Every 12 Months or 7,500 Miles	A-1	•Chassis Lubrication	X	X	X	X	X	X
	A-2	•*Fluid Levels Check	X	X	X	X	X	X
	A-3	*Engine Oil Change	X	X	X	X	X	X
See Explanation	A-4	*Oil Filter Change	X		X		X	
	A-5	Tire Rotation	X		X		X	
	A-6	Rear Axle Lube Change						
Every 12 Months	A-7	Air Conditioning Check		yrly.		yrly.		yrly.
Every 12 Months or 15,000 Miles	A-8	*Cooling System Check		X		X		X
		*—Coolant Change				X		
See Explanation	A-9	Wheel Bearing Repack						
Every 30,000 Miles	A-10	Final Drive Boots & Seals Check (Eldorado)				X		
Every 100,000 Miles	A-11	Auto. Trans. Fluid & Filter Change						
Section B — Safety Maintenance								
Every 12 Months or 7,500 Miles	B-1	Owner Safety Checks	X	X	X	X	X	X
	B-2	Tire, Wheel and Disc Brake Inspection	X	X	X	X	X	X
	B-3	*Exhaust System Check	X	X	X	X	X	X
	B-4	Suspension and Steering Check	X	X	X	X	X	X
	B-5	Brake and Power Steering Check	X	X	X	X	X	X
Every 12 Months or 15,000 Miles	B-6	*Drive Belt Check		X		X		X
	B-7	Drum Brake and Parking Brake Check		X		X		X
	B-8	Throttle Linkage Check		X		X		X
	B-9	Underbody Flush & Check		X		X		X
	B-10	Bumper Check		X		X		X
Section C — Emission Control Maintenance								
At First 6 Months or 7,500 Miles — Then at 18 Month/ 22,500 Miles Intervals as Indicated in Log	C-1	Carburetor Choke Check (Except Fuel Injection)	X		X			X
	C-2	Thermo. Controlled Air Cleaner Check	X		X			X
	C-3	Engine Idle Speed Adjustments	X		X			X
	C-4	EFE System Check (Except Fuel Injection)	X		X			X
	C-5	Carburetor (Or Fuel Injection Throttle Body) Mounting Torque	X		X			X
	C-6	Vacuum Advance System & Hoses Check	X		X			X
Every 12 Months or 15,000 Miles	C-7	Fuel Filter Replacement		X		X		X
	C-8	PCV System Check & Filter Service		X		X		X
		—PCV Valve and Filter Replacement				X		
Every 22,500 Miles	C-9	Spark Plug Wires Check			X			X
	C-10	Spark Plug Replacement			X			X
	C-11	Engine Timing Adjustment & Dist. Check			X			X
Every 24 Months or 30,000 Miles	C-12	ECS System Check & Filter Replacement				X		
	C-13	Fuel Cap, Tank and Lines Check				X		
Every 30,000 Miles	C-14	Air Cleaner Element Replacement				X		

•Also A Safety Service
*Also An Emission Control Service

Your 1977 Cadillac has been certified to meet emission standards at either high or low altitude as designated on the underhood Vehicle Emission Control Information Label. Vehicle operation will be optimum at the altitude designated on the Label but will be satisfactory at all altitudes. The exhaust emission control systems used on 1977 model GM vehicles are not designed for conversion to allow the vehicles to meet emission standards when operated at other than the altitude designated on the Label. However, for some GM vehicles, conversion to meet emission standards at other than the designated altitude is possible and is permitted by government regulations. Information regarding conversion of your vehicle, if permitted, can be obtained from: (Customer Services Manager, Cadillac Motor Car Division, General Motors Corporation, Detroit, Michigan 48232). Include your Vehicle Identification Number in your request.

1977 CADILLAC — COMPLETE VEHICLE MAINTENANCE SCHEDULE II

This Maintenance Schedule is applicable to all Cadillac engines which contain the letter "U" in the Engine Identification Code (which begins with the number "7") shown in the upper left corner of the underhood "Vehicle Emission Control Information" label. (Example: 760J0U.)

When To Perform Services (Months or Miles whichever occurs first)	Item No.	Services (For Details, See Numbered Paragraphs)	Mileage When Service Is To Be Performed					
			7.5	15.0	22.5	30.0	37.5	45.0
Section A — Lubrication and General Maintenance								
Every 12 Months or 7,500 Miles	A-1	•Chassis Lubrication	X	X	X	X	X	X
	A-2	•*Fluid Levels Check	X	X	X	X	X	X
	A-3	*Engine Oil Change	X	X	X	X	X	X
See Explanation	A-4	*Oil Filter Change	X		X		X	
	A-5	Tire Rotation	X		X		X	
	A-6	Rear Axle Lube Change						
Every 12 Months	A-7	Air Conditioning Check		yrly.		yrly.		yrly.
Every 12 Months or 15,000 Miles	A-8	*Cooling System Check		X		X		X
		*—Coolant Change				X		
See Explanation	A-9	Wheel Bearing Repack						
Every 30,000 Miles	A-10	Final Drive Boots & Seals Check (Eldorado)				X		
Every 100,000 Miles	A-11	Auto. Trans. Fluid & Filter Change						
Section B — Safety Maintenance								
Every 12 Months or 7,500 Miles	B-1	Owner Safety Checks	X	X	X	X	X	X
	B-2	Tire, Wheel and Disc Brake Inspection	X	X	X	X	X	X
	B-3	*Exhaust System Check	X	X	X	X	X	X
	B-4	Suspension and Steering Check	X	X	X	X	X	X
	B-5	Brake and Power Steering Check	X	X	X	X	X	X
Every 12 Months or 15,000 Miles	B-6	*Drive Belt Check		X		X		X
	B-7	Drum Brake and Parking Brake Check		X		X		X
	B-8	Throttle Linkage Check		X		X		X
	B-9	Underbody Flush & Check		X		X		X
	B-10	Bumper Check		X		X		X
Section C — Emission Control Maintenance								
See Explanation	C-1	Carburetor Choke Check (Except Fuel Injection)	X			X		X
At First 6 Months or 7,500 Miles — Then at 24 Month/ 30,000 Mile Intervals as Indicated in Log	C-2	Thermo. Controlled Air Cleaner Check	X				X	
	C-3	Engine Idle Speed Adjustments	X				X	
	C-4	EFE System Check (Except Fuel Injection)	X				X	
	C-5	Carburetor (Or Fuel Injection Throttle Body) Mounting Torque	X				X	
Every 12 Months or 15,000 Miles	C-6	Vacuum Advance System & Hoses Check		X		X		X
	C-7	Fuel Filter Replacement		X		X		X
	C-8	PCV System Check & Filter Service		X		X		X
		—PCV Valve and Filter Replacement				X		
Every 15,000 Miles	C-9	Spark Plug Wires Check		X		X		X
Every 30,000 Miles	C-10	Spark Plug Replacement				X		
	C-11	Engine Timing Adjustment & Dist. Check				X		
Every 24 Months or 30,000 Miles	C-12	ECS System Check and Filter Replacement				X		
	C-13	Fuel Cap, Tank and Lines Check				X		
Every 30,000 Miles	C-14	Air Cleaner Element Replcement				X		

•Also A Safety Service
*Also An Emission control Service

Your 1977 Cadillac has been certified to meet emission standards at either high or low altitude as designated on the underhood Vehicle Emission Control Information Label. Vehicle operation will be optimum at the altitude designated on the Label but will be satisfactory at all altitudes. The exhaust emission control systems used on 1977 model GM vehicles are not designed for conversion to allow the vehicles to meet emission standards when operated at other than the altitude designated on the Label. However, for some GM vehicles, conversion to meet emission standards at other than the designated altitude is possible and is permitted by government regulations. Information regarding conversion of your vehicle, if permitted, can be obtained from: (Customer Services Manager, Cadillac Motor Car Divisoin, General Motors Corporation, Detroit, Michigan 48232). Include your Vehicle Identification Number in your request.

A-7 AIR CONDITIONING– Check condition of air conditioning system hoses and refrigerant charge. Replace hoses and/or refrigerant if need is indicated.

A-8 COOLING SYSTEM*– At 12-month or 15,000-mile intervals, wash radiator cap and filler neck with clean water, pressure test system and radiator cap for proper pressure holding capacity, (tighten hose clamps, and inspect condition of all cooling and heater hoses). Replace hoses if checked, swollen or otherwise deteriorated.

Also each 12 months or 15,000 miles clean exterior of radiator core and air conditioning condenser. Every 24 months or 30,000 miles, drain, flush, and refill the cooling system with a new coolant solution as described in the Owner's Manual.

A-9 WHEEL BEARINGS– Clean and repack front wheel bearings (rear on Eldorado) with a lubricant as specified in the "Recommended Fluids and Lubricants" chart at the end of this section at time of major axle or brake service.

A-10 FINAL DRIVE AXLE BOOTS AND OUTPUT SHAFT SEALS (Eldorado only)– Check for damaged, torn or leaking output shaft seal. Replace damaged parts as necessary.

A-11 AUTOMATIC TRANSMISSION FLUID– Under normal driving conditions, change the transmission fluid and sump filter every 100,000 miles.

Under unusual conditions such as constant driving in heavy city traffic, trailer pulling and commercial applications, services should be performed at 50,000-mile intervals. See the Owner's Manual for further details on transmission care.

SECTION B

SAFETY MAINTENANCE

NOTE: Items B-1 (a) thru (w) can be checked by the owner, while Items B-2 thru B-10 should only be checked by a qualified mechanic. It is particularly important that any safety systems which may have been adversely affected in an accident be checked and repaired as necessary before the vehicle is returned to use.

B-1 SAFETY CHECKS TO BE PERFORMED BY OWNER– The following checks should be made regularly during operation at no greater interval than 12 months or 7,500 miles, whichever occurs first, and more often when the need is indicated. Any deficiencies should be brought to the attention of your dealer or another service outlet, as soon as possible, so the advice of a qualified mechanic is available regarding the need for repairs or replacements.

a. STEERING COLUMN LOCK– Check for proper operation by attempting to turn key to LOCK position in the various transmission gear ranges when the car is stationary. Key should turn to LOCK position only when transmission control is in PARK. Key should be removable only in LOCK position.

b. PARKING BRAKE AND TRANSMISSION "PARK" MECHANISM– Check parking brake holding ability by parking on a fairly steep hill and restraining the vehicle with the parking brake only. Check the holding ability of the automatic transmission "PARK" mechanism by releasing all brakes after the transmission selector lever has been placed in the "P" position.

CAUTION: *Before making check "c", be sure to have a clear distance ahead of and behind the car, set the parking brake and firmly apply the foot brake. Do not depress accelerator pedal. Be prepared to turn off ignition switch immediately if engine should start.*

c. STARTER SAFETY MECHANISM– Check starter safety mechanism by attempting to start the engine with the transmission in each of the driving gears. The starter should operate only in the Park ("P") or Neutral ("N") positions.

d. TRANSMISSION SHIFT INDICATOR– Check to be sure automatic transmission shift indicator accurately indicates the shift position selected.

e. STEERING– Be alert to any changes in steering action. The need for inspection or servicing may be indicated by increased effort to turn the steering wheel, excessive free play or unusual sounds when turning or parking.

f. WHEEL ALIGNMENT AND BALANCE– In addition to uneven or abnormal tire wear, the need for wheel alignment service may be indicated by a pull to the right or left when driving on a straight and level road. The need for wheel balancing is usually indicated by a vibration of the steering wheel or seat while driving at normal highway speeds.

g. BRAKES– Be alert to illumination of the brake warning light or changes in braking action, such as repeated pulling to one side, unusual sounds either when braking or between brake applications, or increased brake pedal travel. Any of these could indicate the need for brake system inspection and/or service.

h. EXHAUST SYSTEM– Be alert to any change in the sound of the exhaust system or a smell of fumes which may indicate a leak or overheat condition requiring inspection and/or service. (See also Engine Exhaust Gas Caution and Catalytic Converter information in Owner's Manual and item B-3 in this manual.)

i. WINDSHIELD WIPERS AND WASHERS– Check operation of wipers, as well as condition and alignment of wiper blades. Check amount and direction of fluid sprayed by washers during use.

j. DEFROSTERS– Check performance by moving control to "DEF" and noting amount of air directed against the windshield.

k. REARVIEW MIRRORS AND SUN VISORS– Check friction joints for proper adjustment so mirrors and sun visors stay in the selected position.

l. HORN– Blow the horn occasionally to be sure that it works. Check all horn actuating areas of horn pad.

m. LAP AND SHOULDER BELTS– Check belts, buckles, latch plates, retractors, reminder systems, guide loops and anchors for proper operation or damage. Check to make certain that anchor mounting bolts are tight.

n. SEAT ADJUSTERS– Check that seat adjusters securely engage by pushing forward and backward whenever a manual seat is adjusted.

o. HEAD RESTRAINTS– Check that head restraints adjust properly in the up detent positions, and that no components are missing, damaged or loose.

p. SEAT BACK RECLINER– Check to see that the seat back recliner is holding by pushing and pulling the top of the reclining seat back.

q. SEAT BACK LATCHES– Check to see that Eldorado seat back latches are holding by pulling forward on the top of each folding seat back(with doors closed). The Coupe deVille is equipped with inertial front seat back latches

*Also an Emission Control Service.

designed to prevent forward motion of the back rest only during a sudden slowing of the vehicle. Check that the Eldorado seat back release lever on the bottom, outboard side of each front seat back moves up and down freely. For proper operation, the lever must be in the down position.

r. LIGHTS AND CHIMES OR BUZZERS– Check all instrument panel illuminating and warning lights, seat belt reminder light and chime or buzzer, ignition key buzzer, interior lights, license plate lights, side marker lights, headlamps, parking lamps, tail lamps, brake lights, turn signals, backup lamps, and hazard warning flashers. Have headlamp aim checked every 12 months or 15,000 miles, or more often if light beams seem to be aimed improperly.

s. GLASS– Check for broken, scratched, dirty or damaged glass on vehicle that could obscure vision or become an injury hazard.

t. DOOR LATCHES– Check for position closing, latching and locking.

u. HOOD LATCHES– Check to make sure hood closes firmly by lifting on the hood after each closing. Check also for broken, damaged or missing parts which might prevent secure latching. Check to make sure secondary latch hook is engaging properly when hood is popped open.

v. FLUID LEAKS– Check for fuel, water, oil or other fluid leaks by observing the ground beneath the vehicle after it has been parked for a while. (Water dripping from air conditioning system after use is normal.) If gasoline fumes or fluid are noticed *at any time,* the cause should be determined and corrected without delay because of the possibility of fire.

w. SPARE AND JACK– Check that the spare tire assembly and jack equipment are securely stowed at all times.

B-2 TIRES, WHEELS AND DISC BRAKES– Check disc brake pads for wear and surface condition of rotors while wheels are removed during tire rotation (see item A-5). Check tires for excessive wear or damage. Make certain wheels are not bent or cracked and that wheel nuts have been tightened to the torque value specified in the Owner's Manual. Check tire inflation pressure (including the spare tire, unless it is a stowaway) when the tires are "cold" at least monthly, or more often if daily visual inspection indicates the need.

B-3 EXHAUST SYSTEM*– Check complete exhaust system and nearby body areas and trunk lid for broken, damaged, missing or mispositioned parts, open seams, holes, loose connections or other deterioration which could permit exhaust fumes to seep into the trunk or passenger compartment or cause a heat build-up in the floor pan. Dust or water in the trunk may be an indication of a problem in one of these areas. Any necessary corrections should be made immediately. To help continue integrity, exhaust system components rearward of the muffler must be replaced whenever a new muffler is installed. Also, see Item B-1 (h).

B-4 SUSPENSION AND STEERING– Check for damaged, loose or missing parts, or parts showing visible signs of excessive wear or lack of lubrication in front and rear suspension and steering system. Malfunctioning parts noted should be replaced by a qualified mechanic without delay.

B-5 BRAKES AND POWER STEERING– Check lines and hoses for proper attachment, binding, leaks, cracks, chafing, deterioration, etc. Any malfunctioning parts noted should be replaced or repaired immediately. When abrasion or wear is evident on lines or hoses, the cause must be corrected.

B-6 ENGINE DRIVE BELTS*– Check belts driving fan, AIR pump, generator, power steering pump, and air conditioning compressor for cracks, fraying, wear and tension. Adjust or replace as necessary.

B-7 DRUM BRAKES AND PARKING BRAKE– (See Item B-2 for disc brake check.) Check drum, brake linings for wear or cracks and other internal brake components at each wheel (drums, wheel cylinders, etc.). Parking brake adjustment also should be checked whenever drum brake linings are checked.

NOTE: More frequent brake checks should be made if driving conditions and habits result in frequent brake application.

B-9 THROTTLE LINKAGE– Check for damaged or missing parts, interference or binding. Any deficiencies should be corrected without delay by a qualified mechanic.

B-9 UNDERBODY– Corrosive materials used for ice and snow removal and dust control can accumulate on the underbody. If allowed to remain, these materials can result in accelerated rusting and deterioration of underbody components such as fuel lines, frame and floor pan, exhaust system, etc. At least once each year, preferably after a winter's exposure, these corrosive materials should be removed by flushing the underbody with plain water. Particular attention should be given to cleaning out those areas where mud and other foreign materials collect.

B-10 BUMPERS– Check the front and rear bumper energy absorber systems at 12-month/15,000-mile intervals to be sure that impact protection and clearance originally designed into these systems remain in a state of full readiness. They also should be checked whenever there is obvious bumper misalignment, or whenever the vehicle has been involved in a significant collision in which the bumpers were struck, even when slight or no damage to the bumper systems can be seen.

SECTION C
EMISSION CONTROL MAINTENANCE

NOTE: Additional recommended maintenance instructions relating to vehicle use, evidence of maintenance, and service replacement parts are included in the New Car Warranty Information folder.

C-1 CARBURETOR CHOKE, WIRE, LINKAGES, AND HOSES (Except fuel injected cars)–Check choke mechanism and vacuum break for proper operation. Any binding condition which may have developed due to petroleum gum formation on the choke shaft or from damage should be corrected. Check carburetor choke wire and hoses for proper connection, cracking, abrasion or deterioration and vacuum break units for operation and correct or replace as necessary. Schedule II Only-check operation at 6 months or 7,500 miles, 24 months or 30,000 miles and every 12 months or 15,000 miles thereafter.

C-2 THERMOSTATICALLY CONTROLLED AIR CLEANER– Inspect installation to make certain that all hoses and ducts are connected and correctly installed. Also check valve for proper operation. (Except fuel injected cars.)

C-3 ENGINE IDLE SPEEDS– Adjust engine idle speeds accurately (following the specifications shown on the label under the hood). Adjustments must be made with test equipment known to be accurate.

*Also an Emission Control Service.

C-4 EARLY FUEL EVAPORATION (EFE) SYSTEM (Except fuel injected cars)–Check valve for proper operation. A binding condition must be corrected. Check switch for proper operation. Check hoses for cracking, abrasion or deterioration. Replace parts as necessary.

C-5 CARBURETOR (OR THROTTLE BODY) MOUNTING– At designated intervals, torque carburetor (or fuel injection throttle body) attaching bolts to compensate for compression of the gasket.

C-6 VACUUM ADVANCE SYSTEM AND HOSES– Check system for proper operation and hoses for proper connection, cracking, abrasion or deterioration. Replace parts as necessary.

C-7 FUEL FILTER– Replace the filter in the carburetor (except on cars equipped with fuel injection) at designated intervals or more frequently if clogged. On cars equipped with fuel injection, the filter is located between the fuel pump and engine in the fuel line. On Seville, the filter is located under car, inboard and in front of the left rear wheel.

C-8 POSITIVE CRANKCASE VENTILATION SYSTEM (PCV)– Check the PCV system for satisfactory operation at 15,000-mile intervals, and clean filter (on valve cover). Replace the PCV valve and filter at 30,000-mile intervals and blow out PCV valve hose with compressed air. Replace deteriorated hoses.

C-9 SPARK PLUG WIRES– Clean exterior of wires; remove any evidence of corrosion on end terminals. Inspect spark plug wires for evidence of checking, burning, or cracking of exterior insulation and tight fit at distributor cap and spark plugs or other deterioration. If corrosion cannot be removed or other conditions above are noted, replace wire.

C-10 SPARK PLUGS– Replace plugs at designated intervals with type specified in Owner's Manual.

C-11 TIMING AND DISTRIBUTOR CAP– Adjust ignition timing following the specifications shown on label under the hood. Also, carefully inspect the interior and exterior of the distributor cap and rotor for cracks, carbon tracking and terminal corrosion. Clean or replace as necessary.

C-12 EVAPORATION CONTROL SYSTEM (ECS)– Check all fuel and vapor lines and hoses for proper connections and correct routing as well as condition. Remove canister and check for cracks or damage. Replace damaged or deteriorated parts as necessary. Replace filter in lower section of canister.

C-13 FUEL CAP, FUEL LINES AND FUEL TANK– Inspect the fuel tank, cap and fuel lines for damage which could cause leakage. Remove fuel cap and inspect gasket for an even imprint from the filler neck, and indications of physical damage. Replace any damaged or deteriorated parts.

C-14 AIR CLEANER ELEMENT– Replace the engine air cleaner element at designated intervals. Operation of vehicle in dusty areas will necessitate more frequent replacements. Your dealer can be of assistance in determining the proper replacement frequency for the conditions under which you operate your vehicle.

CAUTION: *Do not operate the engine without the air cleaner unless temporary removal is necessary during repair or maintenance of the vehicle. When the cleaner is removed, backfiring can cause fire in the engine compartment.*

RECOMMENDED FLUIDS & LUBRICANTS

USAGE	FLUID/LUBRICANT
Engine fuel	ONLY Unleaded fuel of at least 91 Research Octane. Refer to Owner's Manual for additional information.
Engine oil	High Quality engine oils rated "SE". Refer to Owner's Manual for oil viscosity recommendation and further information.
Power steering (also Hydra-Boost system) and pump reservoir	GM power steering fluid, Part No. 1050017
Differential—standard	SAE-80W or SAE-80W-90 GL-5 gear lubricant (SAE-80W GL-5 in Canada)
Differential—controlled	Lubricant GM Part No. 1052272 for all exc. Eldorado
Final Drive	Part No. 1050190
Brake system & master cylinder	Delco Supreme 11 fluid or DOT-3
Hood Latch Assembly a. Pivots and spring anchor b. Release pawl	 Engine oil Chassis grease
Hood and door hinges	Engine oil
Hood rear bumpers	Moly disulfide lubricant

USAGE	FLUID/LUBRICANT
Automatic transmission shift linkage	Engine oil
Chassis lubrication	Chassis grease meeting GM6031-M
Automatic transmission	DEXRON® II automatic transmission fluid
Parking brake cables	Chassis grease
Front wheel bearings (rear on Eldorado)	#2 grade lithium high melting point wheel bearing grease. GM Part No. 1051344
Body door hinge pins, fuel door hinge, rear compartment lid hinges	Engine oil
Windshield washer solvent	GM Optikleen washer solvent Part No. 1051515 or equivalent
Engine coolant	Mixture of water and a high quality Ethylene Glycol base type anti-freeze conforming to GM Spec. 1899-M
EFE valve	Manifold heat valve lubricant GM Part No. 1050422
Air conditioning system	Refrigerant "12" and 525 viscosity refrigeration oil

NOTE: Fluids and lubricants identified with GM part numbers or GM specification numbers may be obtained from a Cadillac dealer. Equivalent fluids/lubricants may be substituted.

RECOMMENDED SERVICE PARTS

ITEM	USAGE	TYPE AND NUMBER*
Spark Plugs	All Exc. Seville	AC Type R 45NSX
Spark Plugs	Seville	AC Type R 47SX
Air Cleaner Element	All Exc. Seville	AC Type 332C
Air Cleaner Element	Seville	AC Type A-212-CW
Fuel Filter Element	All Exc. Fuel Inj.	AC Type GF 441
Fuel Filter Element	Fuel Injection	AC Type GF 157
Fuel Filter Pulse Accumulator	All E.F.I. Exc. Seville	5651847
Fuel Filter Pulse Accumulator	Seville	5651839
Hydro-Boost Filter	Eldorado	6439846
Crankcase Ventilator Filter	All Exc. Seville	1498445
P.C.V. Valve	All	AC Type CV 679C
Engine Oil Filter	All Exc. Seville	AC Type PF-45
Engine Oil Filter	Seville	AC Type PF-30
Transmission Filter	All Except Eldorado	AC Type PF-168
Transmission Filter	Eldorado Only	AC Type PF-169
Radiator Cap	All	AC Type RC-27
Air Cond. Compr. Belt	All Exc. Seville	½" x 60½"
Air Cond. Compr. Belt	Seville	7/16" x 60"
A.I.R. Air Pump Belt	All California Exc. Seville	½" x 46½"
A.I.R. Air Pump Belt	California Seville	7/16" x 35½"
Generator Belt Exc. Seville	63 Amp.	15/32" x 37"
	80 Amp.	15/32" x 38½"
	145 Amp.	½" x 57½"
Generator and Fan Belt	Seville	7/16" x 57"
Power Steering Belt	All Exc. Seville	½" x 60"
Power Steering Belt	Seville	7/16" x 45"

*or Equivalent

ENGINE OIL CHANGE INTERVAL AND VISCOSITY CHART

ENGINE OIL RECOMMENDATION

Use only high quality oils intended for service "SE". The chart below will serve as a guide for selecting proper oil viscosity. Change oil every 12 months never to exceed 7,500 miles.

Change oil each 3 months or 3,000 miles, whichever occurs first, under the following conditions: Driving in dusty areas, trailer towing, extensive idling, short trip operation (engine not thorougly warmed up) or sustained high temperatures.

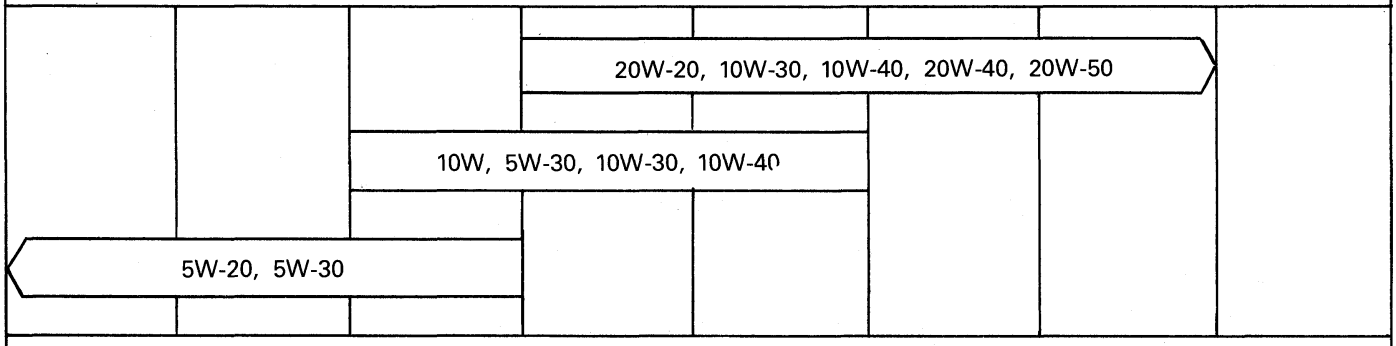
OIL VISCOSITY PRECAUTIONS

SAE 5W-20 oils are not recommended for sustained high-speed driving.

SAE 30 oils may be used at temperatures above 4°C. (40°F.)

SAE 5W-30 viscosity oils recommended for vehicles normally operated in Canada.

Recommended SAE Viscosity Number



FLUID CAPACITIES

All Series Unless Otherwise Noted	Metric Measure	Imperial Measure	U.S. Measure
Engine Oil			
All (Except Eldorado)	3.8 Liters	3-1/3 Quarts	4 Quarts
Eldorado Only	4.7 Liters	4-1/6 Quarts	5 Quarts
When Filter is Changed			
All (Except Eldorado)	4.7 Liters	4-1/6 Quarts	5 Quarts
Eldorado Only	5.7 Liters	5 Quarts	6 Quarts
Cooling System			
All (Except Seville)	18.7 Liters	16.2 Quarts	19.8 Quarts
Eldorado Only	22.9 Liters	20.5 Quarts	24.3 Quarts
Seville Only	17.8 Liters	15.5 Quarts	18.9 Quarts
Air Conditioner-Refrigerant 12			
All (Except Seville)	1.7 Kilograms	3 Pounds	3-3/4 Pounds
Seville Only	1.6 Kilograms	3 Pounds	3-1/2 Pounds
Air Conditioner Compressor Oil-525 Viscosity	297.7 Grams	8.7 Fl. Oz.	10.5 Fl. Oz.
Rear Axle			
All (Except Eldorado)	2.0 Liters	3-1/2 Pints	4-1/4 Pints
Final Drive			
Eldorado Only	1.9 Liters	3-1/3 Pints	4 Pints
Gasoline Tank			
All (Except Eldorado and Seville)	90.8 Liters	20 Gallons	24 Gallons (Approx.)
Seville Only	79.5 Liters	17.5 Gallons	21 Gallons
Eldorado Only	104.1 Liters (Approx.)	23 Gallons (Approx.)	27.5 Gallons (Approx.)
Turbo Hydra-Matic			
All (Except Eldorado)			
Dry	11.8 Liters	10-1/3 Quarts	12 Quarts, 1 Pint
Pan and Filter Removed	3.8 Liters	3-1/3 Quarts	4 Quarts
Eldorado Only			
Dry	12.3 Liters	10-5/6 Quarts	13 Quarts
Pan and Filter Removed	4.7 Liters	4-1/6 Quarts	5 Quarts

AIR CONDITIONING
TABLE OF CONTENTS

DeVILLE AND BROUGHAM
General Description 1-1
Diagnosis 1-36
On-Car Service 1-49
Unit Repair 1-64
Specifications 1-104
Special Tools 1-211
Limousine 1-91
Eldorado 1-105
Seville 1-158

GENERAL DESCRIPTION

INTRODUCTION

The air conditioner system is most easily understood if it is divided into its major functions and studied on this basis. The major functions are 1) the Air Delivery System; 2) the Temperature Control system; 3) the Refrigeration system. These subjects are described in detail on the following pages.

AIR DELIVERY SYSTEM

The air conditioner module, Fig. 1-1, incorporates most of the air conditioning components into one assembly.

Air utilized by the air conditioner system, Fig. 1-1, is drawn into the module through an opening at the base of the windshield and routed to the blower which directs it through the evaporator where it is filtered, dehumidified and cooled to approximately 2°C (35°F). It is then "reheated" as required by being passed through and around the heater core. This air is then directed by air doors to the air conditioner outlets in the instrument panel, to the heater outlets at floor level or to the defroster outlets. Air exhausts from the interior by passing through the air exhaust grilles located in the door lock pillars. This provides positive air flow even when windows are closed. The components comprising the air delivery system are described below:

a. Air Intake

Air intake is controlled by an air door and a vacuum actuator that controls the position of the door, see Fig. 1-1. The air inlet door has two positions - with no vacuum applied to the actuator, the door is in its down position, blocking off the recirculating air opening and allowing only outside air to enter the blower. When vacuum is applied to the actuator, the door is moved to its up position where it blocks most of the outside air and allows approximately 80% of the total air supply to be recirculated from the passenger compartment.

b. Blower

The blower, shown in Fig. 1-1, is located at the right end of the module. The blower is air cooled by having a small portion of blower output air recirculated through the motor housing via a rubber tube.

c. Evaporator Core

The evaporator core, Fig. 1-1, which is aluminum and similar in construction to the car radiator, is the actual cooling unit of the system. The blower forces air through the evaporator core where it is cooled and dehumidified. Condensate which forms on the cold evaporator core is allowed to drain from the module through a small hole in the bottom of the evaporator case.

d. Heater Core

Cold, dehumidified air from the evaporator is forced through or around the heater core and is reheated, as required. The air-mix door controls the amount of reheat that takes place. In one of its end positions it forces all the air from the evaporator to flow through the hot heater core - the resulting air stream is very hot. In the extreme opposite position, the door forces all the air to bypass around the heater core so that no reheat takes place and the resulting air stream is very cold. In intermediate positions, some of the air passes through the heater core and some bypasses it, so that the resulting air stream is mixed to the desired temperature.

The flow of coolant through the heater core is controlled by a restrictor in the hose nipple in the rear of the right cylinder head. The purpose of the restrictor is to limit the coolant pressure in the heater core.

e. Air Distribution

The air stream is next directed by two mode doors so that it either flows into the A/C distributor or it continues to blow to the left toward the heater-defroster outlets. The two mode doors operate in unison most of the time, causing air to be discharged either from A/C outlets or from the heater outlets; however, when "Bi-Level" operation is called for, the lower mode door is not actuated and allows part of the air stream to continue on to the heater outlets while the upper mode door is actuated and positions itself to cause the remainder of the air stream to be delivered from the A/C outlets. This type of air delivery is referred to as "Bi-Level" air delivery.

The defroster door is operated by a two-stage vacuum actuator and has three positions. With no vacuum applied, the door is sealed closed. With vacuum applied to the side port of the actuator, the door is pulled down slightly so that it intercepts a small amount of air to be diverted to the defroster outlet. When vacuum is applied to both the side and center ports, the door is pulled fully down and intercepts most of the air that would normally go to the heater distributor.

f. Air Conditioner Ducts

The A/C distributor is fastened to the rear of the instrument panel. It receives air through the upper and lower mode door opening and channels it to the left hand, center and right hand A/C outlets through a flexible air hose and plastic ducts.

g. Air Conditioner Outlets

Four outlets are located in the instrument panel; one at the left side, two in the center and one at the right side. Each outlet provides an air stream whose direction can be

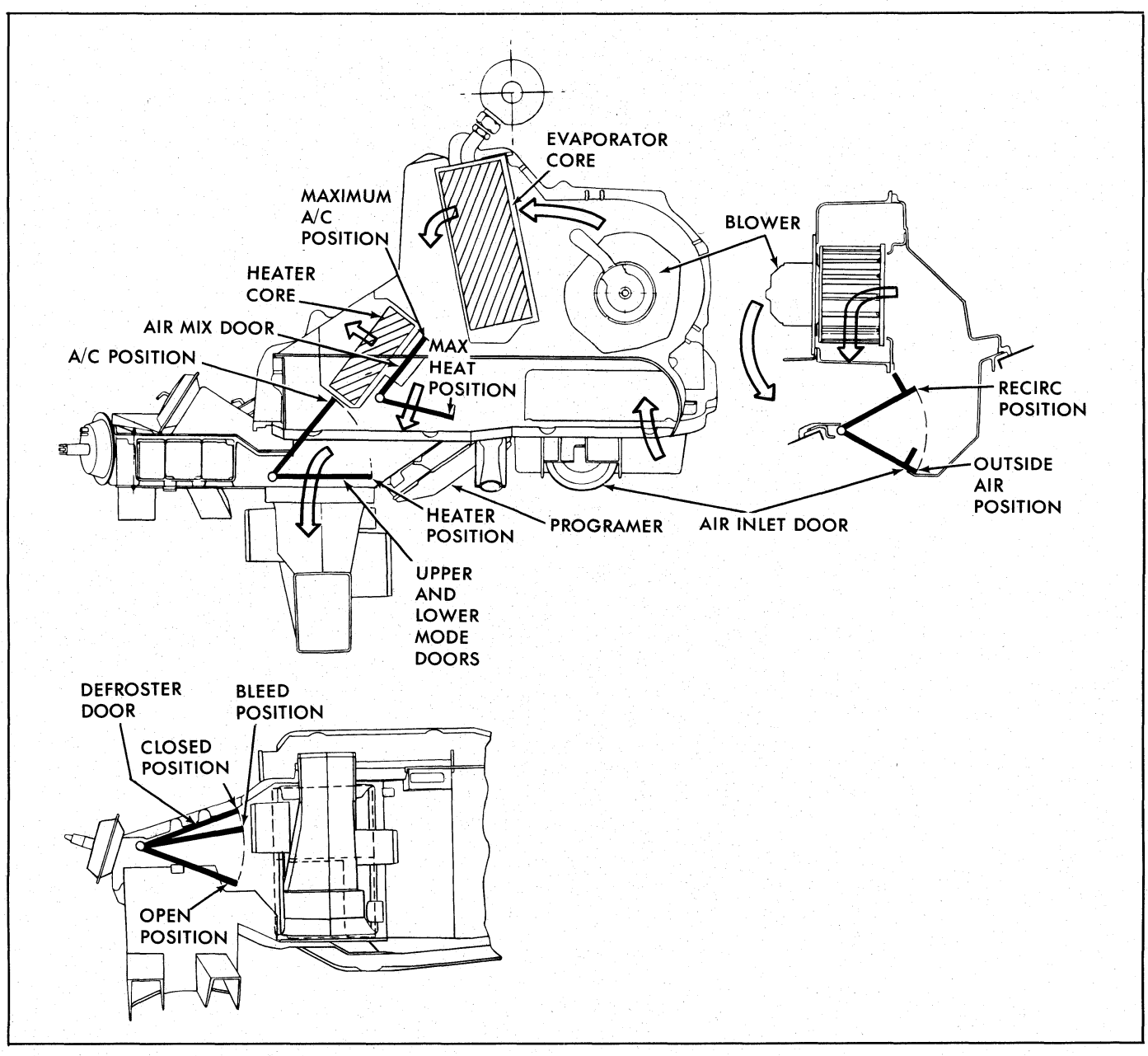


Fig. 1-1 Air Conditioner Module

controlled independently. The outlet may be rotated and the knob in the center of each outlet may be adjusted to provide the desired air direction. Air flow may be stopped altogether from each outlet by moving the shut-off knob beneath the end outlets and beside the center outlets.

A moderate flow of cool air to the floor is provided by two small plastic outlets located on the right side of the A/C distributor and on the rear of the left hand outlet extension. These outlets can be rotated to obtain a more indirect flow of air to the floor area, if desired.

h. Heater Outlet

The heater outlet is located at the bottom surface of the module near the centerline of car. It distributes air to the left-hand and right-hand sides of the front floor and also directs air under the front seat to heat the rear compartment.

i. Defroster Nozzle

A unitized defroster nozzle delivers defrosting air to both sides of the windshield. It is attached to the top of the module near centerline with one screw and to the lower windshield frame.

TEMPERATURE CONTROL SYSTEM

The temperature control system provides automatic regulation of the car interior temperature regardless of outside temperature changes. The control panel, Fig. 1-2, consists of a temperature dial with a range of 18°C to 29°C (65°F to 85°F) and a single sliding lever to permit the driver to choose various modes of operation. The "Auto" setting is recommended for most situations. There are six additional settings which provide driver control for unusual conditions. An explanation of the system operation at various lever settings begin on page 1-13.

Fig. 1-3, schematically shows the relationship of the



Fig. 1-2 Control Panel

components in this system.

Following is a complete list of the components which comprise the temperature control system. The location of the part is given together with a brief description of how the part works.

a. Control Panel

The control panel, Fig. 1-2, is located at center of the instrument panel and consists of a plastic bezel and baseplate, an acrylic lens and the functional components described below.

1. The temperature dial is graduated in 5°F increments between 65°F and 85°F (18°C to 29°C) and is color-coded - red for hot, blue for cold, and white for moderate temperatures. The dial varies the resistance of a wire-wound rheostat mounted directly above it.

2. The circuit board electrical switch is mounted on the baseplate. Attached to and positioned by the control lever are rotary wiper contacts which ride on the circuit board pads to provide the required electrical circuit connections. How these connections are made is discussed beginning on page 1-15 Electrical connections from the switch and from the temperature dial rheostat terminate at the circuit board terminals.

3. The in-car turn-on switch located directly below the temperature dial, is a thermostatic switch which senses car interior temperature and will close and turn the system on if that temperature is above approximately 23°C (73°F), even if engine water is cold and the other turn-on switch, located in the right cylinder head, is cold. This provides immediate cooling in a hot car that has not been run for some time.

4. The control vacuum valve, located at the rear edge of the baseplate, is a nine-port rotary valve which interconnects or vents the vacuum hoses attached to it to perform various vacuum functions required in the system. How the valve performs these functions is discussed beginning on page 1-14.

The control lens and the temperature dial, are illuminated by a single bulb on the right side of the control.

b. Sensors

Two sensors are used, one sensing outside air temperature and the other the car interior temperature. Both are disc-type thermistors approximately .30″ in diameter and .060″ thick. (A thermistor is a special resistor with a resistance valve that changes markedly with temperature change - it also differs from an ordinary resistor in that its resistance decreases as it gets hotter). The changes in resistance of these units form the basic input to the control system. Fig. 1-4 shows sensor characteristics.

The ambient sensor is mounted in the programmer. It is exposed to ambient air through a hole in the module wall.

The in-car sensor is located behind the slots on the instrument panel top cover. To provide accurate sensing of the car interior temperature, a small amount of in-car air is drawn into the in-car sensor housing and passed over the thermistor. See Fig. 1-5. This air movement is accomplished by the use of an aspirator and a rubber hose that connects the in-car sensor housing to the aspirator. The aspirator is a tube-within-a-tube arrangement; air from the module is discharged out the main, outer tube - this air stream causes a suction at the end of the inner tube so that air flows out it also.

c. Programmer

The all new plastic chassis programmer contains the bulk of the temperature control components, and is located in the passenger compartment on the module, Fig. 1-1. It consists of a plastic chassis, a removable plastic cover and the functional components described below and shown in Fig. 1-6.

1. The amplifier, mounted to the programmer chassis, is a three-stage D-C amplifier that accepts a weak electrical signal from the sensors and the temperature dial and provides a strong output signal proportional to input. The amplifier should be serviced only as an assembly. No attempt should be made to repair an amplifier except by an experienced electronics technician with the proper service aids for calibration.

2. The transducer is mounted directly to the amplifier board. This component, in effect, transforms the electrical signal from the amplifier to a vacuum signal which is fed to the vacuum motor.

3. The vacuum checking relay provides two separate vacuum checking functions. See Fig. 1-7. In the upper part of the relay is a conventional rubber check valve which is opened by engine vacuum applied at port 5, allowing port 3, which supplies vacuum to the rotary vacuum valve on the programmer and the control head, to be evacuated. If engine vacuum drops because of acceleration or steep grades, the check valve closes, maintaining the vacuum level at port 3.

In the lower part of the relay is a spring-loaded diaphragm which blocks or passes regulated vacuum from the transducer which is connected at port 2 to the vacuum motor which is connected to port 1. When engine vacuum at port 5 is high, the diaphragm is pulled upward allowing regulated vacuum to pass to the vacuum motor. When engine vacuum drops, the diaphragm moves downward blocking passage and maintaining vacuum in the vacuum motor.

4. The vacuum motor produces all mechanical motion within the programmer. It positions the vacuum motor mechanism which actuates the rotary shaft which drives the air-mix door link. This same mechanism moves the blower circuit board wiper, the vacuum valve operating arm and the feedback potentiometer. The vacuum motor mechanism is spring-loaded by a spring at its left-hand end so that with no vacuum it is fully extended out of the vacuum motor. This is the "Max A/C" position. When vacuum is applied to the vacuum motor, the mechanism is pulled into the vacuum motor–approximately 5 kPa (8″) of vacuum is required to pull the mechanism all the way to the "Max Heat" position. In order to prevent the loss of position during stop/restart operations, it is necessary to add a restriction between the

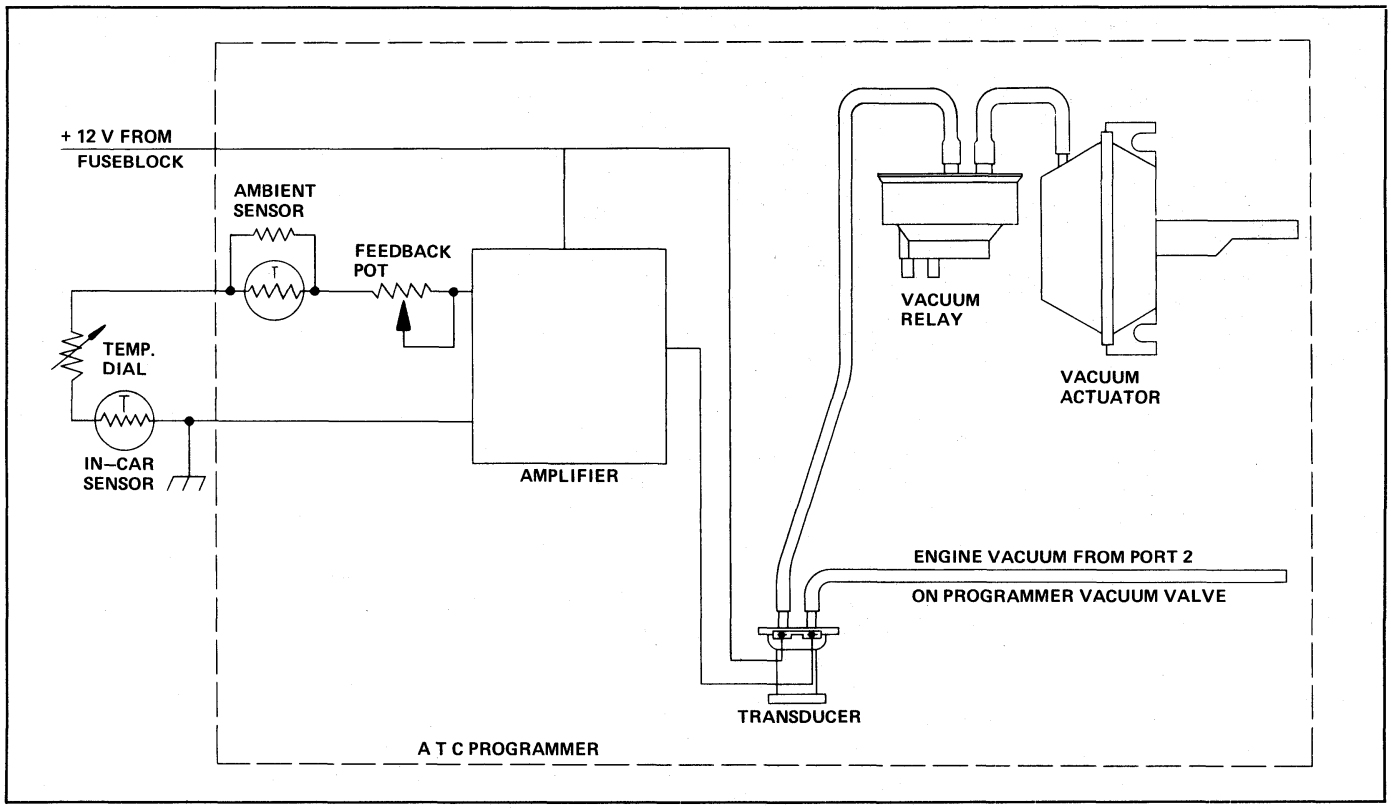


Fig. 1-3 Temperature Control System

vacuum checking relay and the transducer. This is a sintered metal plug in the hose.

5. The blower circuit board switch is located in the center part of the programmer. Spring-loaded contacts move across the board making the required blower circuit connections. The configuration of this switch is similar to that of the circuit board switch on the control head. The function of the switch is to place the blower resistors into the circuit at the required points in the program to control blower speed.

6. The vacuum valve, located in the center of the assembly, is a nine-port rotary valve which makes connections between the various ports or vents them, as required, to move air doors, operate the heater water valve, etc. How the valve performs these functions is discussed beginning on page 1-14.

7. The feedback potentiometer is located just above the vacuum valve. Its function is to snub movement of the vacuum motor so that a small signal from the sensors does not drive the motor all the way, one way or the other. The feedback pot is located, electrically, in the sensor string circuit and operates in opposition to the sensors–if a sensor drives the vacuum motor toward "Max Heat," for example, when the motor starts to move, it will rotate the potentiometer so that its resistance change tends to offset the resistance change of the sensor. This unit is adjustable–follow the procedure on page 1-54 carefully when adjusting it.

8. The ambient sensor, described under "Sensors", is also contained within the programmer.

9. The aspirator for the in-car sensor is an integral part of the programmer chassis. Operation of the aspirator was previously described under "Sensors".

10. The test point pickup is incorporated as an aid to diagnosis. It is electrically located before the ambient sensor to isolate the sensor string. Refer to the Diagnostic Procedure on page 1-47.

The sequence of events in the control program as the programmer moves from "Max A/C" to "Max Heat" is given below:

1. Possibility of recirculated air is terminated.
2. Heater water valve opens.
3. Blower speed drops from Hi to M_3.
4. Blower speed drops to M_2.
5. Air-mix door starts to move, blending in hot air.
6. Blower speed drops to M_1.
7. Mode of air delivery changes from A/C to Bi/Level.
8. Mode of air delivery changes from Bi/Level to heater.
9. Blower speed increases to M_2.
10. Air-mix door reaches "Max Heat" position.
11. Blower speed increased to M_3.
12. Blower speed increases to "Hi."

The sequence of events is reversed as the programmer moves from "Max Heat" to "Max A/C." These events are shown graphically in Fig. 1-8.

d. Air-Mix Door Linkage

The air-mix door linkage consists of a cast aluminum crank arm integral with the output shaft of the programmer, a serrated nylon retainer, and a threaded rod. One end of the rod is fastened to the air-mix door and the opposite end is retained by the serrations in the nylon retainer. The programmer positions the air-mix door by this rod. See page 1-54 for adjustment procedure.

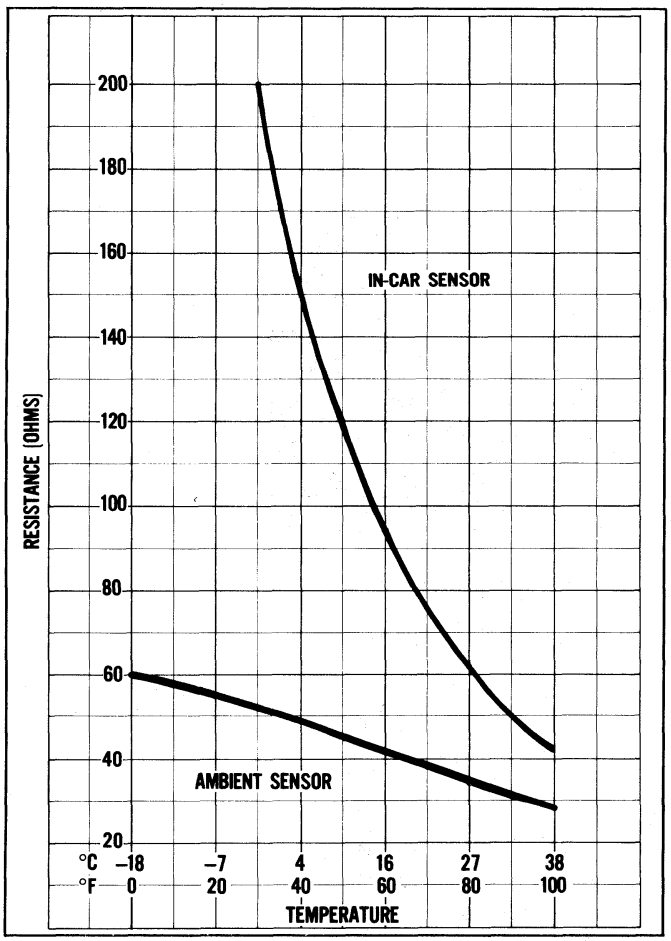


Fig. 1-4 Sensor Characteristics

e. Blower Relay

A single-pole, single throw relay is used to supply power to the blower. It is located in the relay convenience center in the passenger compartment. The relay supplies power in all positions of the control lever.

f. Heater Turn-On Switch

This switch is a bi-metal, snap-action switch located on the front of the right cylinder head. It senses engine coolant temperature; it is closed above approximately 49°C (120°F) and is open below that temperature.

g. Heater Water Valve

This valve is located in the heater hose near the rear of the right cylinder head. Its function is to pass or block flow of water to the heater. It is normally open but is closed by vacuum from the programmer vacuum valve when the programmer is positioned at "Max A/C".

h. Blower Resistor Assembly

The blower motor resistors are mounted on top of the module with the resistance elements inside the case, exposed to cool airflow. The programmer automatically selects the appropriate resistors to provide desired blower speed.

TEMPERATURE CONTROL SYSTEM OPERATION

The automatic temperature control system is made up of three major sections:

A. Temperature Control

B. Blower Control

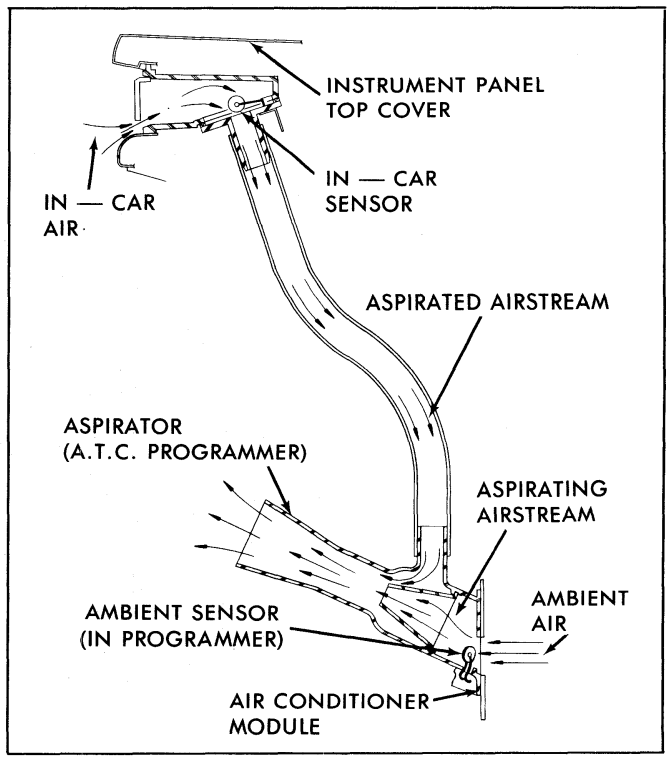


Fig. 1-5 In-Car Sensor Aspirator

C. Auxiliary Electrical and Vacuum Functions

These sections will be described separately and in detail to aid system understanding and service diagnosis.

a. Temperature Control Circuit

This circuit is comprised of the following parts, described in the preceding section and shown in Fig. 1-3.

- Ambient Sensor
- In-Car Sensor
- Temp Dial

} Input to Programmer

- Feedback Pot
- Amplifier
- Transducer
- Vacuum Relay
- Vacuum Motor

} Programmer

The resistance of the two sensors varies with their temperature. Their resistance, plus that of the temperature dial, form the input to the programmer. This weak electrical signal, which varies with the temperature of the sensor or with temperature dial movements, is amplified by the amplifier to produce a relatively strong current flow through the transducer that varies in accord with input signal changes. The transducer converts this electrical signal to a proportional vacuum signal which is routed through the vacuum relay to the vacuum motor. The vacuum motor performs the following three output functions.

1. Positions the air-mix door.
2. Positions the wipers on the blower circuit board pads.
3. Positions vacuum valve for various vacuum functions.

Input-output characteristics of the programmer are shown in Fig. 1-8. Input is resistance in ohms; output consists of the three functions listed above. Several examples are listed below to provide further understanding.

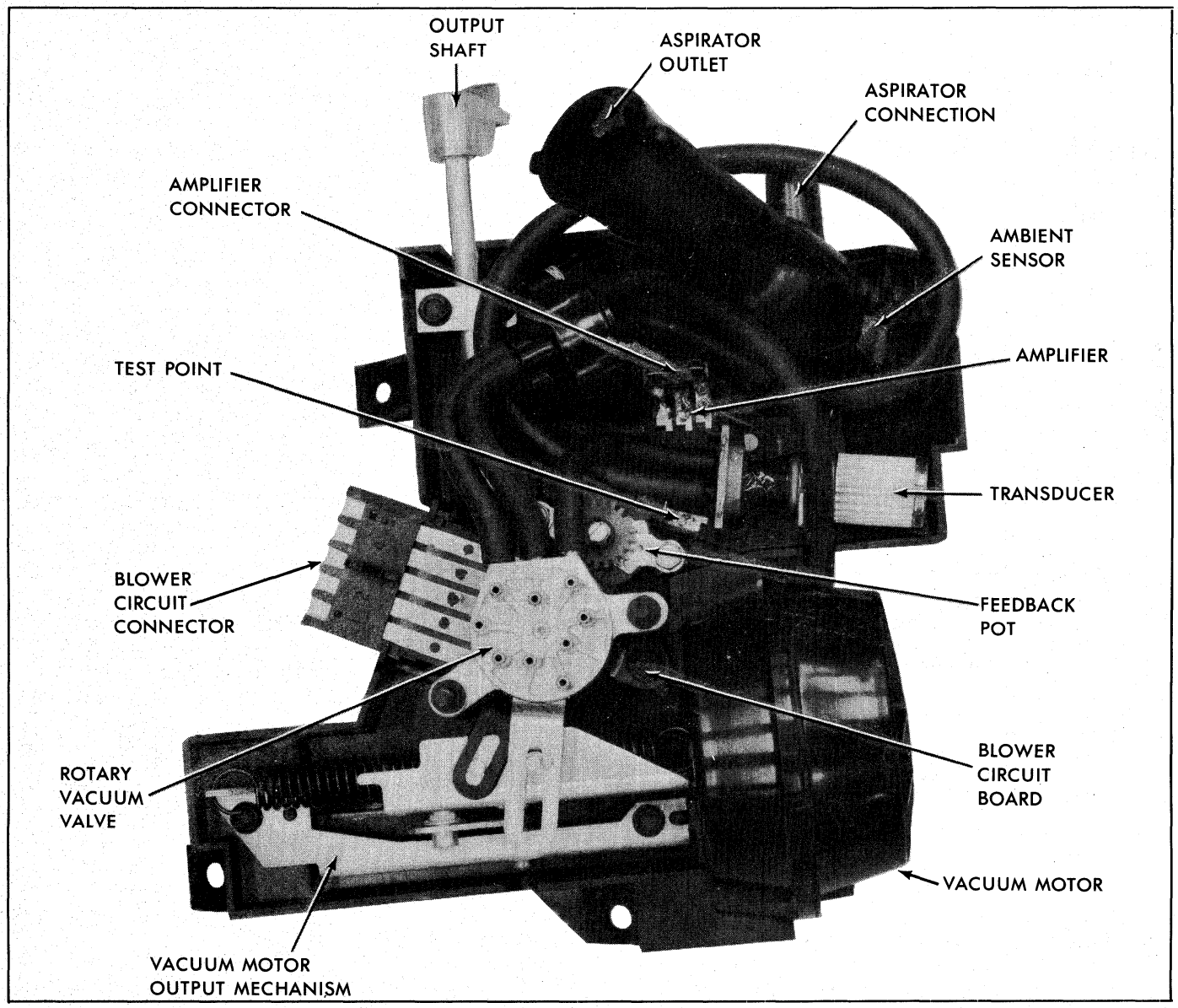


Fig. 1-6 ATC Programmer

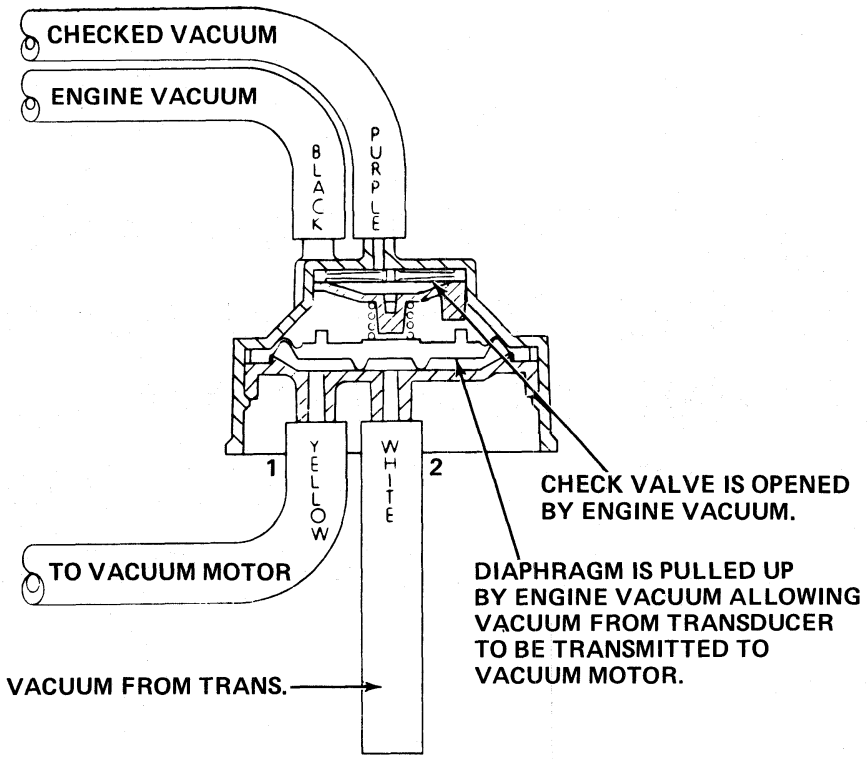
1. Assume the car is stabilized on a sunny 27°C (80°F) day with the in-car sensor being maintained at 24°C (75°F) with a 75°F temp dial setting. The resistance of the ambient sensor at 27°C (80°F) is 35 ohms, the in-car sensor resistance at 24°C (75°F) is 68 ohms, and the temp dial resistance at the 24°C (75°F) setting is 36 ohms. These three resistances total 139 ohms. Referring to Fig. 1-8, this resistance will position the programmer to produce M1 blower speed, an intermediate discharge air temperature (approximately 16°C 60°F), A/C mode, an open heater water valve and outside air.

2. If the ambient temperature were to increase with ambient sensor resistance decreasing to 22 ohms, this change in resistance would cause amplifier output current to decrease which would cause the transducer output vacuum to the vacuum motor to decrease so that the new point of operation would be at the 126 ohm point in Fig. 1-8, producing M2 blower speed and colder discharge air. The system would still be in A/C mode, with the water valve open, utilizing outside air. In this way, the in-car temperature is maintained at 24°C (75°F) despite the change in ambient temperature.

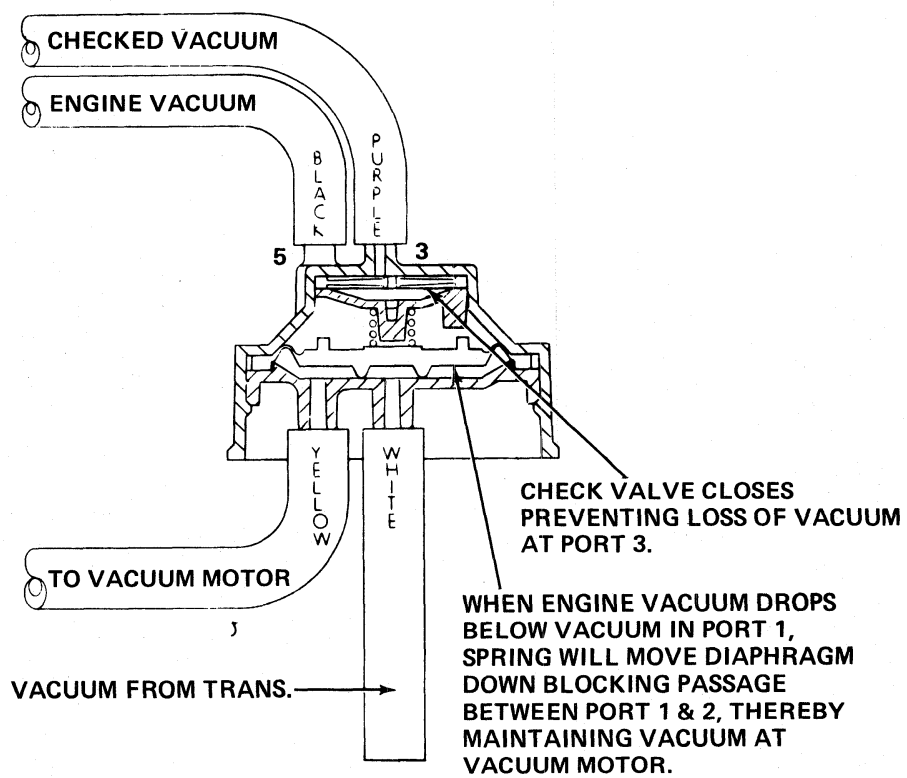
3. If heat load on the car were to be decreased by driving under cloud cover for example, the in-car sensor temperature would tend to decrease. This would cause its resistance to *increase* so that the total resistance to the programmer would increase. This would cause the programmer to move back to the right on the chart to a warmer position.

Note in the foregoing examples that a decrease in amplifier output current causes a *decrease* in transducer output vacuum. Understanding this and similar relationships is important in problem diagnosis - for that reason they are listed below.

- *Hot* sensors result in *low* sensor string resistance which results in *low* amplifier output current which results in low transducer output vacuum which positions the vacuum motor in the *cool* or cold area of operation.
- Conversely, *cold* sensors operate at *high* resistance which results in *high* amplifier output which causes a high transducer vacuum which positions the vacuum motor in the *warm* or hot area of operation.



WITH NORMAL ENGINE VACUUM



WITH LOW ENGINE VACUUM

Fig. 1-7 Vacuum Checking Relay

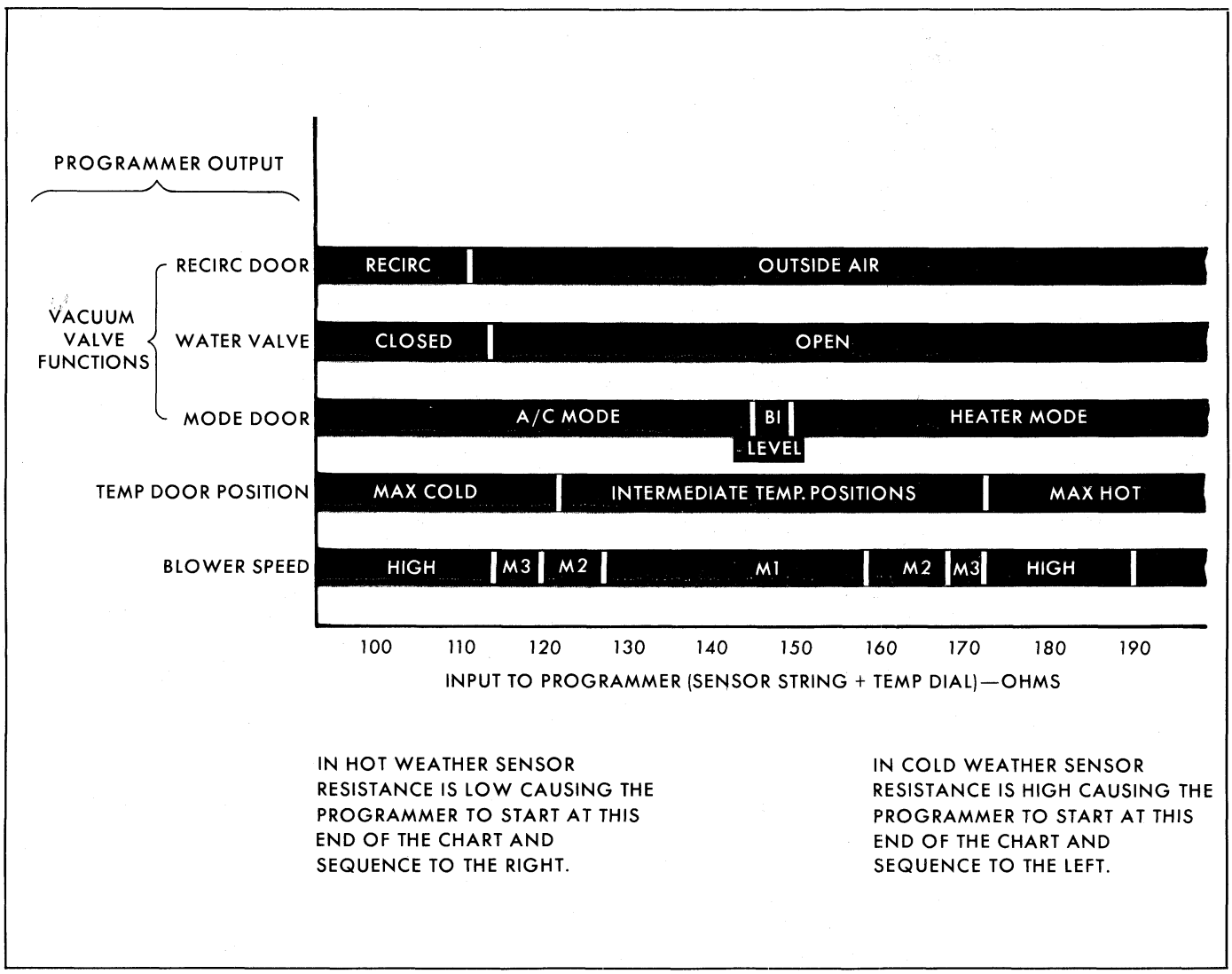


Fig. 1-8 Programmer Input-Output Chart

It is worth noting that an open sensor (disconnected, etc.) would represent a high resistance (as through the sensor were very cold) which would drive the programmer to maximum heat, while a shorted sensor would produce low resistance and drive the system to "Max A/C."

b. Blower Control Circuit

Three modes of blower speed control are available to the driver.

1. Fixed low blower speed.
2. Four blower speeds automatically controlled by the programmer, ranging from M_1, which is slightly higher than the fixed low speed, through M_2, M_3 and "Hi."
3. Fixed high blower speed (approximately the same as the high in the automatic range).

Blower turn-on occurs in the following ways:

1. Delayed turn-on in cold weather until warm water is available from the engine in all positions except "Off" and "Lo."
2. Immediate turn-on in warm weather when the car interior is warm, regardless of engine water temperature.
3. Immediate turn-on regardless of temperatures by override in the "Def" lever setting.

c. Auxiliary Electrical and Vacuum Functions

The *Compressor Clutch Circuit* is shown in Fig. 1-9. When the ignition switch is closed, current flows through the fuse block, two pads on the control head which are interconnected at all lever settings except "Off" and "Economy", the thermostatic cycling switch (if closed), compressor clutch coil and low pressure switch to ground.

Auxiliary vacuum circuits are those which provide vacuum to operate the various air doors and the heater water valve. They do not include vacuum circuitry connected with the transducer and vacuum motor which functions independently and was explained in a previous section.

REFRIGERATION SYSTEM

The sole function of the refrigeration system is to maintain the evaporator core at approximately 0°C (32°F) when refrigeration is required. The major components, interconnected by hose and tubing, accomplish this - the compressor, the condenser, the expansion tube (orifice), the evaporator core and the accumulator. The refrigeration system is shown schematically in Fig. 1-10.

This system incorporates a new cycling clutch expansion (orifice) tube refrigeration system called C.C.O.T.

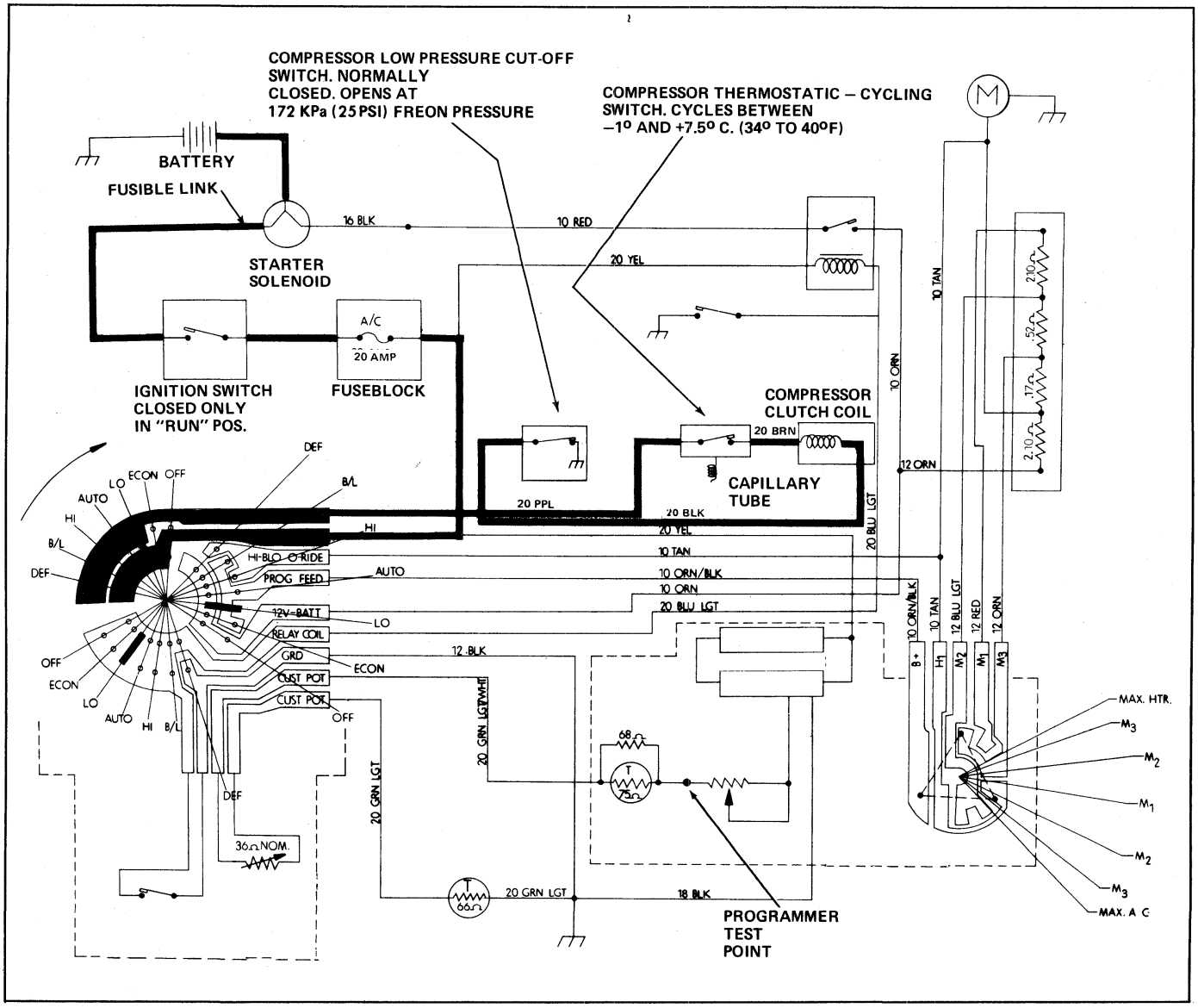


Fig. 1-9 Compressor Clutch Circuit

The refrigeration system is controlled by a temperature sensing switch which turns the compressor on and off as required to prevent evaporator condensate freeze. Thus the compressor runs only as much as necessary which results in fuel savings. An explanation of the refrigeration circuit and a brief description of each component follows.

C.C.O.T.

The cycling clutch - orifice tube refrigeration system exhibits some slightly different characteristics than previous systems.

- During A/C operating conditions, slight increases and decreases of engine speed/power may be noticed. This characteristic should be considered normal as the system is designed to cycle the compressor on and off to maintain desired cooling. The reduced compressor operation benefits fuel economy.
- When the ignition is turned off and the air conditioning has been operating, the refrigerant in the system will continue to flow until pressure is equalized. This may result in a faint sound of liquid flowing for 30-60 seconds.

a. Refrigerant Cycle

Refer to Fig. 1-10 for a generalized schematic of the refrigeration system showing relationship of components. The compressor discharges high temperature, high pressure vapor that contains heat absorbed in the evaporator plus heat imparted to it by the compressor in the compression process. This vapor flows through two parallel tubes in the condenser where it releases heat to the airstream and changes to a medium temperature high pressure liquid. This liquid flows through the liquid line to the orifice where it undergoes rapid expansion and changes from a medium temperature, high pressure liquid to a low temperature, low pressure liquid and vapor mixture. This cold, foamy mixture enters the evaporator core at the bottom end and flows through parallel tubes upward through the core. Heat from the warm airstream passing through the core is transferred to the refrigerant, vaporizing the liquid and cooling the air. Under high load conditions all the liquid is vaporized in the evaporator and only vapor flows to the accumulator and through the suction line to the compressor where heat-laden vapor is drawn into the compressor and the cycle is repeated. Under lighter load conditions the liquid and vapor are

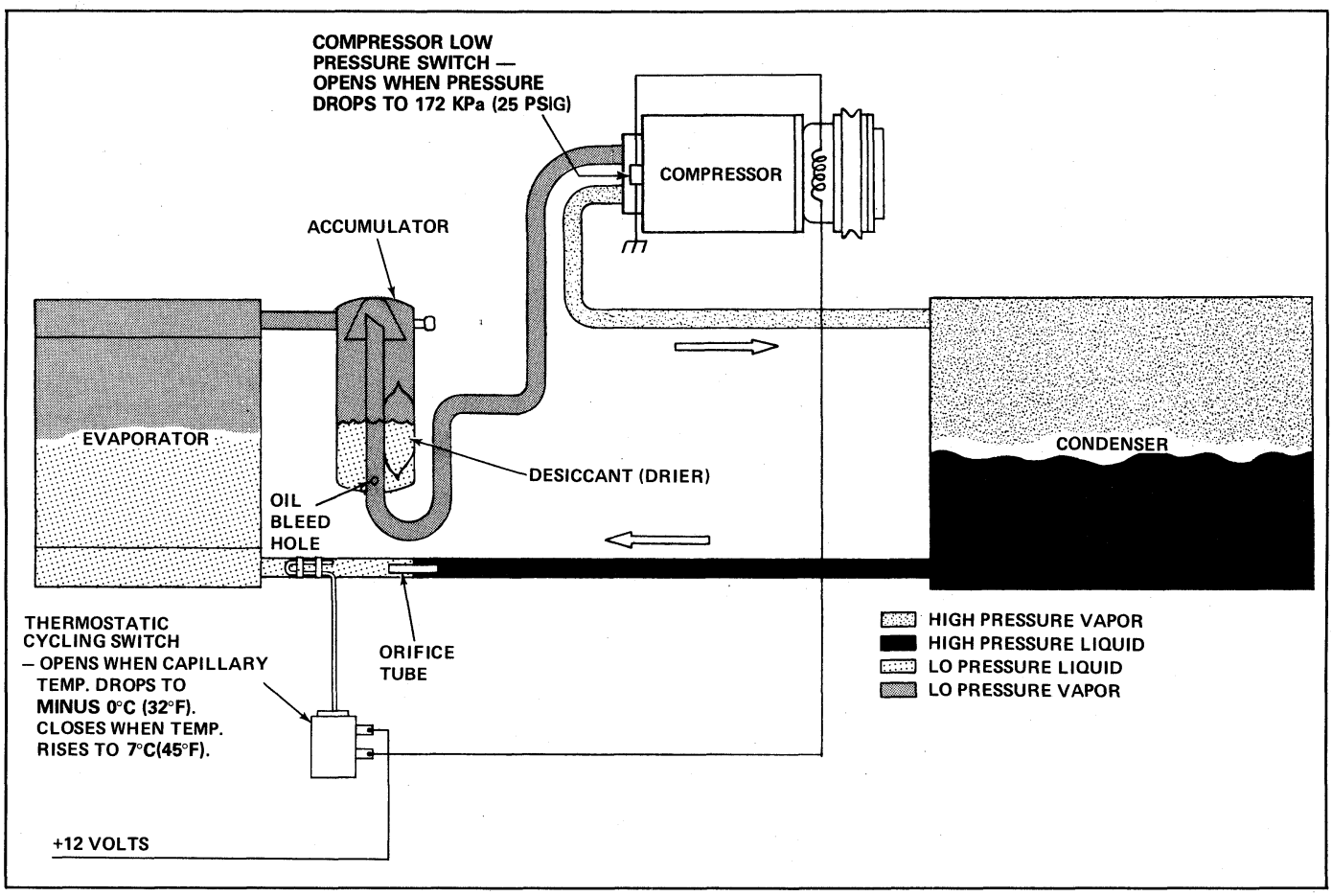


Fig. 1-10 Refrigeration Circuit

separated in the accumulator so that only vapor is drawn into the compressor.

b. Compressor

The compressor, Fig. 1-11, is located on top of the engine near centerline and is belt driven from the crankshaft pulley. Its function is to pump refrigerant around the refrigeration circuit and to provide pressure and temperature levels at which heat exchange can take place. It utlizes three double-acting pistons positioned axially around the compressor shaft, each of which operate in a front and rear cylinder assembly. The pistons are actuated by an axial plate that is pressed on the compressor shaft. The cylinders have a bore diameter of 38mm (1-1/2 inches) and a stroke of 30mm (1-3/16 inches), providing a total piston displacement of 206 cubic centimeters (12.6 cubic inches). Suction and discharge valve plates are located at the forward end of the front cylinder block and at the rear of the rear cylinder block.

A cycling magnetic clutch is used to drive the compressor shaft. When voltage is applied to the clutch coil by closing contacts in the thermostatic switch, the clutch plate and hub assembly, which is solidly coupled to the compressor shaft, is drawn by magnetic force rearward toward the pulley which rotates freely on the front head casting. The magnetic force locks the clutch plate and pulley together as one unit. The compressor shaft then turns with the pulley. When the thermostatic switch removes the voltage from the clutch coil, springs in the clutch plate and hub assembly move the clutch plate away from the pulley and the clutch plate and compressor shaft cease to rotate.

c. Condenser

The condenser is an aluminum tube-and-fin heat transfer unit located directly forward of the radiator, Fig. 1-10. The function of the condenser is to transfer heat from the refrigerant flowing through its tubes to the airstream drawn through it by the engine fan.

d. Compressor Low Pressure Switch

The smallest diameter refrigerant line in the system, the high pressure liquid line, carries the high pressure liquid refrigerant from the condenser to the evaporator. (There is no sight glass in this sytem.) On early vehicles the switch is located in the evaporator inlet line (high pressure), Fig. 1-12.

On later cars, it is installed in the rear head of the compressor, as shown in Figure 1-13. The purpose of the switch is to de-energize the compressor clutch and stop compressor operation to prevent damage to the compressor in the event the system refrigerant charge is lost, and when ambient temperature is below freezing.

The switch contacts are normally "open" at pressures below 135 kPa (20 psi) and normally "closed" at pressures above 205 kPa (30 psi). The switch contacts close on increasing pressure or open on decreasing pressure at (170 kPa $\pm$ 35) or (135-205 kPa)-(25 psi $\pm$ 5 psi, or 20-30 psi).

The pressure switch cavity vents into the high side of the system in the rear head as shown in Figures 1-13 and 1-14.

The pressure switch is mounted and sealed in the rear head of the compressor, Figure 1-14, by means of an O-ring between the switch housing and the cavity wall of the rear head. A special formed retaining ring holds the switch in place and electrically grounds the switch housing to the

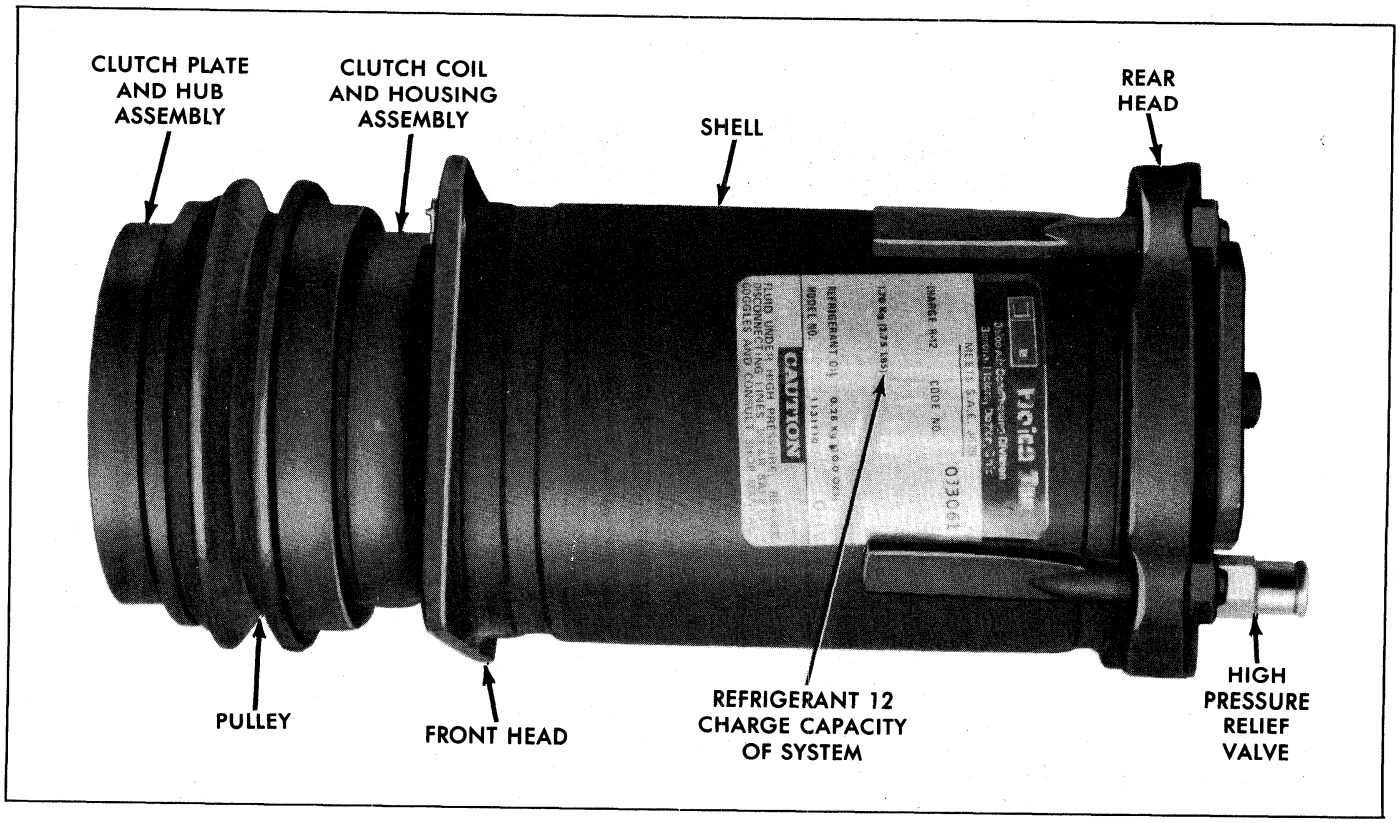


Fig. 1-11 A/C Compressor

compressor rear head. The switch retaining ring must be installed with the high point of the curved sides adjacent to the switch housing. The tips of the retainer ring curve outward when installed properly in the retainer ring groove to provide positive electrical continuity between the switch body and the rear head.

The cross section view of the switch in Figure 1-15 shows the switch contacts in the "open" position. Continuity through the switch is provided when system pressure against the diaphragm overcomes the force of the spring and moves the switch diaphragm, plunger and switch contact washer toward the terminal end of the switch and the contact washer contacts the inner surface of the switch housing. The electrical circuit through the switch is then switch terminal, to spring, to contact washer, to switch housing; then externally from the switch housing through the retainer ring to the compressor rear head and ground.

Should a leak develop in the diaphragm of the switch, a vent hole is provided in the terminal housing of the switch for leak detection purposes, Figures 1-13 and 1-15.

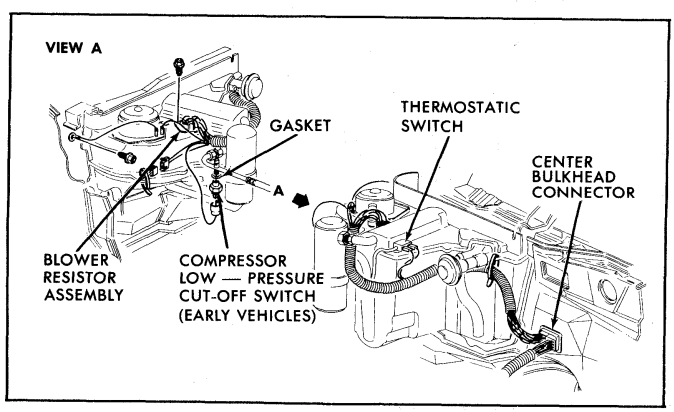


Fig. 1-12 Compressor Switches

e. Expansion Tube (Orifice)

The expansion tube is located in the evaporator inlet line.

The expansion tube (orifice) provides resistance to the high pressure liquid, thereby controlling the flow of refrigerant to the evaporator and allowing it to enter the evaporator as a low pressure liquid. There is also a fine mesh screen located at the expansion tube inlet, which acts as a strainer for refrigerant flowing through it.

An extended wire screen downstream of the orifice tube serves to reduce the flow noise associated with the pressure equalization when the system is shut off.

The expansion tube cannot be adjusted or repaired and must be replaced as a unit. After passing through the expansion tube, the low pressure refrigerant enters the evaporator.

f. Evaporator

The evaporator, Fig. 1-10, is located in the module on the engine compartment side.

The evaporator core, which is aluminum and similar in construction to the car radiator, is the actual cooling unit of the system. The blower forces air through the evaporator core where it is cooled and dehumidified. Condensate, which collects on the cold fins of the condenser, is allowed to drain from the housing through a small hole in the bottom. Unlike a radiator which transfers heat to the air flowing through it, the evaporator absorbs heat from the passing air. This is how the air is cooled. The heat that is absorbed from the air causes most of the refrigerant to boil into a vapor.

This vapor then flows out the top of the evaporator and into the accumulator, carrying with it some liquid refrigerant and refrigerant oil.

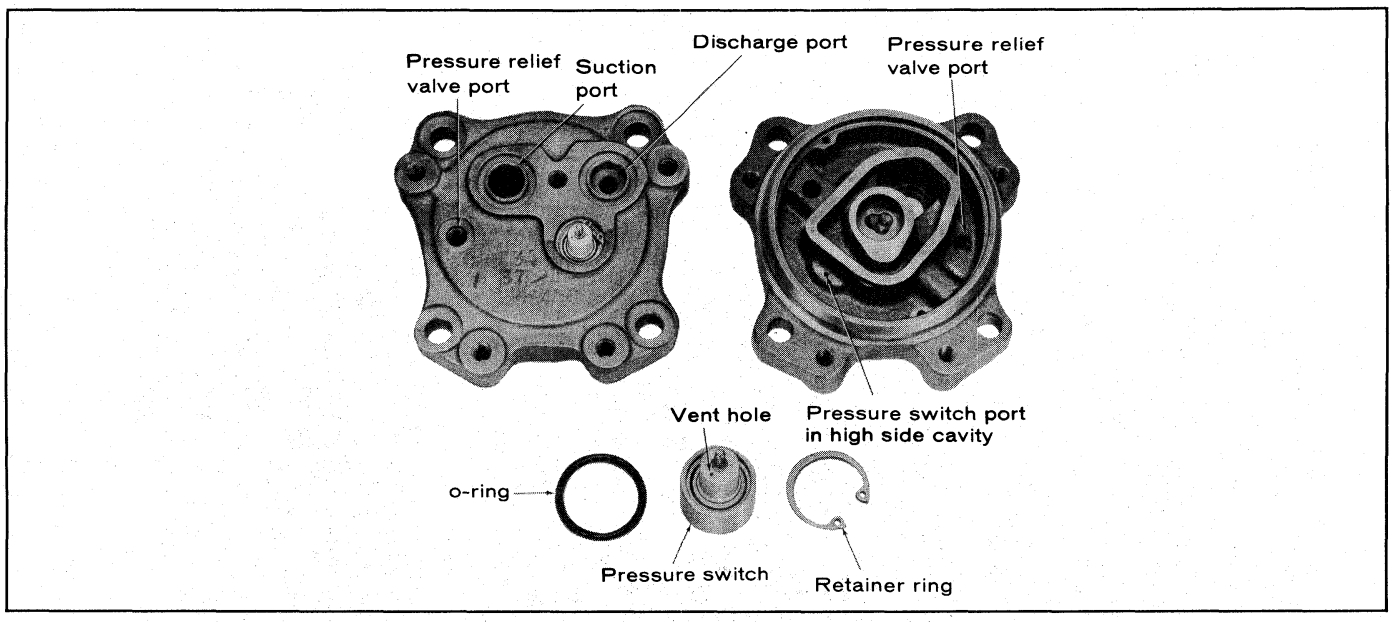


Fig. 1-13 Low Pressure Switch-Compressor Mounted

g. Accumulator

The main function of the accumulator, Fig. 1-10, is to separate the liquid refrigerant from the vapor, and to act as a storage device for the liquid refrigerant.

At the bottom of the accumulator is a drying agent, or desiccant, which absorbs any reasonable amount of moisture that may have entered the system. An oil bleed hole is also located in the lower portion of the accumulator to prevent oil from being trapped, thus assuring the return of oil to the compressor. The desiccant within the accumulator is not serviced separately - it is part of the sealed accumulator assembly which is replaced as a unit.

The low pressure vapor now flows from the accumulator back to the compressor where it will be compressed and the cycle will begin again.

h. Thermostatic Switch

The thermostatic switch, mounted on the module cover, Fig. 1-12, is used to cycle the compressor clutch.

The thermostatic switch is operated by a small bellows, which in turn is connected to a metallic tube which is charged with R-22. The tube is positioned on the evaporator inlet pipe

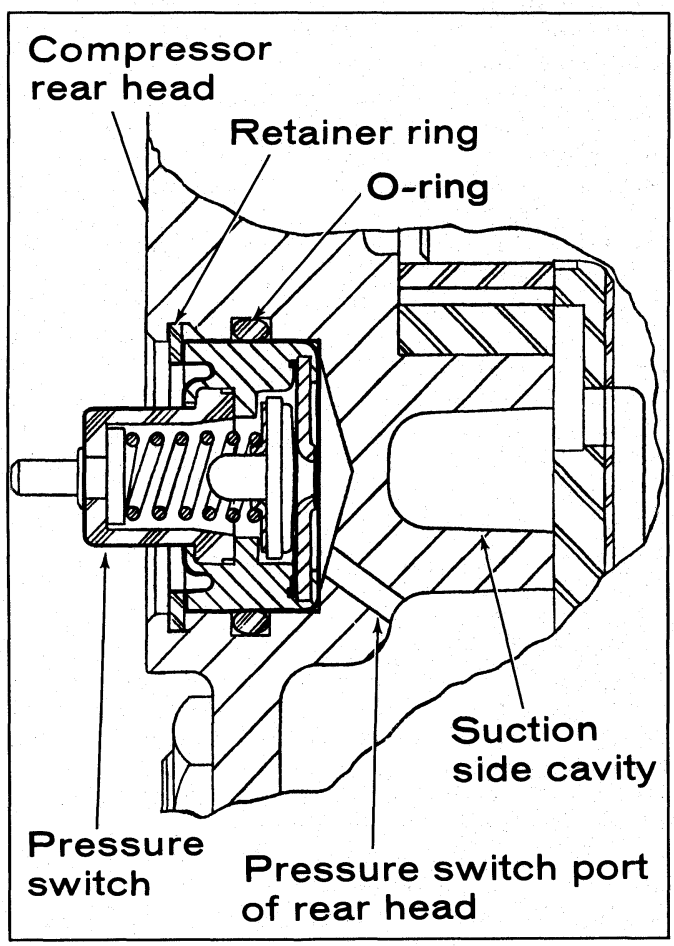


Fig. 1-14 Low Pressure Switch Venting

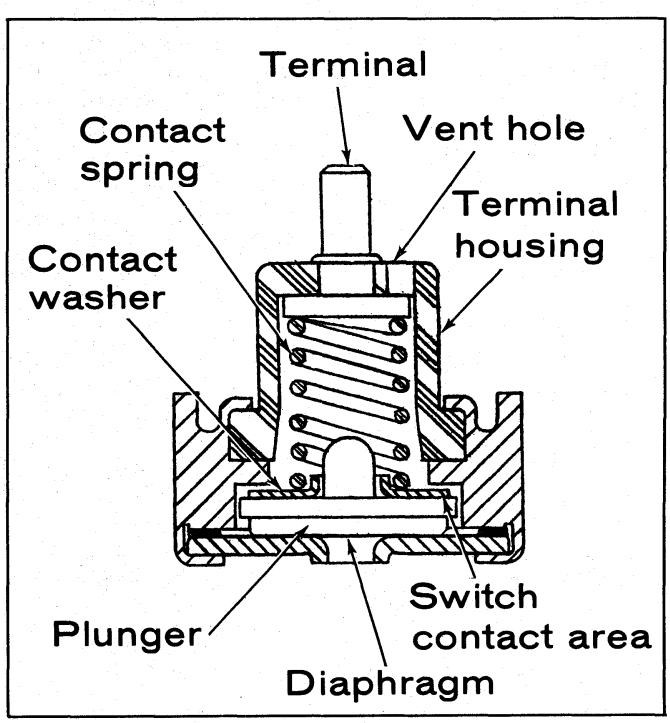


Fig. 1-15 Low Pressure Switch Cross Section

and secured by two clamps. As the temperature at the evaporator core decreases, the charge inside the tube contracts, thus reducing the pressure on the switch bellows.

The switch contacts open, and the compressor clutch disengages. With the compressor off, the temperature at the evaporator rises, causing the charge inside the tube to expand and exert pressure on the bellows. The expansion of the bellows closes the switch contacts, causing the compressor to engage. In this way, the compressor cycles off and on in order to maintain the proper temperature at the evaporator core.

SYSTEM OPERATION AT VARIOUS LEVER SETTINGS

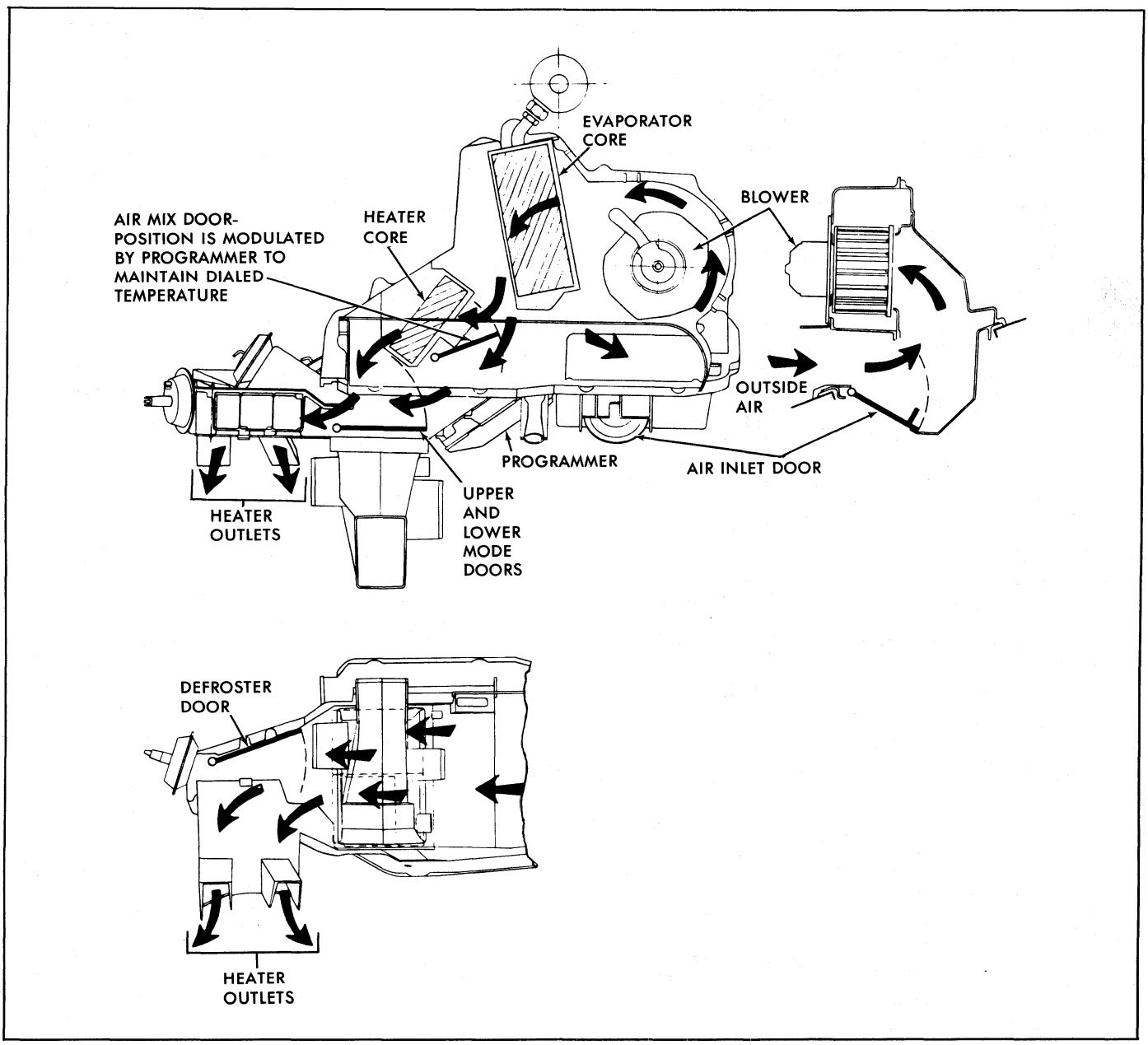


Fig. 1-16 Airflow at "Off"

AIRFLOW AT OFF (Fig. 1-16)

Outside air is circulated at a fixed low blower speed through the evaporator and heater assembly and discharged into the passenger compartment from the heater outlet when the ignition switch is in the "Run" position and turn on requirements are met. The temperature of the air is modulated by the air-mix door to maintain the temperature on the dial. The ability of the system to maintain this temperature in warm weather is restricted, however, since the compressor is disengaged at this setting.

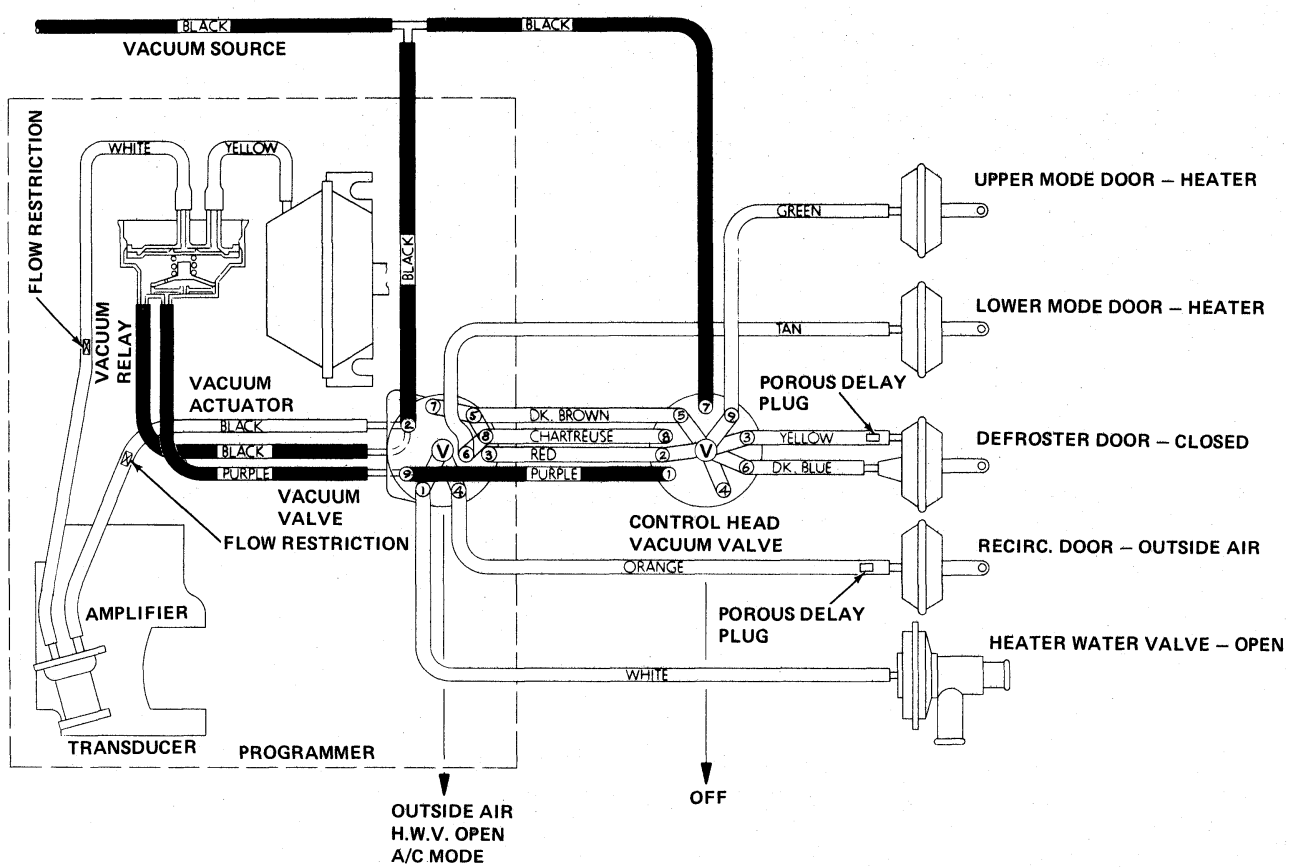


Fig. 1-17 Vacuum Circuit at "Off"

VACUUM CIRCUIT AT OFF (Fig. 1-17)

With the control head in the "Off" position, vacuum is not available at any of the actuators. This results in the upper and lower mode doors being closed which routes air flow to the heater outlets. The defroster door is also closed which also forces air out the heater ducts. The recirc door is in the outside air position and the water valve is open allowing water to flow into the heater core.

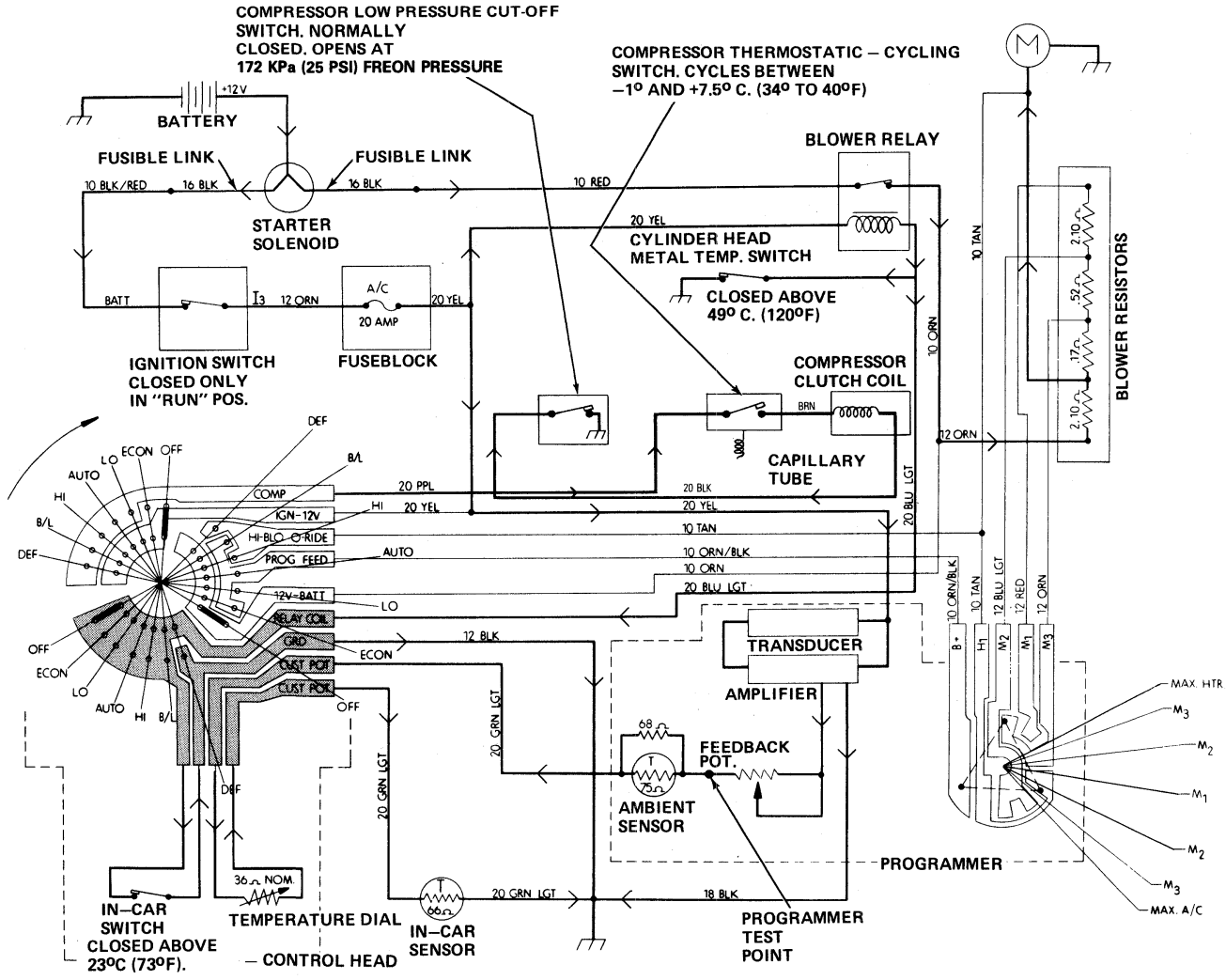


Fig. 1-18 Blower Operation at "Off"

BLOWER OPERATION AT OFF (Fig. 1-18)

Blower operation in "Off" is delayed in cold weather by the metal temperature switch and the in-car switch. As the engine is started and run and the coolant temperature reaches 49°C (120°F), the metal temperature switch closes providing a ground for the relay coil which closes the relay and provides battery voltage to the blower motor through the single fixed low blower resistor. This provides fixed low blower speed. In warm weather the in-car switch closes above 23°C (73°F) to ground the relay coil providing this same action. Movement of the programmer has no effect on blower speed.

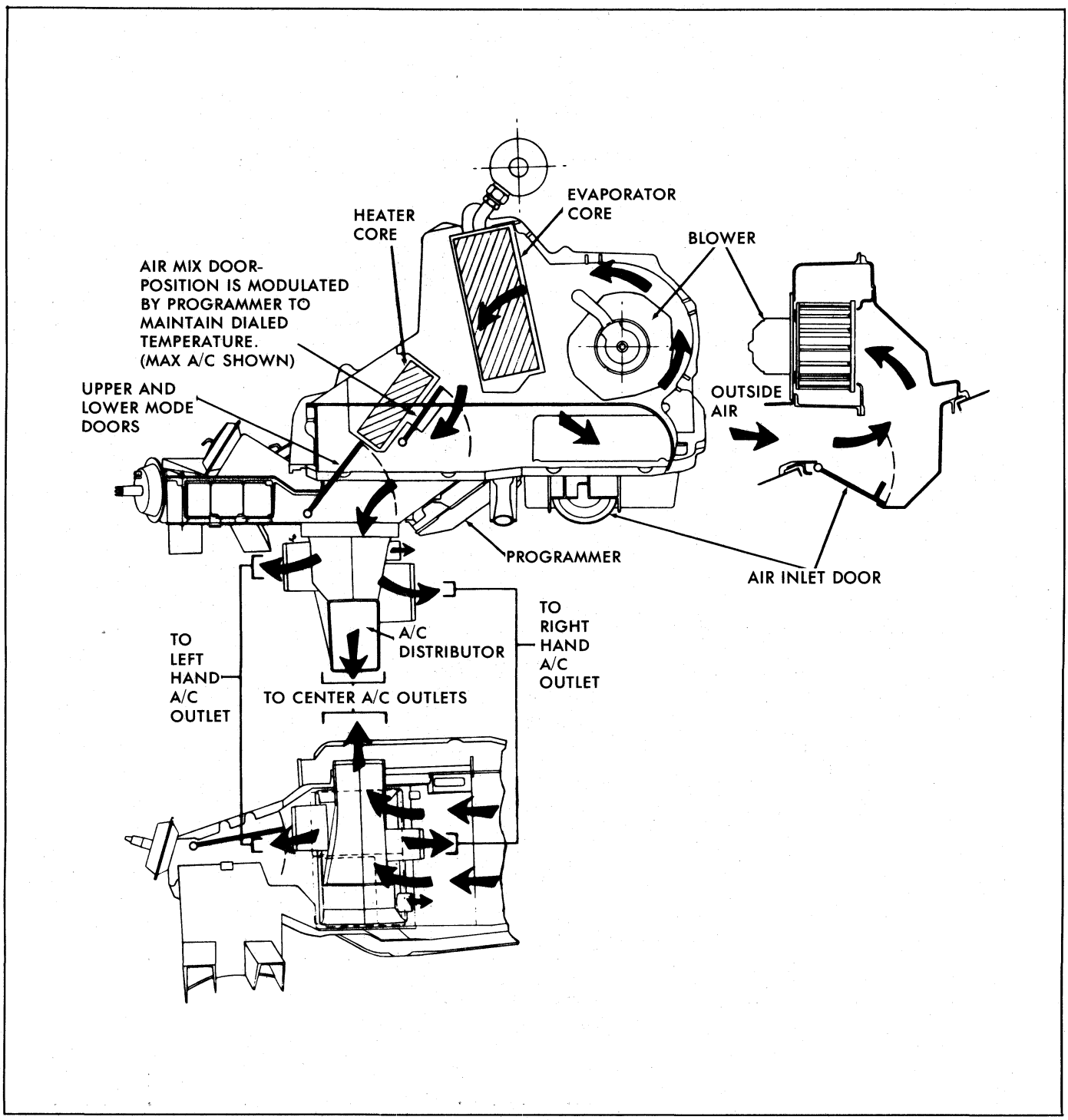


Fig. 1-19 Airflow at "Economy"

AIRFLOW AT ECONOMY (Fig. 1-19)

Airflow at "Economy" is the same as described for Auto. However, since the compressor is disengaged at this setting, the ability of the system to maintain the dial temperature is restricted. It may be necessary to set the dial approximately 5° cooler than normal to maintain comfort at 10°C to 21°C (50° to 70°F) ambient temperatures.

In the upper part of the usable range of this setting (approximately 10°C t 21°C or 50°F to 70°F) air is delivered from the air conditioner outlets. Below 10°C (50°F) air is delivered in BI-LEVEL fashion - from both the air conditioner and heater outlets or from the heater outlet only in cold weather. System turn on will be delayed, if the engine is cold, until engine coolant reaches approximately 49°C (120°F).

The "Economy" setting is designed so that it is possible to maintain comfort at ambient temperatures below approximately 21°C, (70°F) without having the compressor operate.

In some situations (high sunload or excessive humidity) this setting may not provide comfort, or windows may tend to become fogged. Under these conditions, the control lever should be turned to the "Auto" setting.

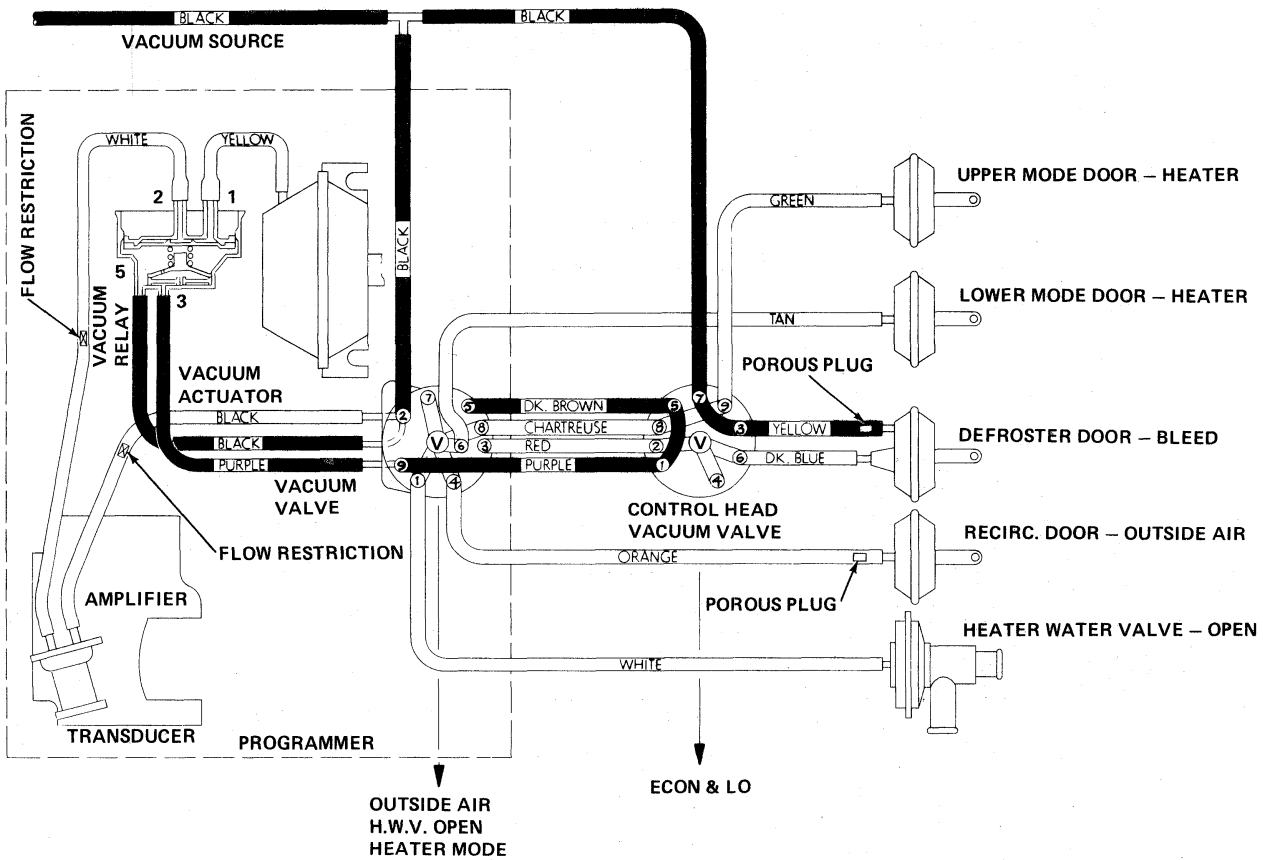


Fig. 1-20 Vacuum Circuit at "Economy" and "Lo" - Heater Mode

VACUUM CIRCUIT AT ECONOMY AND LO-HEATER MODE (Fig. 1-20)

With the control lever in either "Economy" or "Lo" the control head vacuum valve is positioned as shown in Fig. 1-20. This figure also illustrates the position of the programmer vacuum valve when the control system calls for heater mode. With this porting arrangement the mode doors are vented which allows them to remain closed for heater airflow. To provide a small "bleed" of air to the defroster outlet the defroster door is opened approximately 3/4 inch. This is accomplished by applying vacuum to the outer nipple of the two-stage defroster actuator. The porous delay plug in the hose provides a delay of approximately 45 seconds in the operation of the door. Note that the defroster bleed port is connected to full engine vacuum, not checked vacuum. This is done to allow the vacuum to escape when the engine is stopped so that the defroster door will seal. These two features are used to prevent fogging of the windshield which sometimes can occur when the car is restarted.

The recirc door actuator is vented to position the door for outside air. The water valve is also vented (open) which allows a flow of coolant through the heater core.

Refer to Fig. 1-23 for operation in the A/C mode.

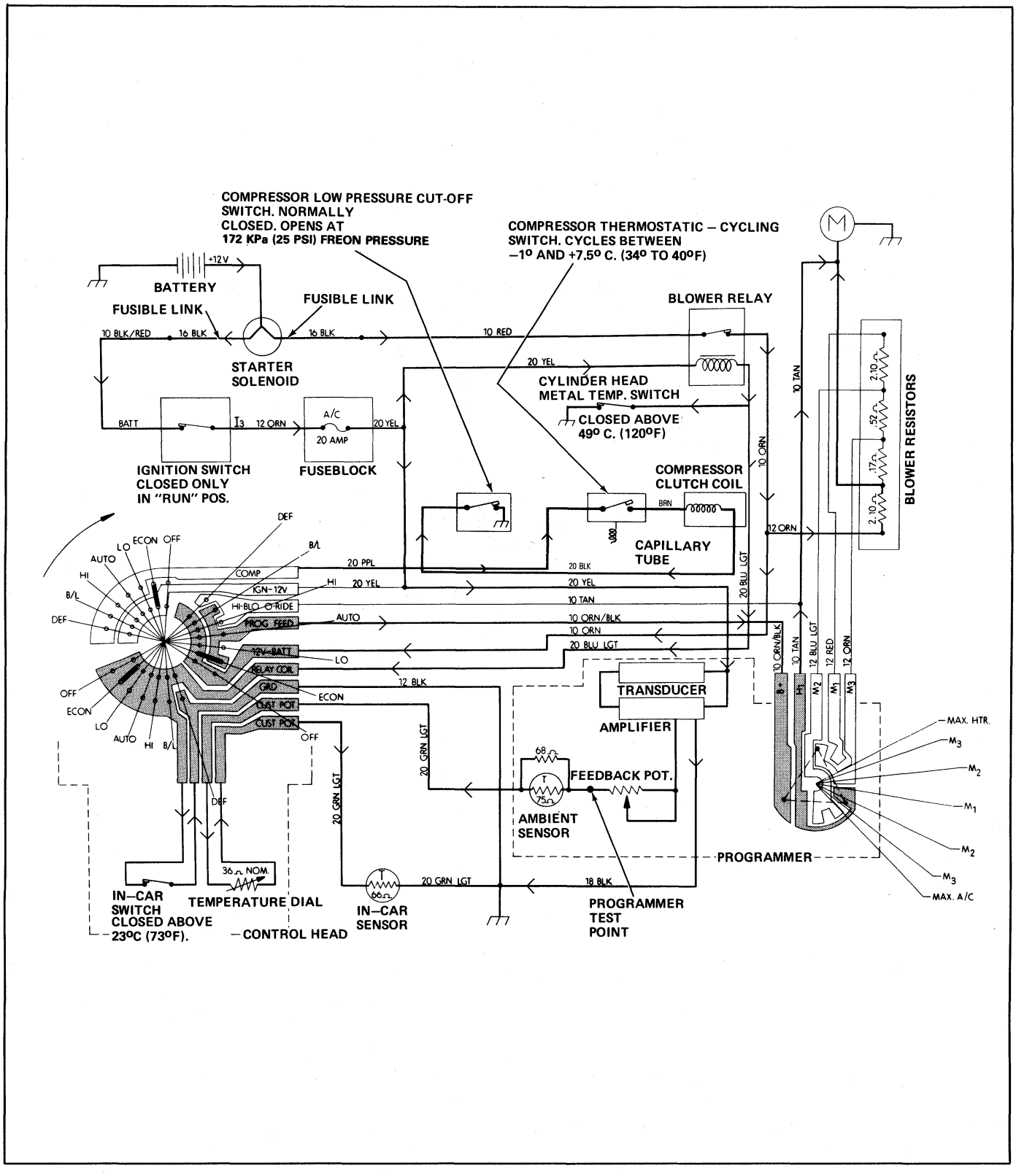


Fig. 1-21 Blower Operation at "Economy"

BLOWER OPERATION AT "ECONOMY" (Fig. 1-21)

Operation in "Economy" is restricted by the metal temperature switch and the in-car switch as in "Off". However, in this position, once system turn-on is accomplished, battery voltage is supplied to a pad on the control head which is connected to the programmer feed terminal. With battery voltage at the programmer B+ terminal, current flows through none, one, two or three resistors, depending on the position of the programmer, to the blower motor.

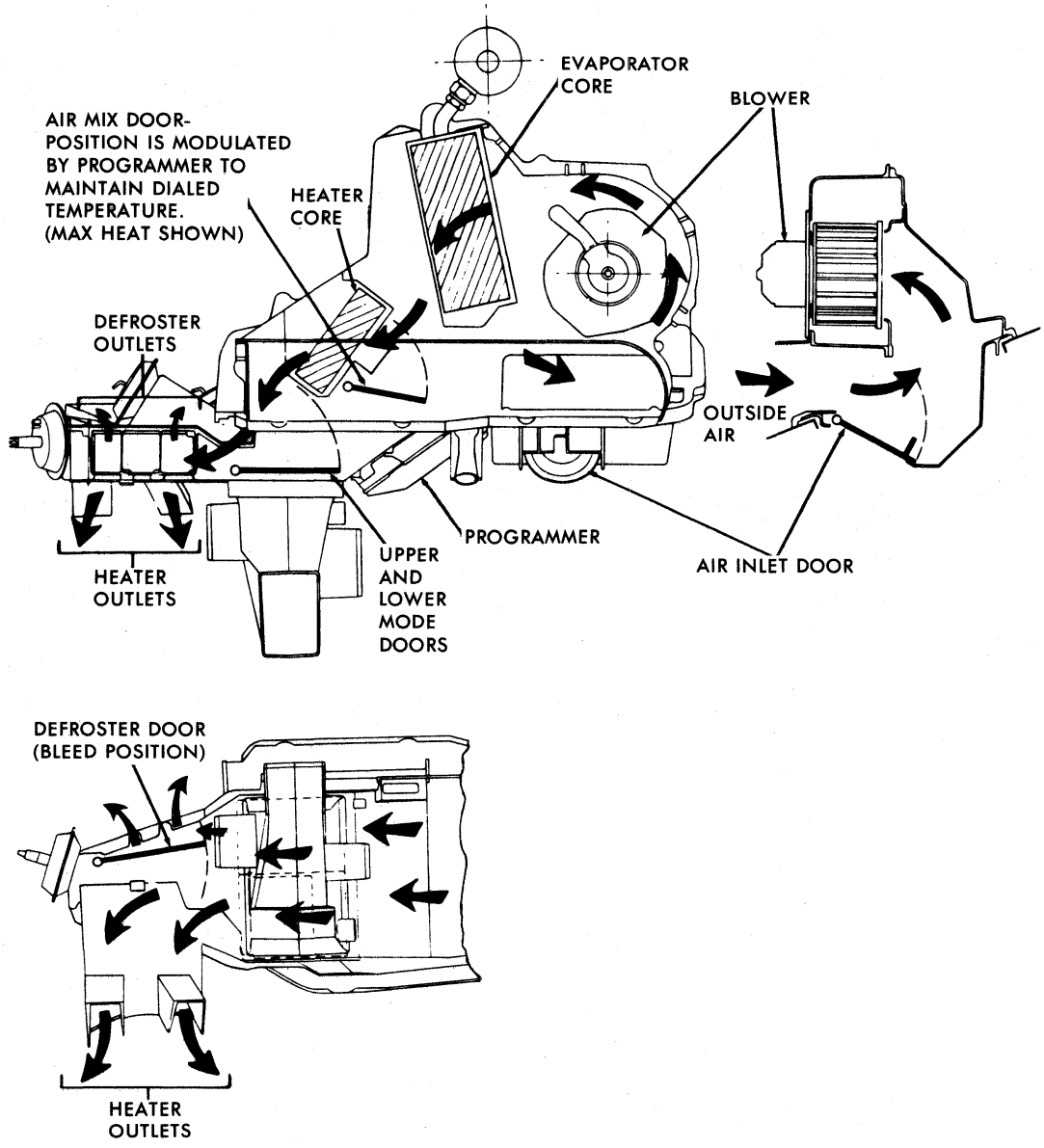


Fig. 1-22 Airflow at "Lo"

AIRFLOW AT LO (Fig. 1-22)

Operation at this setting is identical to that provided at "Auto" except that the blower operates at a fixed low speed and there is no recirculation.

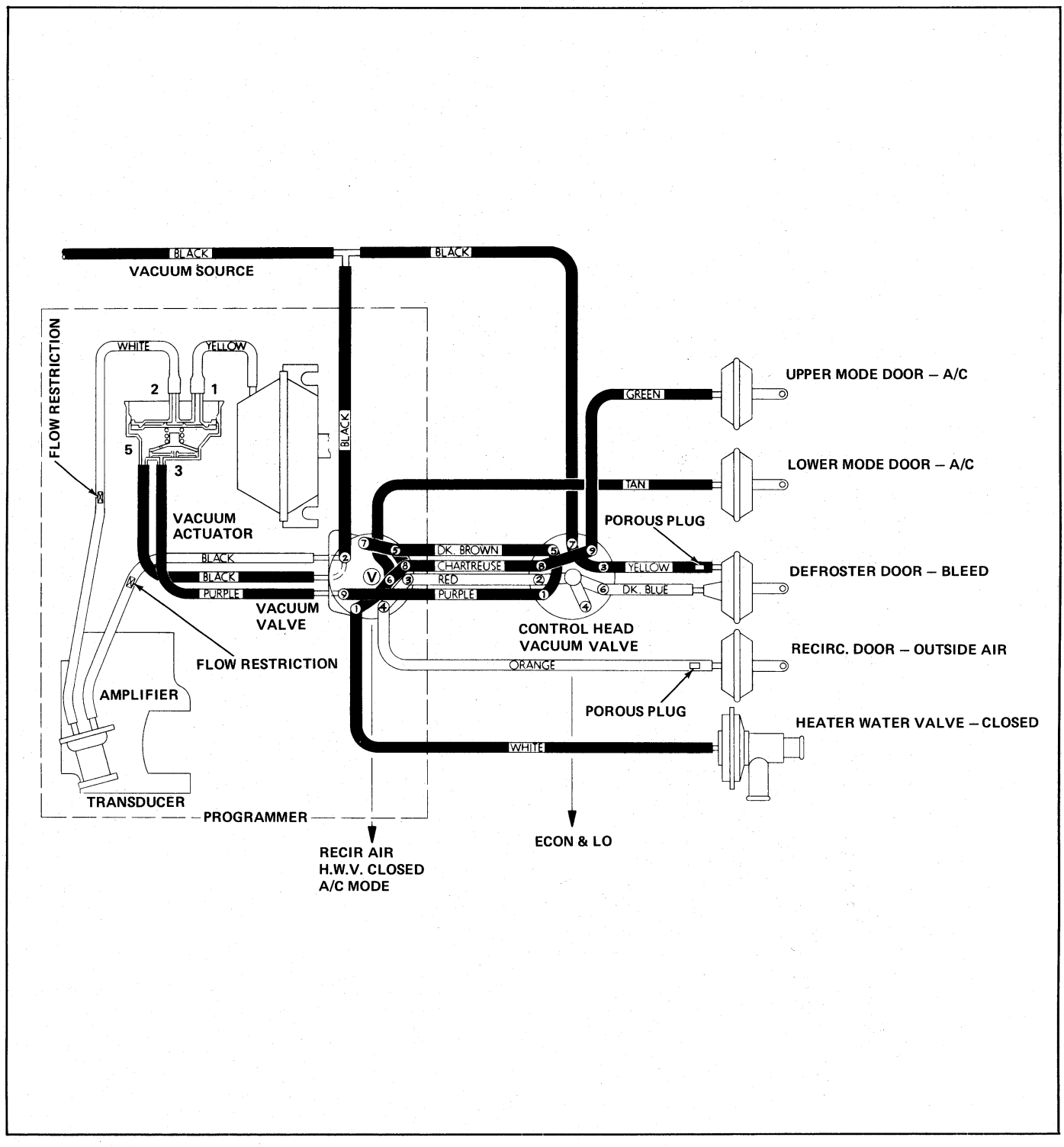


Fig. 1-23 Vacuum Circuit at "Economy" and "Lo" - A/C Mode

VACUUM CIRCUIT AT ECONOMY AND LO - A/C MODE (Fig. 1-23)

With the control head in either "Economy" or "Lo", the control head is positioned as shown. When the sensor string moves the vacuum motor to the A/C position, the programmer valve provides the connections shown in Fig. 1-23. This combination of valve porting provides vacuum to both upper and lower mode door actuators which moves the doors to the A/C position providing airflow from the A/C outlets. The defroster door "bleed" port is supplied vacuum to open the defroster door. However, with the mode doors open all of the air is intercepted and delivered through the A/C outlets. The recirc actuator is vented providing outside air. The programmer valve connects source vacuum to port 7 supplying vacuum to the water valve which closes the valve and prevents water flow through the heater core.

Refer to Fig. 1-20 for operation in the heater mode.

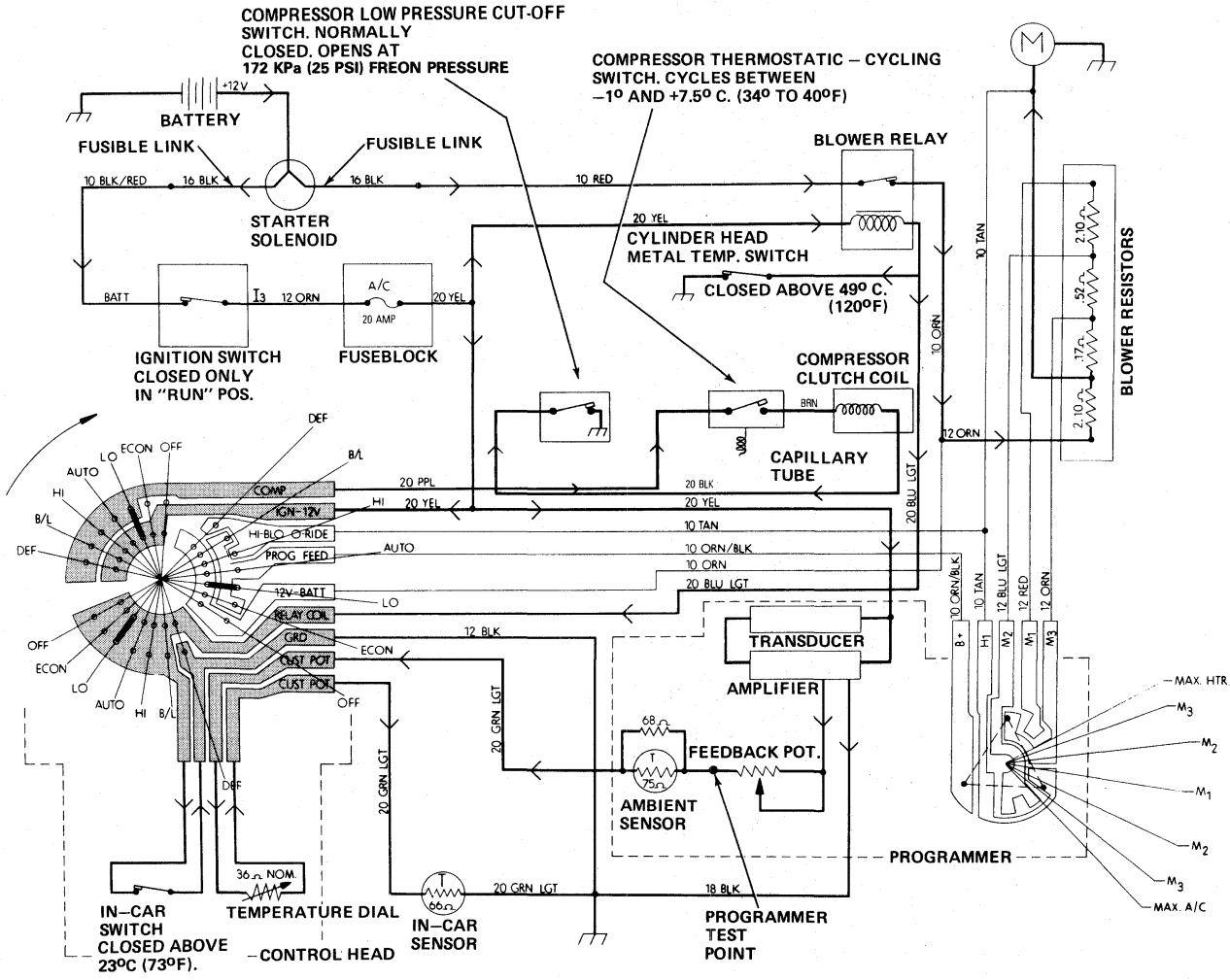


Fig. 1-24 Blower Operation at "Lo"

BLOWER OPERATION AT LO (Fig. 1-24)

In "Low", battery voltage flows thru the fusible link, ignition switch and fuse block to the ignition pad on the control head which is connected to the compressor feed pad by the wiper contacts. This provides energizing of the compressor clutch if the evaporator pressure switch is closed.

Blower operation is again delayed until the relay coil circuit is completed by the metal temp. or in-car switches. Once completed, a fixed low blower speed is provided as blower current travels through the single fixed lo blower resistor before reaching the blower motor. Multiple blower speeds are not provided since the programmer B+ feed circuit is not completed at the control head.

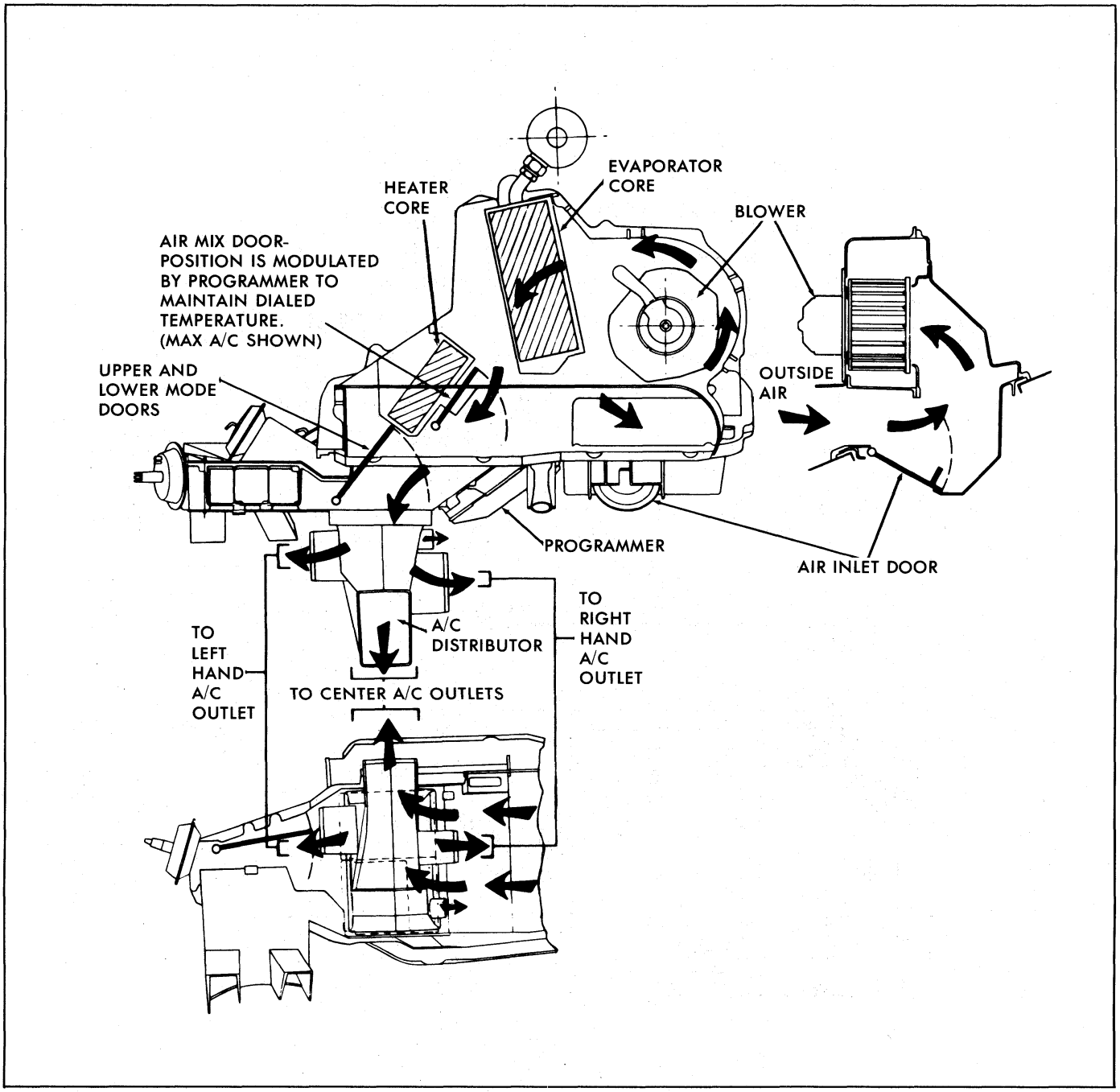


Fig. 1-25 Airflow at "Auto"

AIR FLOW AT AUTO (Fig. 1-25)

Regulation of blower speed, discharge air temperature, air delivery mode, system turn-on and compressor operation are all accomplished automatically to maintain the temperature on the dial and to provide comfort.

Four blower speeds, HI, MED3, MED2, and MED1 are utilized. If the car interior is significantly hotter or colder than the temperature on the dial, the blower will start at a higher speed and then sequence down to lower speeds as the dial temperature is approached.

Discharge air temperature will be varied automatically between approximately 7°C and 66°C (45°F and 150°F). If the discharge air temperature is above approximately 38°C (100°F), the air will be delivered from the heater outlet (Fig. 1-22; below approximately 24°C (75°F) it will be delivered from air conditioner outlets, Fig. 1-25. Between these temperatures, air is provided from both the heater and air conditioner outlet (Bi-Level operation), Fig. 1-31.

If the car interior is above approximately 23°C (73°F), the system will turn on immediately when the car is operated. If the car interior is below 23°C (73°F), system turn-on will be delayed, if the engine is cold, until engine coolant reaches approximately 49°C (120°F).

The system is designed to cycle the compressor on and off to maintain desired cooling at all ambient temperatures above approximately 0°C (32°F) even when not required for cooling, to assure maximum dehumidification of the air.

Recirculated air is used when maximum cooling is required.

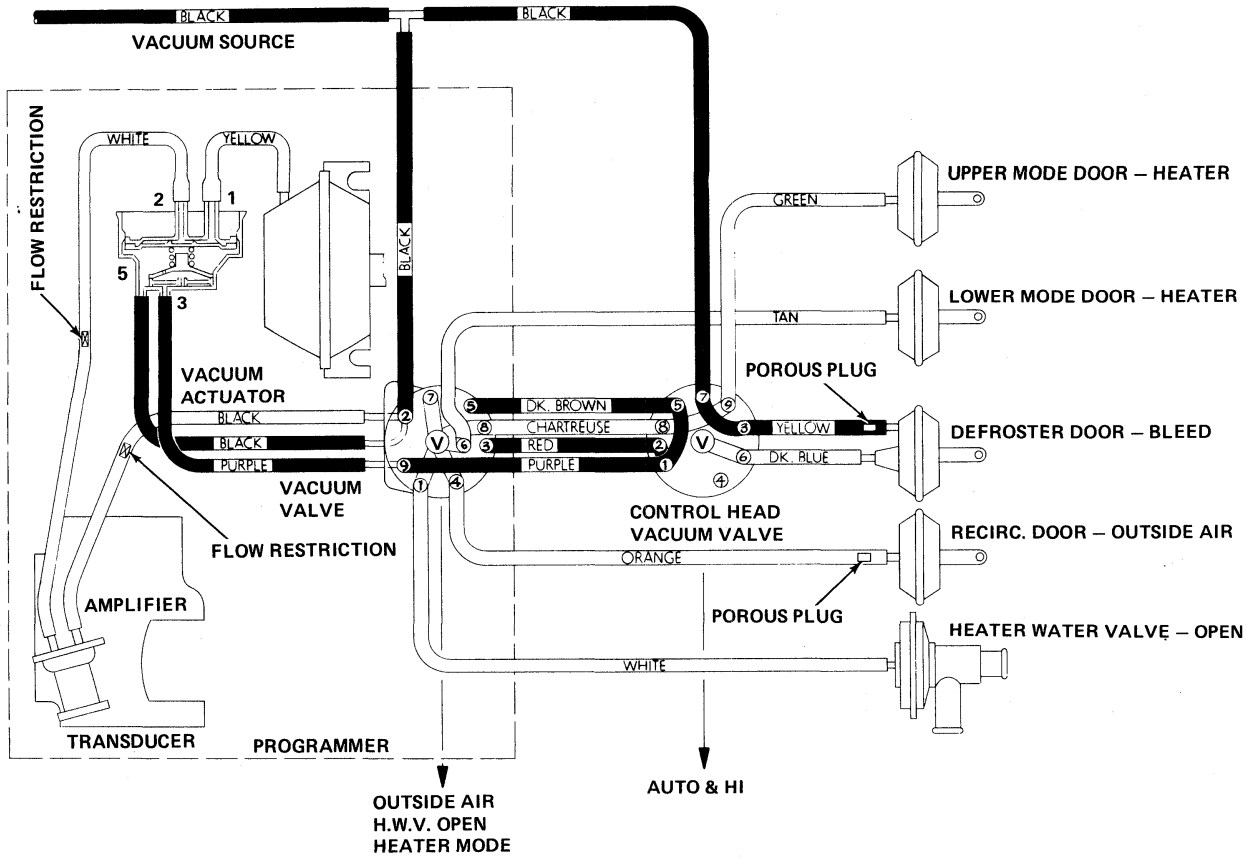


Fig. 1-26 Vacuum Circuit at "Auto" and "Hi" - Heater Mode

VACUUM CIRCUIT AT "AUTO" AND "HI"- HEATER MODE (Fig. 1-26)

Three modes of operation are available in the "Auto" and "Hi" settings; heater, bi-level and A/C. The following discussion presents the heater mode while Fig. 1-29 will discuss the A/C mode and Fig. 1-32 presents bi-level operation.

The control head and programmer port arrangement shown in Fig. 1-26, represents the control head setting at "Auto" or "Hi" when the sensor string dictates heater operation. Only slight differences exist between this vacuum circuit and the "Economy - Lo" operation in Fig. 1-20. These differences do not change any door positions or airflow.

If exact porting needs to be analyzed, this can be determined from Fig. 1-38.

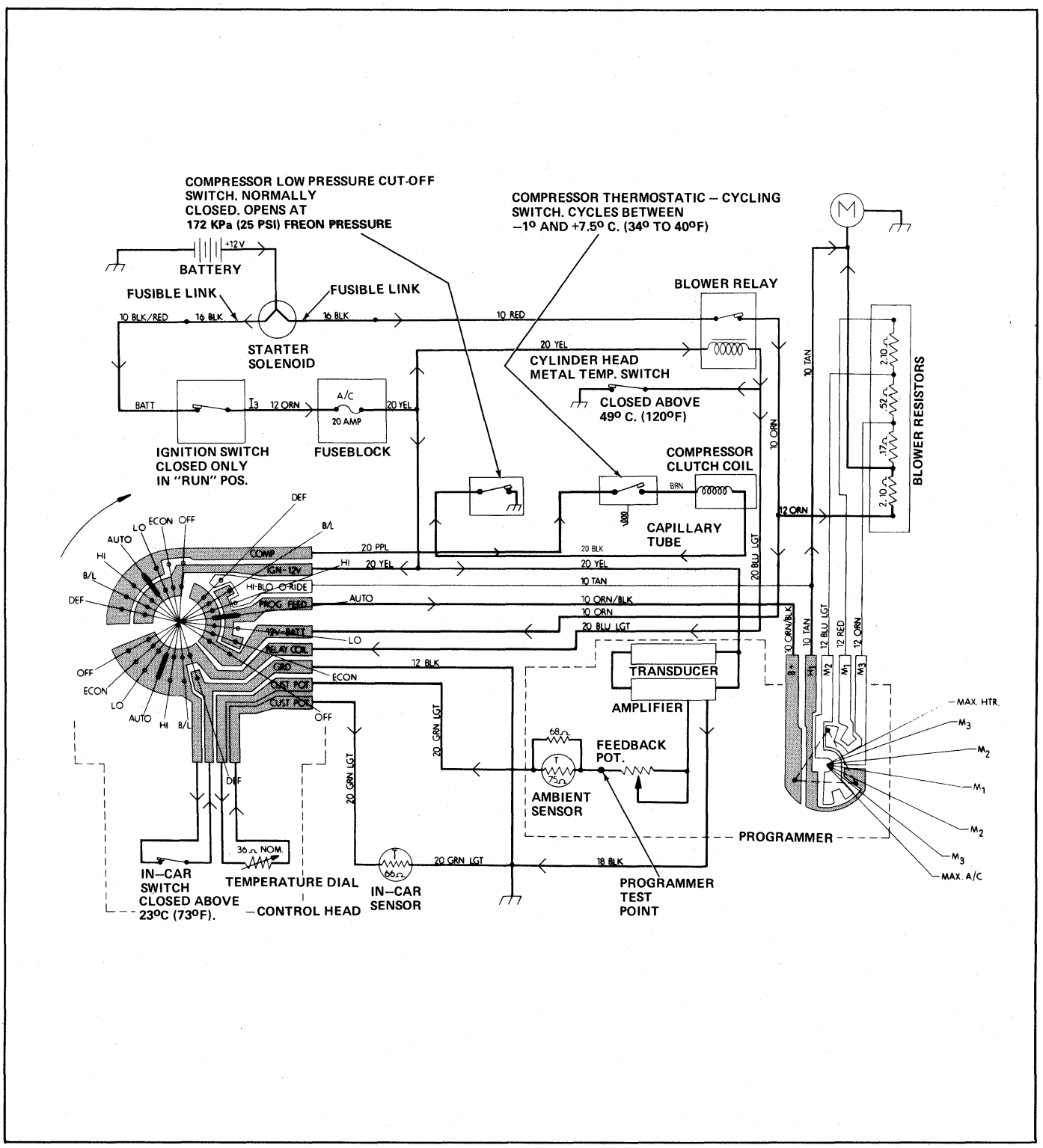


Fig. 1-27 Blower Operation at "Auto"

BLOWER OPERATION AT AUTO (Fig. 1-27)

In "Auto", battery voltage flows through the fusible link, ignition switch and fuse block to the ignition pad on the control head which is connected to the compressor feed pad by the wiper contacts. This provides energizing of the compressor clutch if the evaporator pressure switch is closed.

Blower current is again delayed until the relay coil circuit is completed by the metal temperature or in-car switches. Once this is accomplished blower current is provided to the programmer B+ terminal through the control head wiper contacts connecting the 12 volt and programmer feed pads. From the programmer blower current flows through none, one, two or three resistors, depending on the position of the programmer, to the blower motor providing multiple blower speeds.

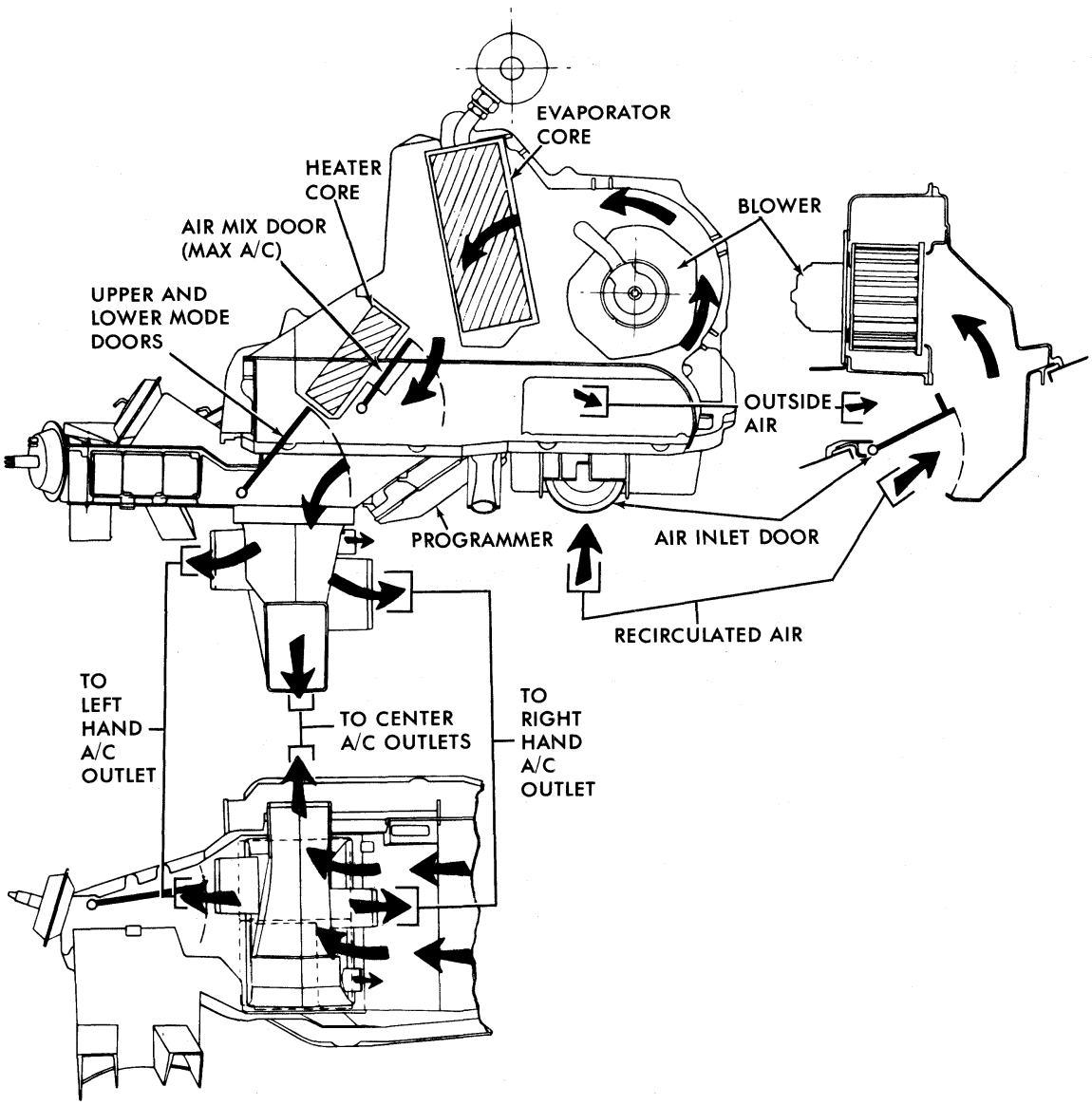


Fig. 1-28 Airflow at "Hi"

AIRFLOW AT HI (Fig. 1-28)

Operation at this setting is identical to that provided at "Auto" except that the blower operates at a fixed maximum speed. Recirculated air is used when maximum cooling is required. This setting is provided to clear smoke or odors from the car interior as rapidly as possible.

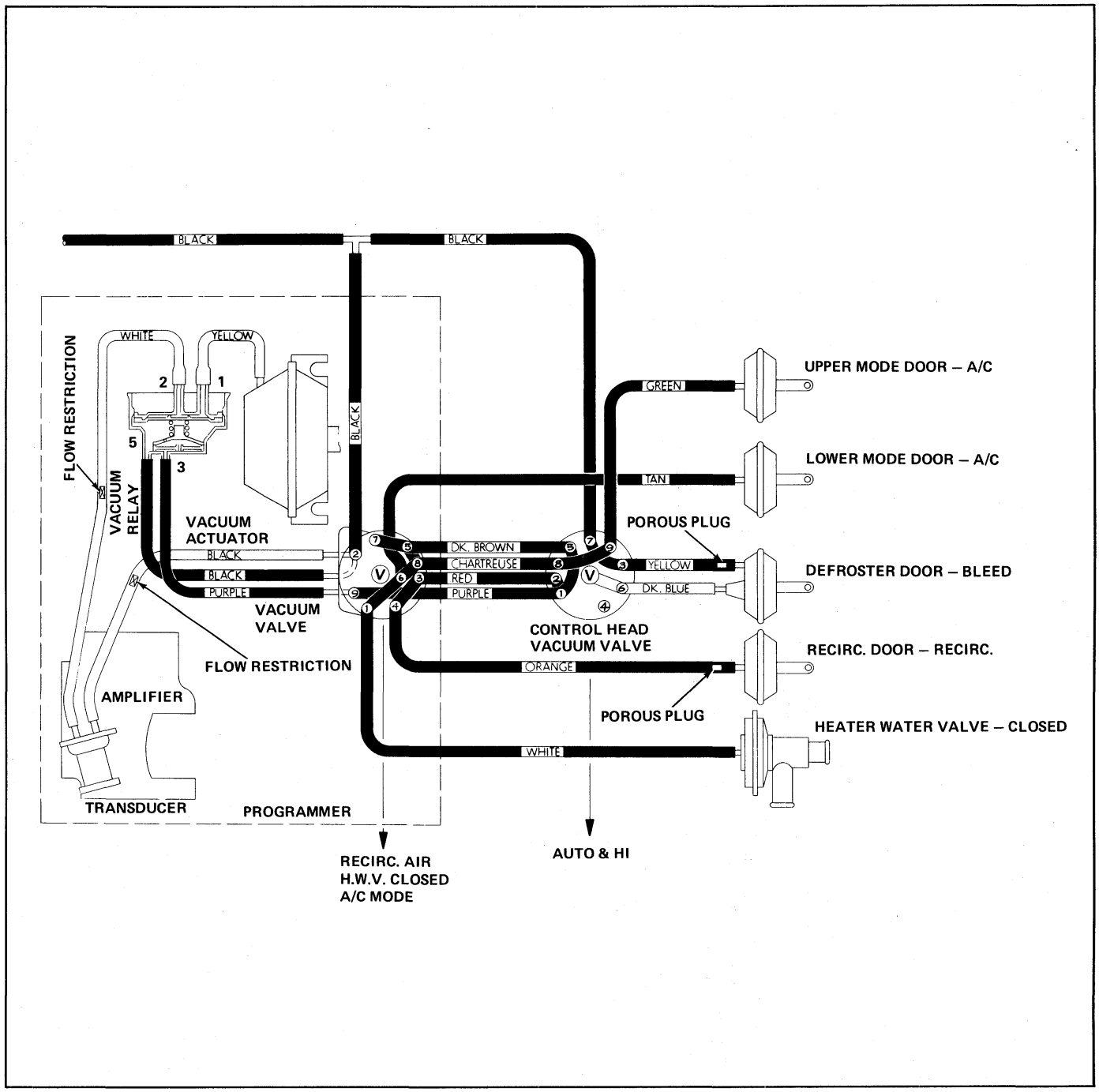


Fig. 1-29 Vacuum Circuit at "Auto" and "Hi" - A/C Mode

VACUUM CIRCUIT AT AUTO AND HI - A/C MODE (Fig. 1-29)

Three modes of operation are available in the "Auto" and "Hi" settings; heater, bi-level and A/C. The following discussion presents the A/C mode while Fig. 1-26 discussed the heater mode and Fig. 1-32 presents bi-level operation.

The control head and programmer port arrangement shown in Fig. 1-29, represents the control head setting at "Auto" or "Hi" when the sensor string dictates A/C operation. The upper and lower mode doors are both provided with vacuum which moves them to the A/C position. In this position th doors intercept all of the air flowing through the module and channels it out the A/C ducts. The defroster bleed port is supplied, however, the open mode doors prevent air from reaching the defroster door. Therefore, in spite of the open defroster door, there is no windshield airflow.

Fig. 1-29 shows the programmer positioned for maximum A/C. In this position, the programmer valve provides vacuum to the recirc door actuator which moves the recirc door to a position where 80% of the air needed is drawn from the passenger compartment (recirculated) and 20% is outside air. As the sensor string senses that passenger compartment temperature is cooling down the programmer valve moves and vents the recirc actuator to again allow 100% outside air.

If exact porting of this position needs to be analyzed, refer to Fig. 1-38.

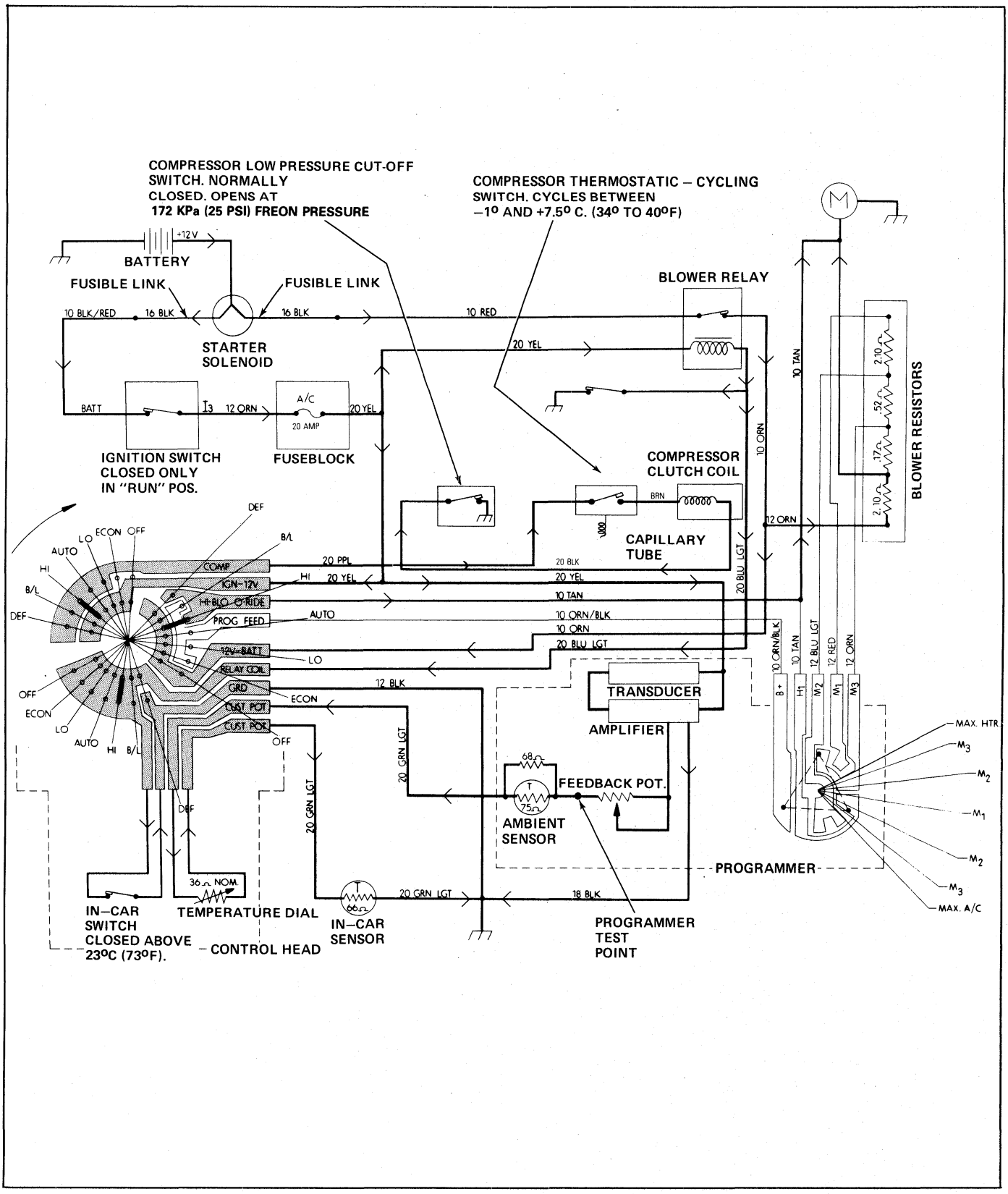


Fig. 1-30 Blower Operation at "Hi"

BLOWER OPERATION AT HI (Fig. 1-30)

Operation in "Hi" is the same as described for "Auto" except that the programmer feed is not available and the hi-blower override pad is connected to the 12 volt pad when the relay coil circuit is completed by the metal temperature switch or in-car switch. This provides fixed high blower speed.

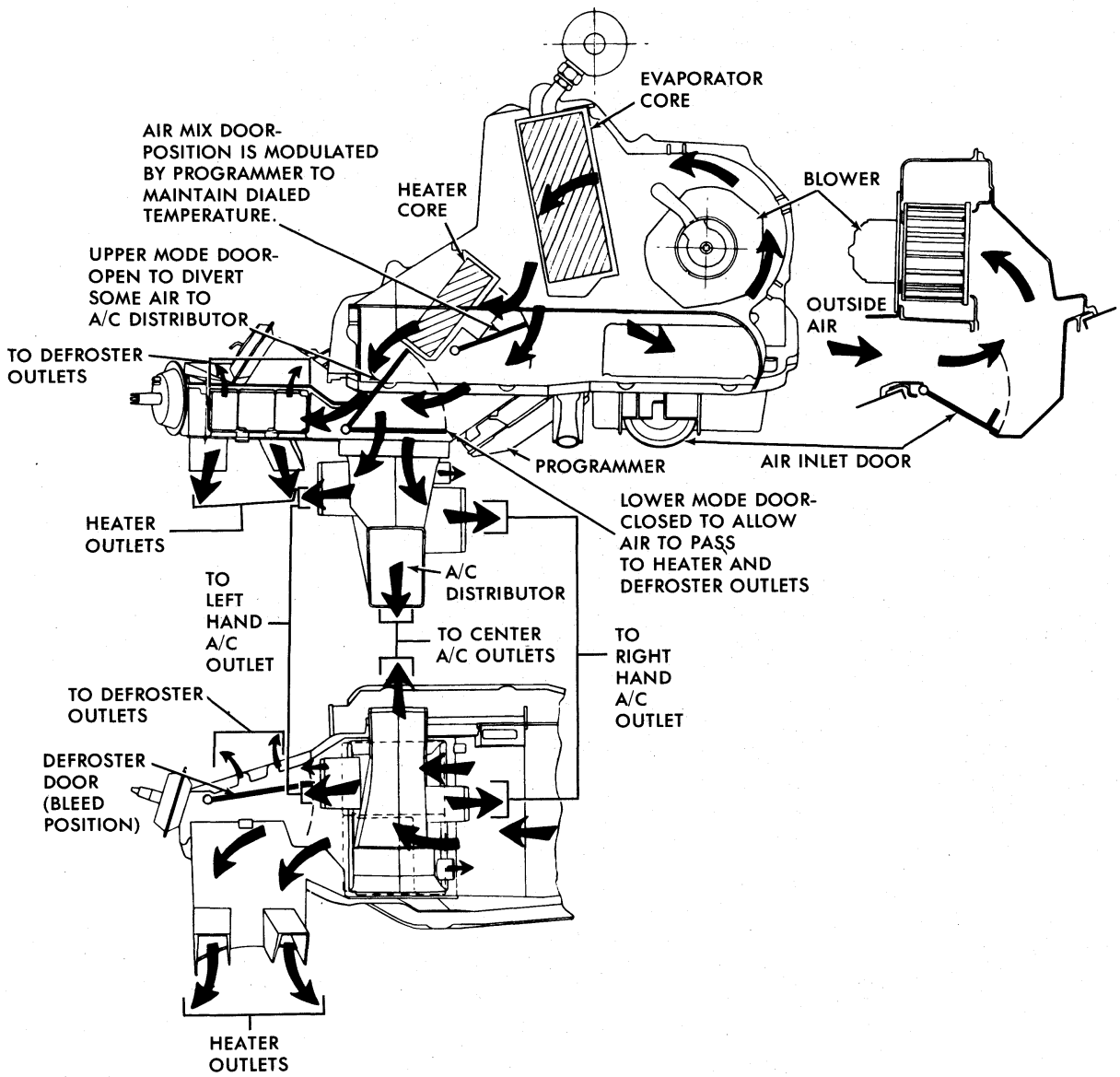


Fig. 1-31 Airflow at "Bi-Level"

AIRFLOW AT BI-LEVEL (Fig. 1-31)

Operation at this setting is the same as at "Auto" except Bi-Level air delivery is provided - approximately half the air is delivered from the heater outlet and the other half is discharged from the air conditioner outlets. This provides a pleasant, draft-free mode of operation in mild weather; it also permits defrosting of the side windows by the air streams from the end air conditioner outlets in cold weather.

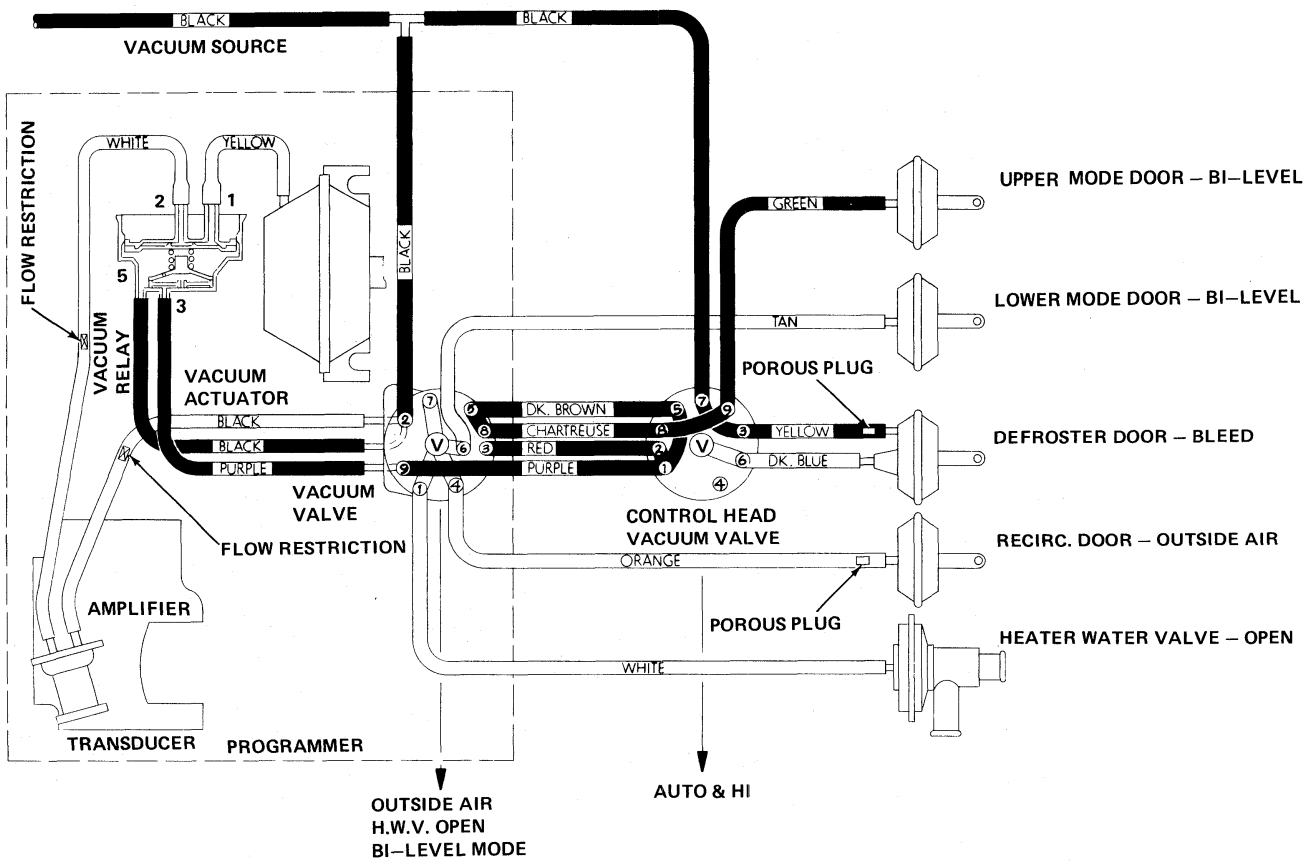


Fig. 1-32 Vacuum Circuit at "Bi-Level" and at "Auto" and "Hi" in Bi-Level Mode

VACUUM CIRCUIT AT BI-LEVEL AND AT AUTO AND HI IN BI-LEVEL MODE (Fig. 1-32)

The vacuum valve porting arrangement shown in Fig. 1-32 represents the control head setting at "Bi-level." While the porting arrangement is different with the control head at "Auto" or "Hi", the door actuation is the same. If exact porting needs to be analyzed, refer to Fig. 1-38.

Bi-level airflow is obtained by actuating the upper mode door and venting the lower mode door. The closed lower mode door allows some airflow to pass the A/C opening in the module and continue out the heater opening. Since the defroster bleed port is supplied the defroster door is partially open and some windshield airflow is obtained.

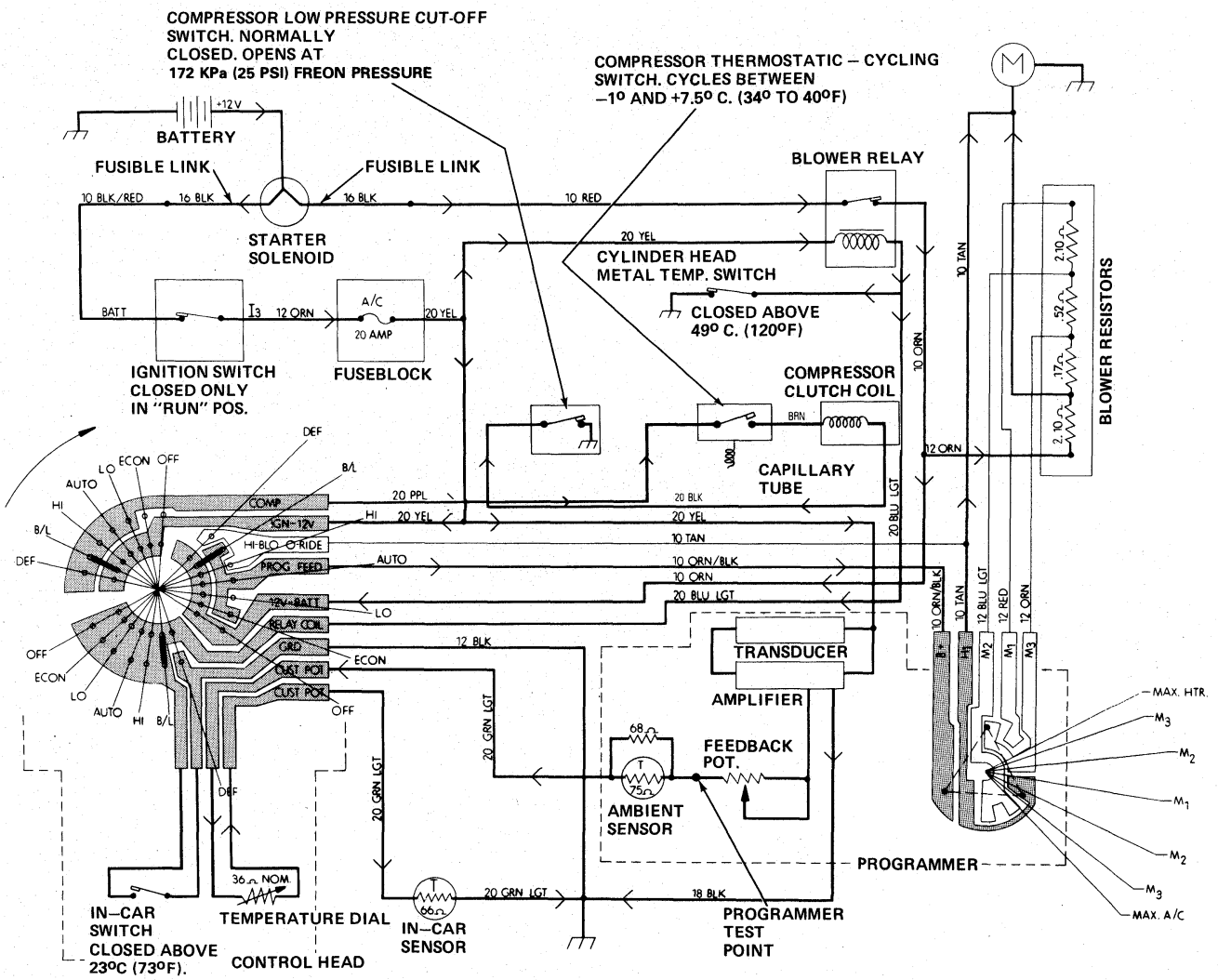


Fig. 1-33 Blower Operation at "Bi-Level"

BLOWER OPERATION AT BI-LEVEL (Fig. 1-33)

Electrically, "Bi-Level" operation is the same as previously described in "Auto".

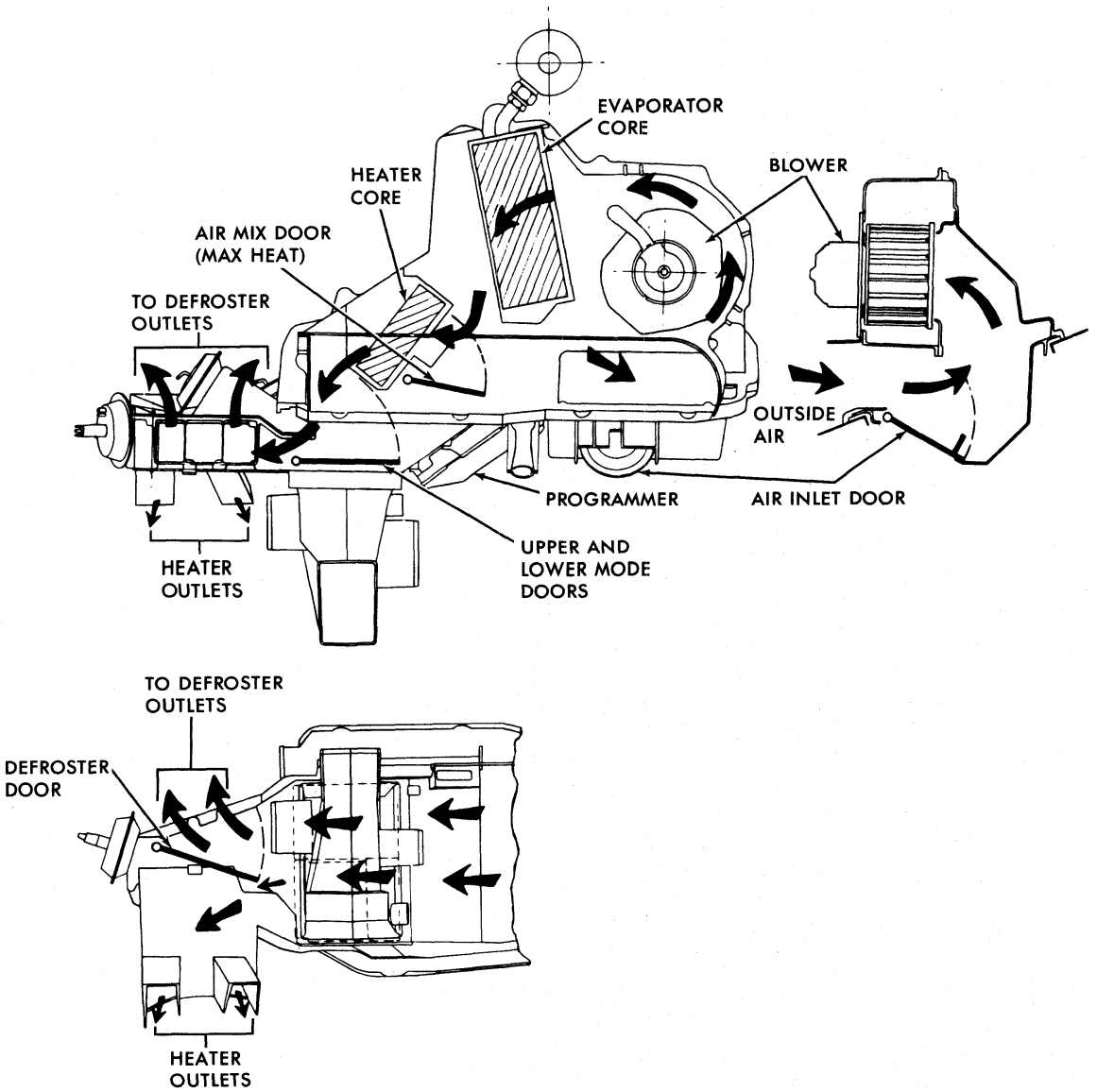


Fig. 1-34 Airflow at "Def"

AIRFLOW AT DEF (Fig. 1-34)

At this setting all the air is delivered to the windshield and the blower operates at a fixed high speed. Temperature regulation is maintained. Blower turn-on is immediate, even with a cold engine.

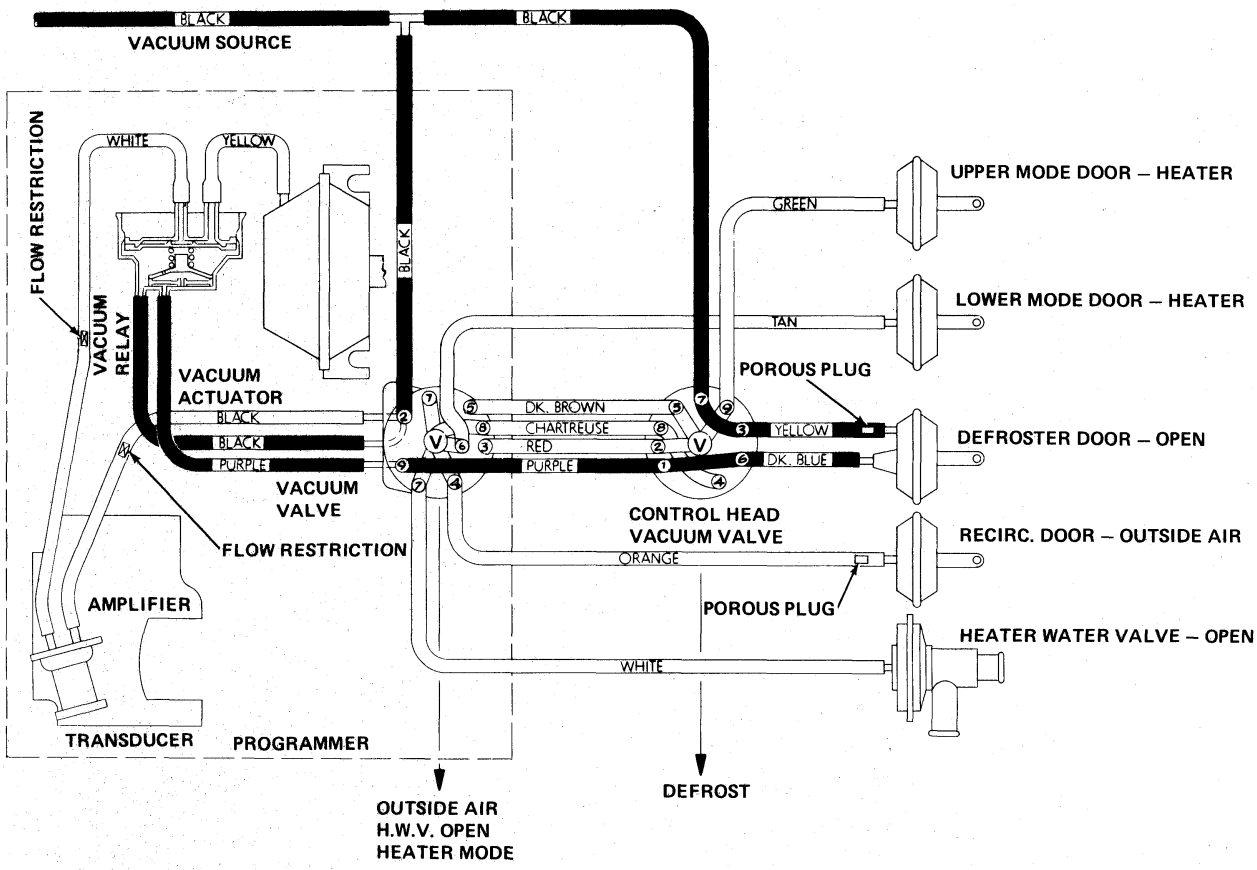


Fig. 1-35 Vacuum Circuit at "Def"

VACUUM CIRCUIT AT DEFROST-HEATER MODE (Fig. 1-35)

The "Defrost" lever setting is most commonly used in cold weather. Therefore, the heater mode is analyzed in Fig. 1-35. If the vacuum circuit in the A/C mode needs to be determined, refer to Fig. 1-38.

With the control head in "Defrost" vacuum is supplied to the center port of the defroster door actuator which moves the defroster door full open. The position of the programmer valve has no effect in this circuit. With both mode doors vented, the doors remain closed providing heater airflow, however, since the defroster door intercepts most of this air, very little heater airflow results. The recirc actuator and water valve are vented so that outside air and coolant flow through the heater core are provided.

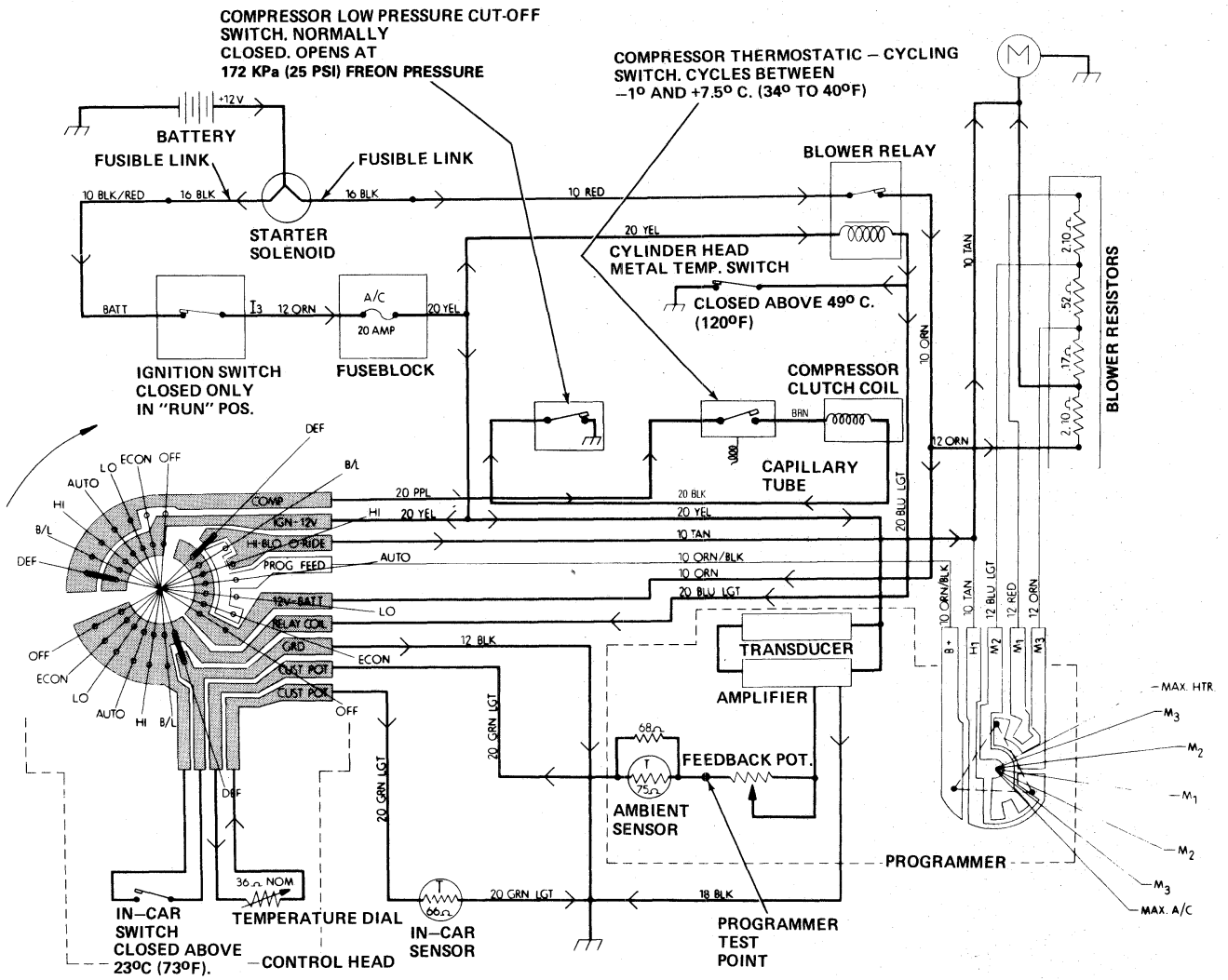


Fig. 1-36 Blower Operation at "Def"

BLOWER OPERATION AT DEF (Fig. 1-36)

The "Defrost" position provides compressor operation the same as at all positions except "Off" and "Economy". Fixed high blower speed is provided by connecting the 12 volt and high blower override pads as in "Hi"; however, this action occurs immediately by grounding the relay coil through the wiper contacts and ground pad on the control head.

SYSTEM RESPONSE									
		BLOWER SPEED	AIR INLET DOOR POSITION	TEMPERATURE DOOR POSITION	MODE DOORS POSITION	DEFROSTER DOOR POSITION	COMPRESSOR	HTR-WATER SHUT-OFF VALVE	IS BLOWER DELAYED FOR ENGINE WATER WARMUP?
CONTROL LEVER SETTINGS	OFF	FIXED LOW 5.0V – HTR 4.5V – A/C	OUTSIDE AIR	VARIES – RESPONSIVE TO SENSORS	FORCED TO HEATER	SEALED	DOESN'T OPERATE	USUALLY OPEN – EXC. CLOSED AT MAX. A/C POSITION OF PROGRAMMER	YES – EXCEPT WHEN CAR INTERIOR IS WARM, IN WHICH CASE IN-CAR SWITCH ON CONTROL HEAD TURNS BLOWER ON IMMEDIATELY, EVEN IF ENGINE IS COLD.
	ECON.	VARIABLE BLOWER PROGRAM			EITHER HEATER, BI-LEVEL OR A/C DEPENDS ON PROGRAMMER POSITION	DOOR WILL ASSUME "BLEED" POSITION AFTER 45 SECOND DELAY AND WILL DELIVER BLEED AIR TO W/S IF IN HEATER OR BI-LEVEL MODE			
	LO	FIXED LOW 5.0V – HTR 4.5V – A/C					CYCLES ON AND OFF TO MAINTAIN EVAPORATOR BETWEEN MINUS 1°C AND 7 1/2°C (31°F TO 34°F)		
	AUTO.	VARIABLE BLOWER PROGRAM	RECIRCULATE AIR WHEN PROGRAMMER IS AT MAX. A/C - OTHERWISE OUTSIDE AIR						
	HI	FIXED HI - 13.5 V							
	BI-LEVEL	VARIABLE BLOWER PROGRAM			BI-LEVEL			OPEN	
	DEF	FIXED HI - 13.5 V	OUTSIDE AIR		FORCED TO HEATER	FULL OPEN TO W/S			NO – BLOWER IS TURNED ON BY O'RIDE SW.

Fig. 1-37 System Operation at Various Settings

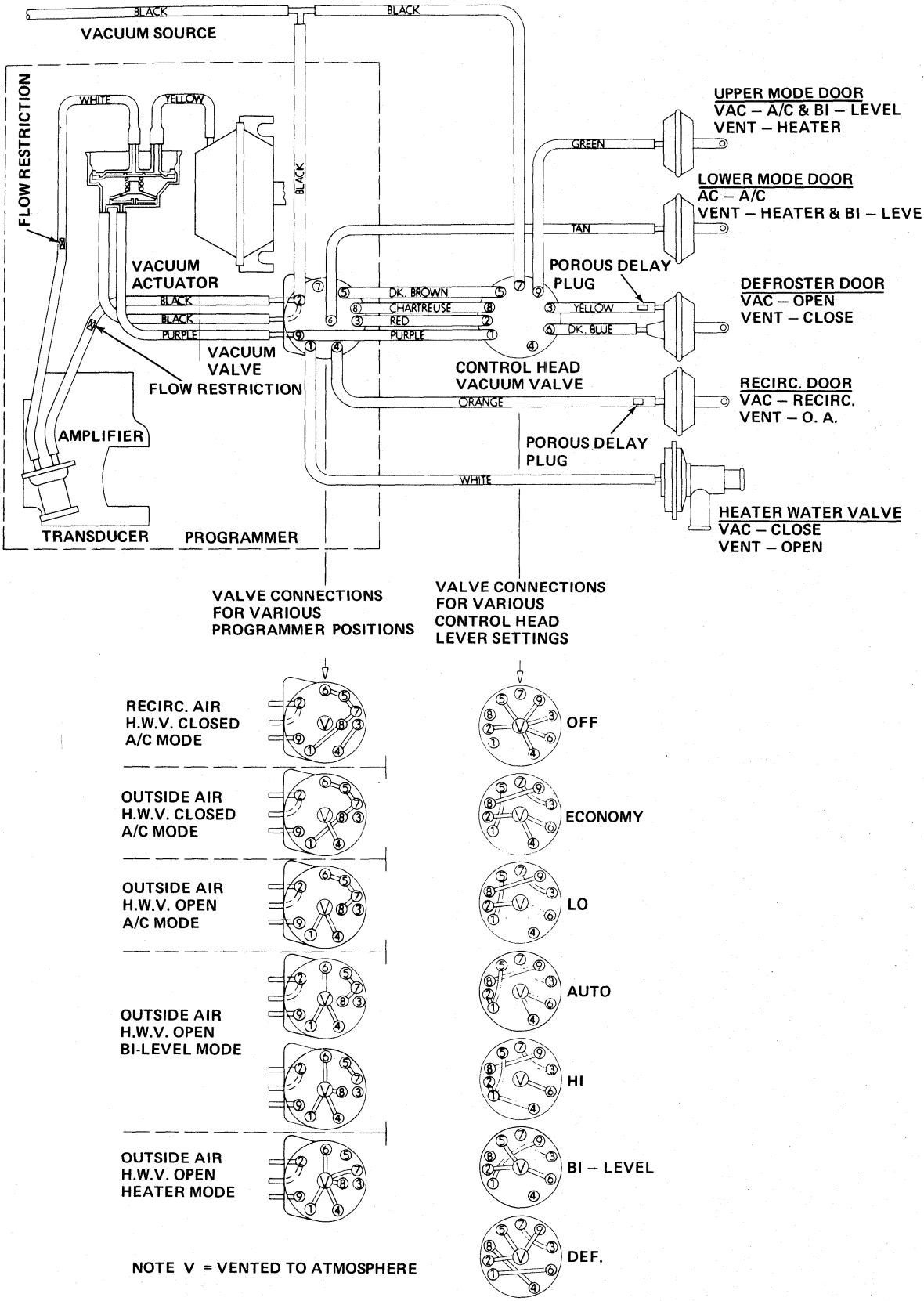


Fig. 1-38 Complete Vacuum Circuit

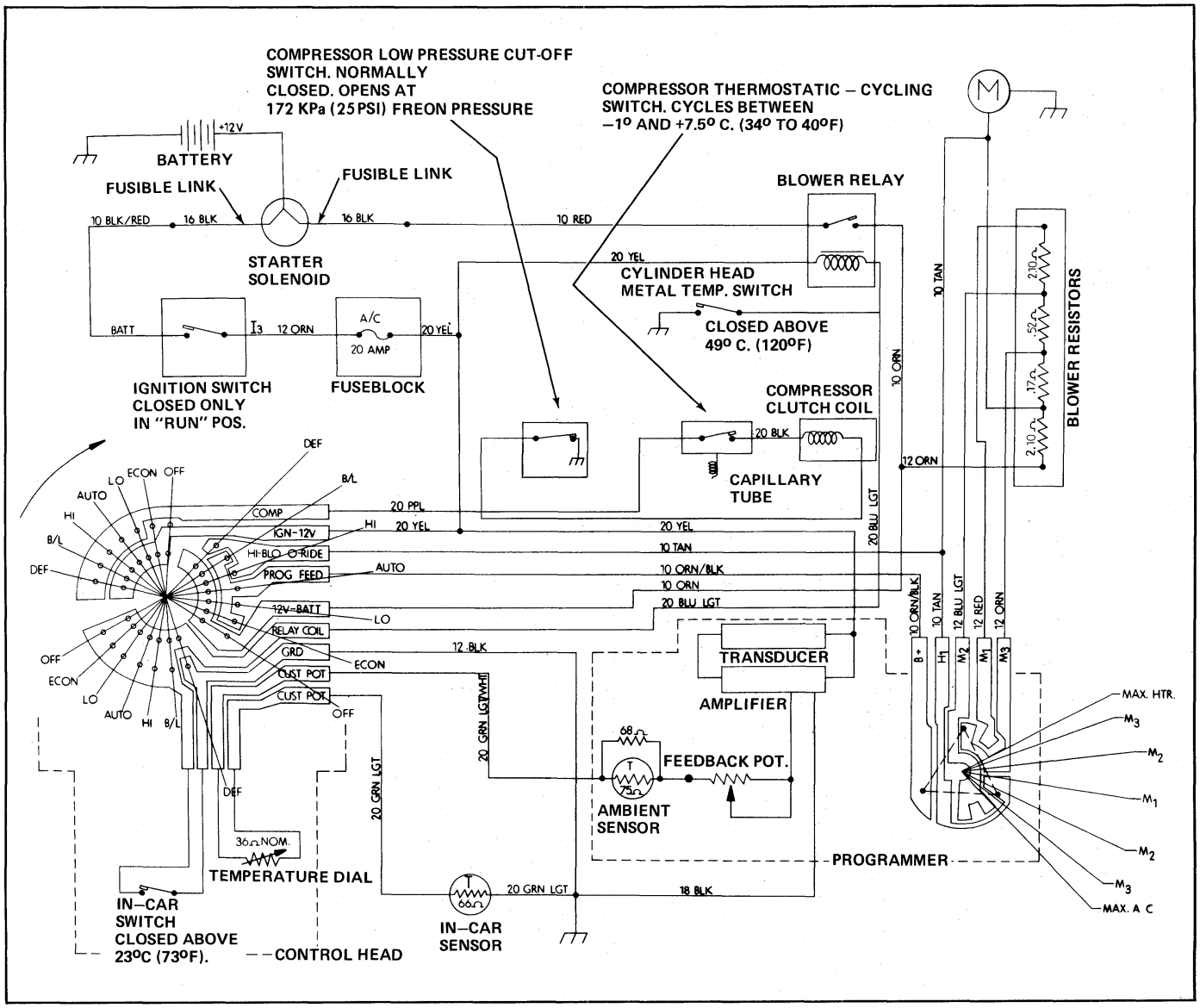


Fig. 1-39 Complete Electrical Circuit

DIAGNOSIS

HOW TO ISOLATE THE PROBLEM

To diagnose an air conditioner problem in the shortest time and with the least effort, it is essential to follow a logical service procedure. Time spent in conducting a system functional performance test and analyzing the malfunction in order to isolate it to a specific control function area will be repaid in reduced repair time. A recommended diagnosis procedure follows:

STEP 1 - andAttempt to get an accurate, detailed description of the owner's complaint in writing on the repair order. "A/C inop." or "erratic operation" do not provide much information to the repairman.

STEP 2 - To confirm the system malfunction, make a brief check of system operation by sitting in the car and operating the controls, with the engine warmed up and running at 1000 RPM or higher, in the following sequence:

During the above tests, be sure to note the following;

a. Check to assure that air delivery is *not* coming from both the A/C and heater outlets when only one mode is indicated. A split air delivery is indicative of a vacuum leak.

b. Note whether program events (air delivery mode change, blower speed change, recirc air, etc.) occur without change in discharge air temperature. This would indicate the

AUTOMATIC TEMPERATURE CONTROL FUNCTIONAL TEST	
CONTROL SETTING	**SYSTEM SHOULD OPERATE AS FOLLOWS**
"DEF" DIAL @ 85°	Air should be delivered out of defroster outlets at a fixed high blower speed. Some floor bleed out heater.
"BI-LEVEL" DIAL @ 85°	Air should be delivered from *both* the A/C and heater outlets. Only a small portion of air will come out the defroster outlet.
"HI" DIAL @ 65°	Air should be delivered out the A/C outlets at a fixed high blower speed and cool to cold temperature. The recirculating air door should open (blower noise increases). Door movement will be slow because of vacuum delay porous plug.
"AUTO" DIAL @ 85°	Blower speeds should drop (Hi-M_3-M_2-M_1-etc.). Recirc air door should close (noise level will drop). Discharge air temperature should increase. Depending on the temperature in the work area, the air delivery mode should change from the A/C outlets to the heater outlets.
"LO" DIAL @ 85°	Air should be delivered at a fixed low blower speed.
"ECONOMY" DIAL @ 65°	Blower speeds should increase (M_1-M_2-M_3-etc.) Depending on the temperature in the work area, the air delivery mode should change from the heater outlets to both heater and A/C outlets or the A/C outlets only. The A/C compressor should not operate.
"OFF" "DIAL" @ 65°	Air should be discharged out the heater outlet at a fixed low blower speed. No A/C compressor operation.

programmer is operating without moving the temperature air door. Check the air mix door link to programmer connection.

c. If neither the program events nor the discharge air temperature change, an incorrect vacuum or electrical signal to the programmer or a programmer malfunction is indicated.

d. Malfunction of a specific vacuum operated door function could indicate a vacuum disconnect of the vacuum diaphragm at that door. See illustrations for locations of the different function doors.

STEP 3 - Perform the easiest checks first! A simple, visual inspection of the easily accessible underhood and instrument panel electrical and vacuum connections will, in many instances, reveal the problem on the spot, Fig. 1-40.

STEP 4 - Based on information gained during the functional test performed in step 2, try to elate the problem to one of the following areas:

1. Temperature Control Problems
2. Blower Control Problems
3. Auxiliary Vacuum Problems
4. Refrigeration System Problems

Once a problem has been isolated to one of the areas listed above, refer to that diagnosis section on the following pages. Diagnosis charts and control circuit illustrations are provided. It is of special importance to be familiar with the general description of the major sections of the system as presented beginning on page 1-1.

STEP 5 - After the problem has been properly diagnosed and the repair made, it is important to run through the brief check listed in Step 2 in order to assure that the system is now performing correctly.

TEMPERATURE CONTROL PROBLEM DIAGNOSIS

The primary function of the temperature control circuit is to determine the correct temperature of the air to be discharged into the passenger compartment and to set the air mix door position to accomplish that function. The signal used for this purpose (vacuum to position the programmer vacuum motor) is also used in the blower speed control circuit, and the auxiliary vacuum function circuit. Those uses may be disregarded when dealing with problems which relate only to the temperature control circuit.

Examples of temperature control problems are:

"System operates at maximum air conditioning (no heat) or only at maximum heating (no air conditioning)," "Temperature dial does not provide comfort," "Poor heating" or "poor cooling." Blower cycling and mode cycling are also caused by a malfunction in the temperature control circuit.

It is important to separate temperature control circuit problems from refrigeration or heater circuit problems. If the complaint is "poor" or "no" heating or cooling and the programmer moves to both extremes of travel with the air mix door and program functions known to follow, the problem probably lies in the refrigerant or heater water circuits. Refer to pages 1-40 and 1-41 later in this section.

Many temperature control problems result from poor electrical or vacuum line connections. The following relationships may aid diagnosis:

- A *disconnected sensor or temperature dial andinterrupts the electrical signal and drives the programmer to maximum heating.*
- *A poor sensor connection andadds resistance to the sensor string driving the system hotter.*
- *An open amplifier power feed andeliminates the output signal and drives the programmer to maximum A/C.*
- *A disconnected vacuum hose* supplying the vacuum checking relay actuating nipple will lock the relay in an intermediate position.
- A *disconnected vacuum hose* in the transducer-programmer vacuum motor line will drive the system to maximum cooling.
- A *leak* in the auxiliary vacuum circuit may reduce the transducer vacuum supply level below control requirements, causing an "off-calibration" or "poor heating" type complaint.
- A *loss* of supply vacuum usually results in cold air flow on the floor.

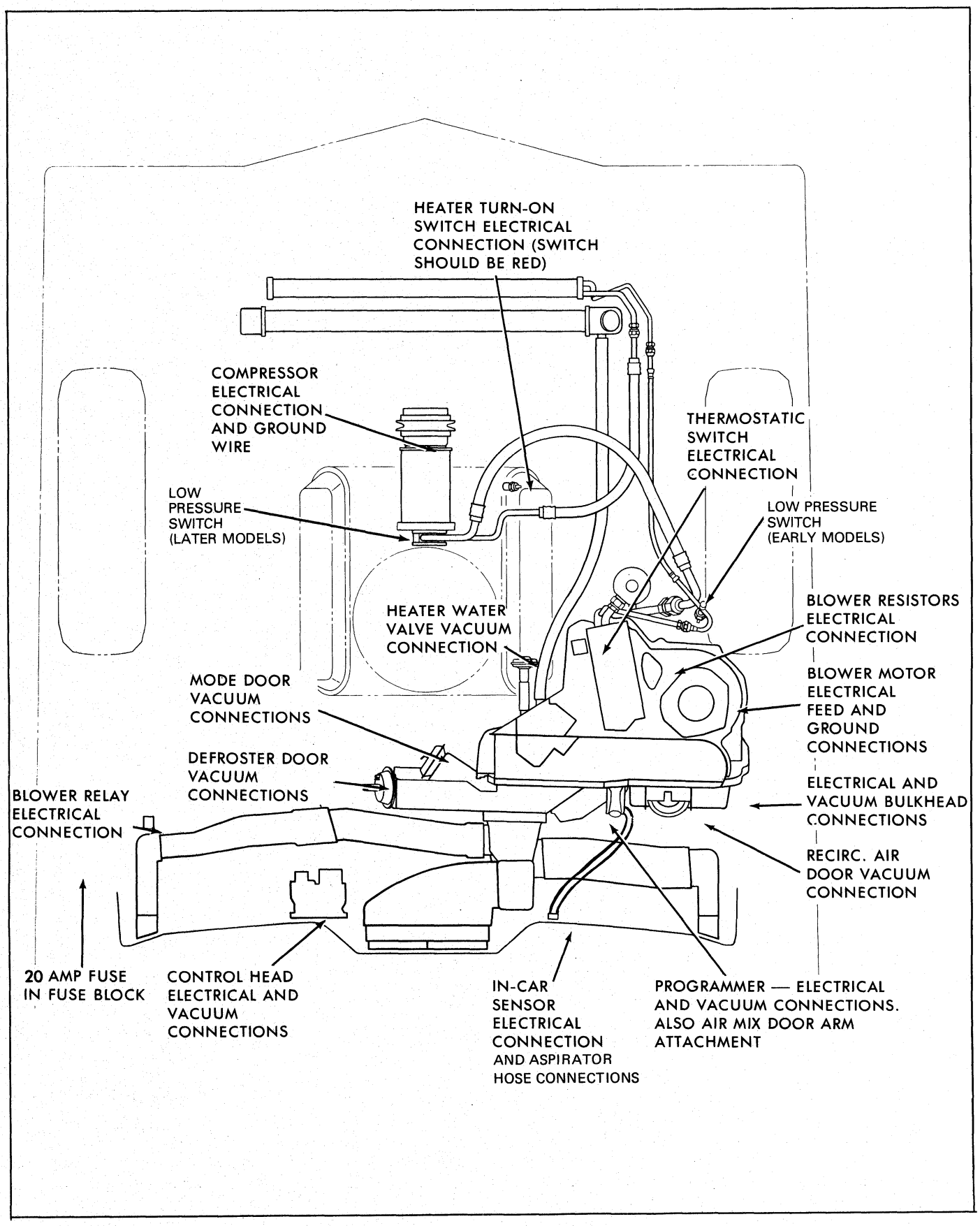


Fig. 1-40 Diagnosis Areas

Diagnosis of most of the problems encountered in the temperature control circuit will be greatly aided by use of tester, J-23678 (use Harness Adapter J-23678-77 to connect to programmer and harness). Information on how to use the A.T.C. Tester is provided on instruction card J-23678-51.

Specific problems and probable causes are as follows:

SYSTEM OPERATES ONLY AT MAXIMUM AIR CONDITIONING

This can be a vacuum or electrical problem. The problem can be separated into problems of erroneous signal external to the programmer or internal programmer malfunctions. To isolate this problem, install test harness J-23678-77 with single connector open and 8 pin connectors fastened together, between amplifier connector and amplifier terminals. With the system operating, observe the vacuum motor position through the slot at the bottom of the programmer cover. If the programmer remains in the maximum air conditioner position, remove the vacuum harness and check for supply vacuum at the black hose. If no (or low) vacuum supply, check for leaks or disconnects in vacuum hose assembly. If vacuum supply is okay, programmer is malfunctioning. Remove programmer cover and inspect for obvious disconnects. If no programmer problem is obvious, use Tester J-23678, Adapter Harness J-23678-77 and Instructions J-23678-51 to analyze and correct problem.

If the programmer moved to the maximum heater position with the test harness installed, the problem is *external* to the programmer. Check the following items:

1. Shorted in-car sensor.
2. Shorted or miscalibrated temperature dial.
3. A short in the sensor circuit of the wiring harness.
4. Disconnect or open in ground circuit (black wire) between control head and programmer.
5. No electrical power to programmer (yellow wire).

Use Tester, J-23678, Adapter Harness J-23678-77 and Instructions J-23678-51 to analyze and correct the above problems.

SYSTEM OPERATES ONLY AT MAXIMUM HEATING

This is usually an electrical problem. The problem can be separated into problems of erroneous signal external to the programmer or internal programmer malfunctions by disconnecting the three-wire amplifier connector from the programmer. With the system operating, observe the programmer movement through the slot at the bottom of the programmer cover. If the programmer remains in the maximum heater position, remove the multiple vacuum connector and check for supply vacuum at the black hose. If no (or low) vacuum supply, check for leaks or disconnects in vacuum hose assembly. If vacuum supply is okay, programmer is malfunctioning. Remove programmer cover and inspect for obvious disconnects. If no programmer problem is obvious, use Tester J-23678, Adapter Harness J-23678-77 and Instructions J-23678-51 to analyze and correct problem.

If the programmer moved to the maximum A/C position when the amplifier connector was removed, the problem is *external* to the programmer. Check the following items:

1. Disconnected or malfunctioning in-car sensor.
2. Disconnected or malfunctioning ambient sensor.
3. Open circuit or backed-out terminal in the wiring harness sensor string circuit.
4. Disconnected or malfunctioning temperature dial.

Use Tester, J-23678, Adapter Harness J-23678-77 and Instructions J-23678-51 to analyze and correct the above problems.

SYSTEM FLUCTUATES BLOWER SPEEDS and/or MODE SHIFTS DURING ACCELERATION

1. Malfunctioning vacuum checking relay (inside programmer).
2. Leaking programmer vacuum motor.

It is possible to distinguish between the two above items. With the system operating and the programmer cover removed, reinstall the vacuum and electrical connectors, and perform the following steps:

a. Install Test Harness J-23678-77 with single connector open and 8 pin connectors fastened together, between amplifier connector and amplifier terminals to force the programmer to maximum heating (full vacuum).

b. Remove the vacuum hose assembly connector. The programmer should remain in the maximum heat position. If it does not, repeat Step a, and then pinch the programmer vacuum motor supply hose with a pair of needle-nose pliers. If the programmer still moves, the vacuum motor is leaking. If the programmer does not move, the checking relay is malfunctioning.

c. If the original complaint was mode shifts without blower change, the check valve portion of the checking relay is probably malfunctioning.

DIAL SETTING DOES NOT PROVIDE COMFORT

The best approach to solving problems of the "off calibration" variety, is to use Tester, J-23678, Adapter Harness J-23678-77 and Instructions J-23678-51 to check and reset calibration on *all* of the following parts (see Page 1-47.):

1. The temperature dial.
2. The feedback potentiometer in the programmer.
3. The temperature door link adjustment.

NOTE: Check to assure that in-car sensor aspirator hose is attached at both the in-car sensor and the aspirator and not kinked in routing.

Refer to the instruction sheet included with the Tester or the section on System Adjustments for procedures on checking and calibrating the above items.

BLOWER CYCLING AND MODE CYCLING

Erratic system performance may be caused by poor electrical connections, "cold" solder joints, or a malfunctioning sensor or amplifier. The problem may be intermittent and occur from the shock of going over road bumps. Such a problem may be accompanied by a clicking or buzzing of the transducer. To isolate the problem area, "rap" the areas around the sensors, control head, and programmer, and shake the wires attached to those areas. Listen for buzzing or clicking of the transducer. If the problem cannot be pinpointed by transducer buzzing, remove the programmer cover, (reinstall the vacuum and electrical connectors) and attach a *good* voltmeter to the transducer output terminal (grey wire). Repeat the rapping and wire shaking, and observe the voltmeter for violent, erratic voltage fluctuations. Replacement of parts or resoldering of terminals may be necessary. The sensors may be individually checked to the sensor resistance curve, Fig. 1-4.

NOTE: Some system cycling may also occur and is normal if the temperature dial is moved in large increments. Instruct owner of this, and explain system operation.

INSUFFICIENT HEATING OR COOLING

This problem may be caused by a control system malfunction or by the refrigerant or heater systems. Determine first which area to pursue:

1. Check for compressor clutch actuation (no cooling). If not operating, refer to refrigeration diagnosis on page 1-43.
2. Check engine coolant level (no heating).
3. Check temperature of heater hoses by feel with engine hot to see if hot water is entering the heater core (no heating).
4. Check for proper air flow at the "Auto" and "HI" lever settings. (Improper air flow may be a blower relay problem, a blocked air passage, or a disconnected air hose.)

If a refrigeration problem exists, refer to the refrigeration diagnosis section on page 1-43. If the problem appears to be caused by the temperature control system, locate problem area using Tester, J-23678, Adapter Harness J-23678-77 and Instructions J-23678-51 or as specified elsewhere in this section. Also check air mix door link adjustment.

BLOWER SPEEDS AND MODE SHIFT OCCURS WITHOUT TEMPERATURE CHANGE

Check connection of air mix door link to programmer shaft.

BLOWER CONTROL CIRCUIT PROBLEM DIAGNOSIS

The components and electrical circuits that make up the blower control circuit are shown in Fig. 1-39. Blower control can be divided into two separate categories, blower turn-on and blower speed control. Blower turn-on is accomplished when a ground path for the relay coil is completed by (a) the heater turn-on switch which provides delay for heater water warm-up in winter operation, (b) the in-car switch which provides immediate turn-on in summer operation, or (c) manual override in the "Def" setting. Blower speed control is accomplished by selective use of the blower resistors on the

A/C module in the "Lo", "Economy," "Auto" and "Bi-Level" lever settings, or by a high blower override circuit in the "Hi" and "Def" lever positions. It should be noted that the system air doors are always positioned to allow delivery of air into the passenger compartment. Problem descriptions and probable causes are listed in the following diagnosis charts:

SYSTEM OPERATES ONLY AT LOW BLOWER

1. Back-out terminal or disconnect at control head. Trace blower circuit using electrical wiring diagram, Fig. 1-39.
2. Open in blower circuit wiring. Refer to wiring diagram Fig. 1-39.

NO BLOWER OPERATION IN ANY LEVER SETTING

1. Electrical disconnect at blower motor.
2. Disconnect at blower relay or malfunction of blower relay.
3. Blown or open 15 amp. A/C-heater fuse.
4. Stalled blower motor.
5. Open circuit in wiring harness to blower motor.

NO BLOWER IN "OFF" OR "LO" SETTINGS

1. Open resistor on blower resistor board.
2. Open in blower circuit wiring. Refer to wiring diagram, Fig. 1-39.

OPERATES AT LOW BLOWER ONLY EXCEPT IN "HI" AND "DEF"

1. Problem in programmer wiper contacts or board.
2. Backed-out terminal or disconnect at programmer electrical connector.
3. Backed-out terminal at blower resistor connector or open resistor in blower resistor assembly.
4. Backed-out terminal at control head programmer feed terminal.
5. Open in blower circuit wiring.

BLOWER OPERATION ONLY IN "HI" OR "DEF"

1. Electrical disconnect at blower resistor assembly.
2. Open in circuit wiring between resistor assembly and blower motor.

BLOWER OPERATES AT LOW SPEED IN "HI" AND "DEF"

1. Malfunction in control head wipers or circuit board.
2. Open in by-pass circuit in wiring harness (refer to electrical circuit diagram, Fig. 1-39).

BLOWER OPERATES WITH IGNITION OFF

1. Malfunctioning blower relay (closed contacts).

BLOWER SPEEDS SKIPPED IN "ECONOMY," "AUTO" OR "BI-LEVEL" SETTING

Open resistor in blower resistor circuit board.

NO HEATER TURN-ON IN COLD WEATHER EXCEPT IN "DEF"

1. Electrical disconnect at heater turn-on switch (loaded at front of R.H. cylinder head).
2. Heater turn-on switch inoperative (will not close). Check by grounding switch feed wire.
3. If problem persists, refer to electrical circuit diagrams for wiring discontinuity.

NOTE: If problem does *not* occur in shop, it is probable that the system is turned on by the in-car switch. Disconnect control head electrical connector to disarm the in-car switch. If the blower turns off (with the engine warmed up), ground the heater turn-on switch feed wire. If the blower now turns on (in low blower speed), the heater switch is probably malfunctioning.

IMMEDIATE HEATER TURN-ON IN COLD WEATHER

1. Normal condition in "Def" lever setting.
2. Malfunctioning (closed) heater turn-on switch (remove and check cold).
3. Malfunctioning (closed) in-car switch.
4. If problem persists, refer to electrical circuit diagram, Fig. 1-39, and trace wiring continuity.

A/C DELAYED IN HOT WEATHER UNTIL ENGINE WARMS UP

1. Malfunctioning (open) in-car switch.
2. Open in control head wiring harness (in-car switch circuit).
3. If problem persists, check wiring continuity in the in-car switch circuit. Refer to the wiring diagram, Fig. 1-39.

AUXILIARY VACUUM PROBLEM DIAGNOSIS

Auxiliary vacuum functions are defined as those vacuum circuits in the automatic temperature control system which do not affect the temperature of discharge air. Specifically that would include all vacuum functions except the transducer, relay portion of the vacuum checking relay, and the programmer vacuum motor. The following are examples of auxiliary circuits.

1. Upper mode door vacuum circuit.
2. Lower mode door vacuum circuit.
3. Defroster bleed vacuum circuit.
4. Defroster door vacuum circuit.
5. Recirc door vacuum circuit.
6. Heater water valve vacuum circuit.
7. Auxiliary vacuum circuit check valve.

Because of the relative simplicity of each of the auxiliary vacuum circuits, the best diagnostic aid will be a clear understanding of the type of problem or complaint which would result from a malfunction in any of the individual circuits. Once the problem has been isolated to a specific circuit, diagnosis will generally consist of checking vacuum connections at one or two points. The following chart presents the types of problems most likely to be encountered in each of the auxiliary circuits. For more complex problems a procedure to completely qualify the vacuum system is presented immediately following the diagnosis charts.

It should be noted that because of the inter-relationship of the vacuum circuits, a leak in one circuit may reduce the vacuum supply to another circuit sufficiently to cause a malfunction of the second circuit. For example, a water valve vacuum hose disconnected may prevent the mode doors from moving full travel causing a split mode condition.

UPPER AND LOWER MODE DOOR ACTUATION PROBLEMS

The most likely malfunctions would be "no air conditioner operation" and "split mode operation." Vacuum is required to get air conditioner mode. *Check the hose connections at the mode door upper and lower vacuum actuators.* Split modes may occur because of malfunctions in either the upper or lower door circuit, or because of leaks in other auxiliary vacuum circuits. It is recommended that the auxiliary vacuum circuit test procedure listed below be used to isolate mode door vacuum problems. Vacuum harness routing is shown in Fig. 1-41.

DEFROSTER BLEED PROBLEMS

Actuation of the side (bleed) port of the defroster diaphragm is delayed by a porous delay plug inserted in the yellow-coded vacuum hose. Complaints relating to defroster bleed operation will generally be of two types:

1. No defroster bleed. Check hose connection at defroster bleed nipple of defroster vacuum actuator. If connections are satisfactory, porous plug is probably too restrictive. Replace plug. (Before installing new plug, check for vacuum in yellow line; and apply hose to nipple, without the plug, to check bleed door operation.)
2. Rapid fogging of windshield when heater turns on. Either there is no porous delay plug or installation of the plug is incorrect.

DEFROSTER DOOR ACTUATION PROBLEMS

The most common problem to be expected in this circuit would be "no air out of defroster outlets in 'Def' setting." Vacuum to the defroster actuator is required for defroster operation. Vacuum harness routing is shown in Fig. 1-41.

1. Check hose connections (blue and yellow) at defroster actuator.
2. If system stays in A/C mode at "Def," check vacuum circuit to determine why mode override did not occur.

If problem persists, see auxiliary vacuum circuit test below.

RECIRC AIR DOOR ACTUATION PROBLEMS

The most likely problem to be encountered will be "no recirc air in Hi or Auto lever settings." Vacuum is required to obtain recirc air. *Check hose connection at recirc air door.* Remove vacuum delay plug to check for adequate vacuum at "Hi" and "Auto" settings and 65° dial. If vacuum is available but door won't move with plug in circuit after approximately three minutes, replace plug. Vacuum harness routing is shown in Fig. 1-41.

HEATER WATER VALVE CONTROL PROBLEMS

The water valve is a normally open valve requiring vacuum to close off water flow. It would be very difficult for a driver to recognize a problem in the water valve circuit by "no heater water shut-off;" however, a leak in that circuit may manifest itself by reduced vacuum levels available in other vacuum functions. The most likely such complaint would be a split mode delivery. Use the auxiliary vacuum circuit test presented below to isolate vacuum problems. Vacuum harness routing is shown in Fig. 1-41.

AUXILIARY VACUUM CIRCUIT CHECK VALVE PROBLEMS

The check valve for the auxiliary vacuum circuit is located in the programmer vacuum checking relay assembly. A malfunction of this check valve will probably result in complaints of loss of a specific function (such as "A/C shuts off") during accelerations or mountain driving. The check valve may be checked with the system operating by disconnecting and plugging the black hose feeding the programmer checking relay. The vacuum functions (a vacuum gage in the purple hose or the system in A/C mode) should hold. If they do not hold, reinstall the black hose, and pinch the purple hose. If the functions now hold, the check valve is bad. If the functions continue to leak down, there is a circuit leak further upstream. Use the auxiliary vacuum circuit test below to locate the leak. Vacuum harness routing is shown in Fig. 1-41.

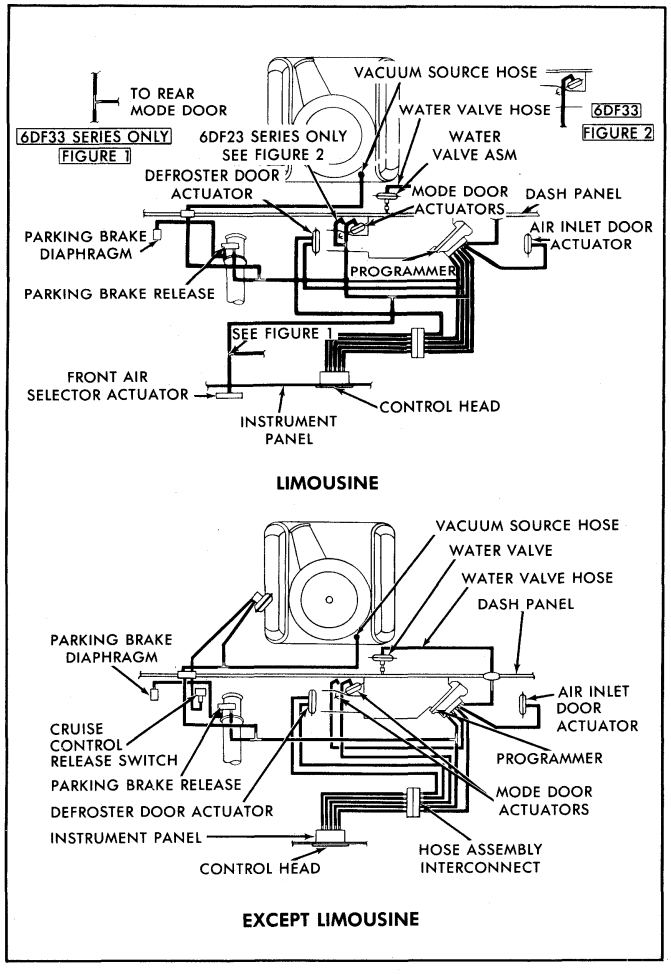


Fig. 1-41 Vacuum Circuit Schematic

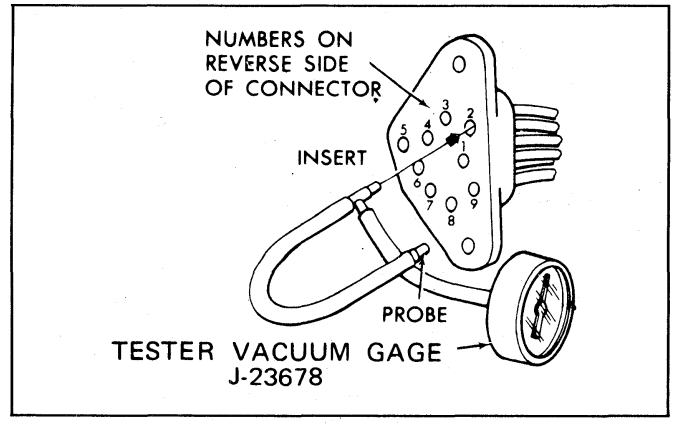


Fig. 1-42 Probing for Vacuum

AUXILIARY VACUUM CIRCUIT TEST

Remove car vacuum harness plug from programmer valve, which should direct all airflow to floor except for defroster bleed air. Connect tee with short hose and union to J-23678 tester vacuum gauge hose as shown in Fig. 1-42. Insert "tee" in Port No. 2 of harness plug and probe each of the other ports in chart. Make sure that control head lever is set as specified for each step. Cover up probe on Port No. 9 when called for, to seal off other circuit branches. For each step, full vacuum should be read after actuator-travel is completed.

Control Lever	Probe Port:	Hose Color	Cover Up	Other Hoses In Circuit	Action Expected
Lo	None	Black	Probe	Yellow	Defroster door moves to "bleed" position
	1	White	None	None	Hot water valve closes - Check air in "max. heat"
	4	Orange	None	None	Recirc. door opens - 1-2 min. delay
	5	Dk. Brown	Port 9	Purple	None - Checks control head vacuum leakage
	8	Chartreuse	None	Green	Upper mode door moves to A/C position
	6	Tan	None	None	Upper and lower mode doors move to A/C position
Def	9	Purple	None	Dk. Blue	Defroster door moves to full "DEF" position

A low vacuum reading in any step indicates a leak in control head valve or in the hoses and components listed in that step. If some function is missing even though full vacuum is available, reconnect harness plug to programmer and check vacuum at extreme end of hoses involved, to distinguish between a pinched hose and a mechanical bind in actuator door.

REFRIGERATION PROBLEM DIAGNOSIS

A properly operating refrigeration system will maintain evaporator core cooling surfaces at 0°C (32°F) when refrigeration is required, if engine speed is sufficient and the heat load on the system is not excessive. A refrigeration problem exists when there is malfunction in one of the refrigeration components or in the overall system which interferes with this function. In most cases, the problem will result in higher-than-normal core temperature and loss of effective cooling; in a few specific cases the core will operate at a temperature lower than 0°C (32°F) and condensate in the core will freeze and block airflow, again causing a loss of cooling.

It is important to separate refrigeration problems from

temperature control problems. This can be done simply during the control system function test.

1. Perform control system functional test described on page 1-47. If problem is no refrigeration because compressor is not engaging, see chart on page 1-45.

2. If system operates properly, return lever to "Auto" and set dial at 65°F.

3. Install thermometer in right hand air conditioner outlet. Wait approximately one minute. Thermometer should read 5°C to 10°C (40°F to 50°F) unless temperature or humidity of test area is excessively high. The C.C.O.T. system cycles compressor operatin which results in a 3°C to 6°C (5°F to 10°F) change in outlet temperature between compressor operation and no compressor operation. If temperature variation is 8°C (15°F) or greater a refrigeration problem exists, refer to chart on page 1-46.

4. If the average discharge temperature is significantly higher than 10°C (50°F), disconnect the three-wire amplifier connector from the programmer. Check to assure that the air-mix door link arm is pivoted fully to the "Max A/C" position. Adjust as required.

If the average temperature does not change with the amplifier disconnected and is still significantly higher than 10°C (50°F), a refrigeration problem exists, refer to chart on page 1-46.

Listed below are a number of problems which will cause a relatively minor loss of capacity (gage set required).

1. Excess bugs, leaves, etc. on condenser will cause higher-than-normal head pressure.

2. Excess oil or refrigerant in system.

3. Air in system -
Will cause higher-than-normal head pressure.
Will also cause internal corrosion of parts.

Let system stand inoperative overnight. With the same gage, check first the low side pressure and then the high side pressure. If the high side pressure is significantly higher than the low side pressure, there is probably air in the system. Purge, evacuate and recharge.

With the engine at operating temperature, hood open, doors and windows closed, A/C outlets open, control at Auto (-65°) and 2000 engine RPM, system pressures should be as follows:

TEST CONDITIONS

°C	21°C	27 °C	32°C	38 °C
°F	70°F	80°F	90°F	100°F
Head Pressure	120 TO 160	150 TO 190	195 TO 235	230 TO 270
Evaporator Pressure	Cycles From: 186kPa-310kPa (27-45PSIG)			

Fig. 1-43 Maximum Pressure at Ambient Temperatures

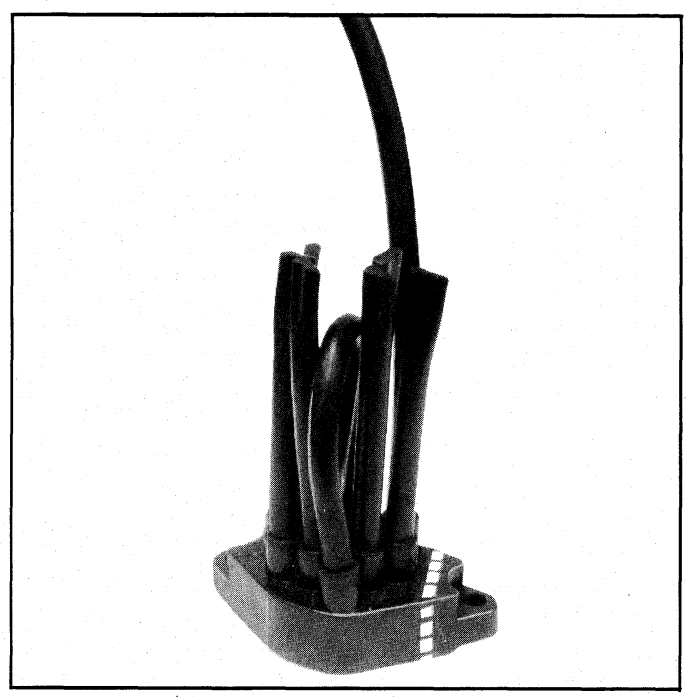


Fig. 1-44 Modified Dummy Plug

ATC TESTER J-23678

The ATC Tester, J-23678, is designed for on-car diagnosis of control system problems. The tester must be used with Adapter Harness J-23678-77 and following instruction card J-23678-51.

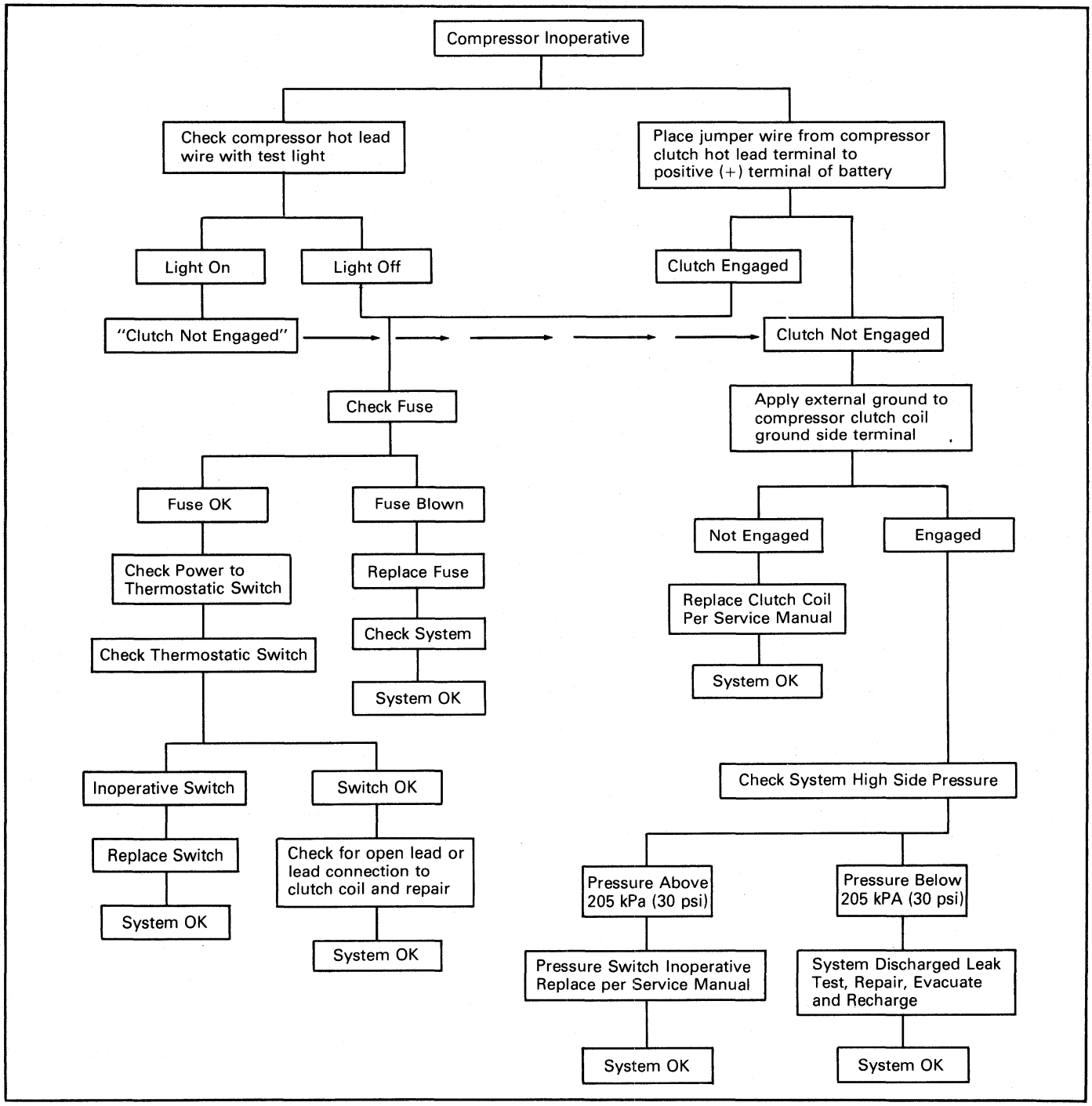
The dummy vaccuum plug furnished with tester J-23678 must be modified as shown in Fig. 1-44. Trimming the plug along the dotted line as shown will allow it to be used on 1977 and past model cars.

COMPRESSOR ELECTRICAL PROBLEMS

Malfunctions in the compressor electrical circuit would result in complaints of "no cooling," or "insufficient cooling." Perform the following checks:

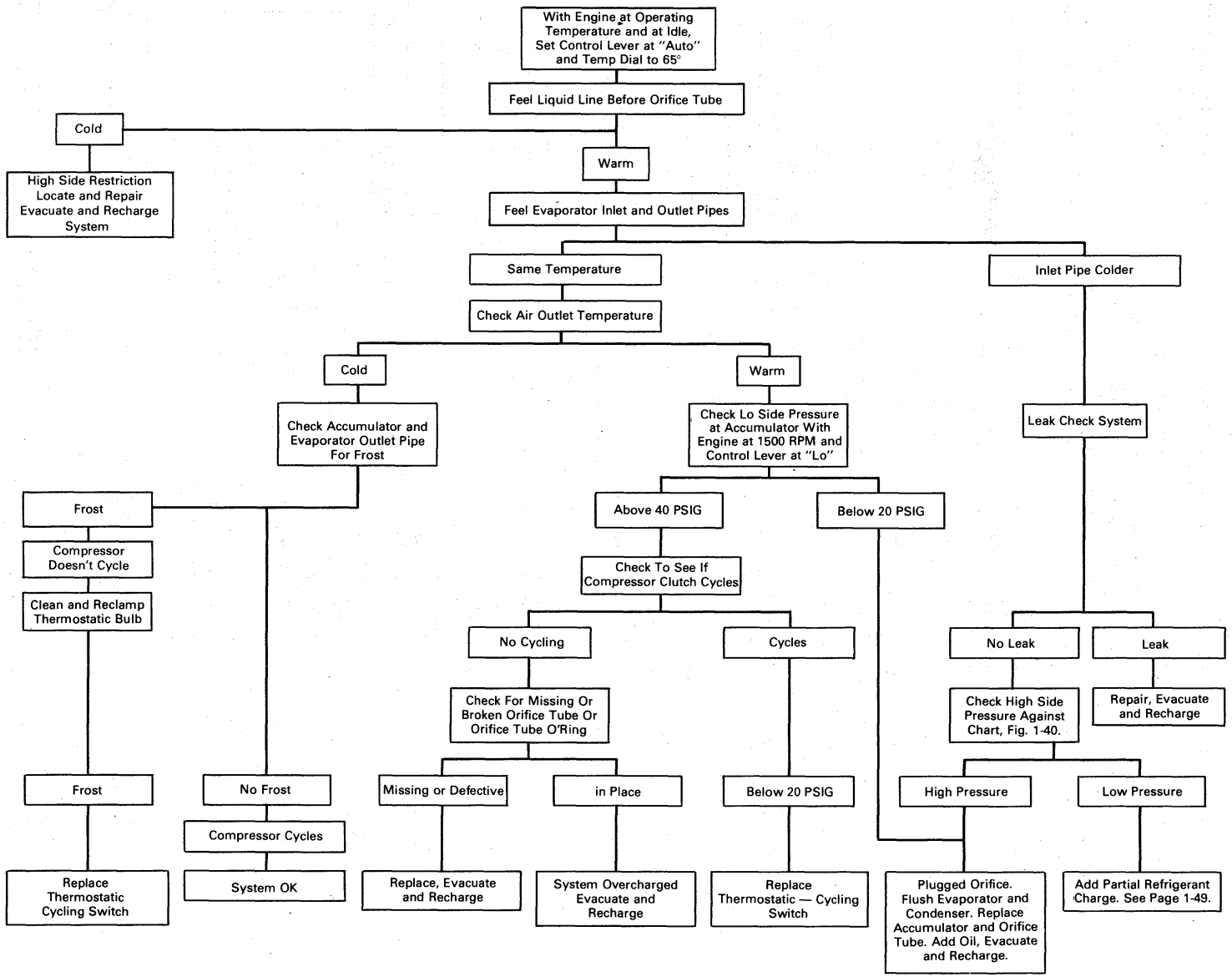
1. Blown 15 amp fuse in fuse block.
2. Electrical disconnect at compressor clutch coil or at compressor low pressure switch or low pressure switch not grounded at compressor head.
3. Electrical disconnect at compressor thermostatic cycling switch.
4. Backed-out terminal or disconnect at the control head electrical connector.
5. Malfunctioning compressor low pressure switch. See Diagnosis Below.
6. Open in wiring harness. Refer to electrical circuit diagram, Fig. 1-39.
7. Compressor seized (clutch plate slips). Clutch plate moves rearward and engages pulley but pulley cannot drive it.
8. Compressor belt slipping.

LOW PRESSURE SWITCH DIAGNOSIS



INSUFFICIENT REFRIGERATION

Compressor operates properly but discharge temperature varies over 8°C (15°F) or greater range or is too warm.



System Functional Test

Always Start Diagnosis With This Test

Set Control Lever At:	System should operate as follows (engine running — 70° F -80 °F ambient):
DEF .....85°F	Fixed high blower — most of air delivered from defroster outlets — some air from heater outlet — immediate blower turn-on.
BI-LEVEL .....75 °F	Lower blower speed — cooler air from both A/C and heater outlets — very small amount of air out of defroster.
HI .....65°F	Fixed high blower — cold air from A/C outlets — recirc. should occur (will take approx. 1 min. because of restriction in hose.
AUTO .....65 °F	Recirc. maintained — blower speed may drop.
AUTO .....85°F	Blower speed should drop then increase — air should become warmer — air should change from A/C to bi-level to heater.
LO .....85°	Blower should drop to fixed low speed.
ECONOMY .....85 °F	Same as auto except no compressor operation.
OFF	Fixed low blower — mild air out heater outlets — no air out A/C or defroster ducts — no compressor operation.

Programmer Functional Test

1. Connect tester electrical harness to programmer and car harness to tester using Adapter Harness J-23678-77. Connect single connector to programmer test point.

2. Operate car at idle - approx. 1000 RPM.

3. Set control head lever at "Auto."

4. Turn temp. dial Calibration switch off.

5. Place Manual-Automatic switch in manual position.

NOTE: This substitutes variable resistor (manual control switch in tester) for sensor string at all control head settings.

6. Place the Manual Control at maximum heat and then rotate slowly counterclockwise. The vacuum motor mechanism which can be seen through the slot in the programmer cover should start moving at 180 ohms. Rotating the knob to maximum cold should move the programmer to its full A/C position. Check air-mix door for full travel and no obstructions. If the programmer operates in this manner, the components governing programmer movement - amplifier, transducer and vacuum motor - are OK. Proceed to Sensor String Test.

7. If the programmer moves but the movement does not start at 180 ohms $\pm$ 3.0 ohms adjust feedback pot as described in Test 5.

8. If the programmer does not move, check as follows for supply voltage and supply vacuum:

a. Place Voltmeter switch in position 2. Battery voltage should be indicated on meter. No voltage indicates lack of ground on terminal 2 or no battery supply to terminal 1 of programmer.

b. Dummy vacuum plug must be modified as shown in Fig. 1-44. Plug tester's Dummy Vacuum plug on programmer valve. Connect dummy hose to vacuum supply (port 2 hose in car vacuum harness). Make sure vacuum is present (11 in. HG or more). Programmer now has vacuum supply with no car vacuum system components connected. If programmer functions using Manual Control, troubleshoot car vacuum system. If programmer does not function, defect is in programmer. See Tests 1 and 2.

Sensor String Test (Do Programmer Functional Test First)

1. Set control lever at "Auto" and temperature dial at 75°F.

2. Place temperature dial Calibration switch at off.

3. Place Manual-Automatic switch at automatic position and remove single connector from programmer test point.

4. Observe position of vacuum motor mechanism through slot in programmer cover. Mark position on cover.

5. Turn tester Manual-Automatic switch to manual and connect single connector to programmer test point. Adjust Manual Control until vacuum motor is in same position as step 4.

6. Read Manual Control. This indicates the resistance of the sensors and the temperature dial combined and should be 120 to 150 ohms at 21°C to 23°C (70°F to 75°F) room temperature.

7. If reading is not 120 to 150 ohms, perform the temperature dial calibration test below to check the temperature dial. If temperature dial checks OK, the in-car or ambient sensor or connecting wiring is malfunctioning.

Temperature Dial Calibration

To calibrate temperature dial remove control head and remove two green wires from temperature dial pot. Connect

an ohmmeter to terminals and set temperature dial at 75°F. Ohmmeter should read 36 ohms. If not, slip temperature dial clutch to adjust.

Blower Circuit Tests

1. Place Calibration switch in off position.

2. Place Manual-Automatic switch in manual position and connect single connector to programmer test point.

3. Set control lever at "Lo". With voltmeter knob at 6, there should be (3.5-4.5) volts on voltmeter. If there is no voltage at 6, there is a defect in the blower circuit.

4. Set control lever at "Auto." There should be battery voltage at 8 and the voltage at 6 should stairstep down and then back up as the Manual Control is rotated from max. Heat to max. cold. If there is no voltage at 8, there is a defect in the blower circuit. If the voltage at 6 does not change as described, the programmer is defective.

NOTE: A good connection between 6 and the blower motor is assumed. If the blower wire is disconnected, only battery voltage will appear at 6.

Diagnosing Defects in Programmer

The following tests should be performed to determine a defective internal part. Tests should be made in the numbered sequence.

Test 1 - Programmer Vacuum Circuit

With Adapter Harness J-23678-77 installed, proceed as follows:

1. Disconnect single wire in light green wire of Harness J-23678-77. If programmer goes to max heat, proceed to Test 2.

2. Remove programmer cover and install dummy vacuum plug which has been modified as shown in Fig. 1-44.

3. Tee the testers vacuum gauge into the dummy plug and port 2 of car vacuum harness.

4. Use long needle nose pliers to pinch the center and right side hoses from the vacuum valve.

5. If vacuum reading improves over vacuum reading taken during programmer functional test, check programmer vacuum hoses for leaks.

6. If vacuum reading does not improve, leak is in vacuum valve. Replace valve.

Test 2 - Vacuum Motor and Checking Relay

1. With single connector in light green wire of Harness J-23678-77 disconnected, programmer should go to full heat.

2. Disconnect dummy vacuum plug from programmer. Vacuum checking relay should hold vacuum motor in full

Test 2 - Vacuum Motor and Checking Relay

1. With single connector in light green wire of Harness J-23678-77 disconnected, programmer should go to full heat.

2. Disconnect dummy vacuum plug from programmer. Vacuum checking relay should hold vacuum motor in full heat.

3. If mechanism moves, vacuum motor or checking relay is leaking.

4. Reinstall car vacuum harness then pinch hose at motor to see if leak is in motor. Repair as required.

Test 3 - Amplifier and Transducer

With Adapter Harness J-23678-77 installed, proceed as follows:

1. With Manual-Automatic switch in manual and single connector attached to programmer test point, place temperature dial Calibration switch in off position.

2. Place voltmeter switch in probe and clip position connect clip to bottom transducer wire.

CAUTION: *Transducer wires are very delicate. Use appropriate caution when making or removing this connection. Do not short transducer terminals together or amplifier will be damaged.*

3. Push probe into programmer connector body making contact with term. 1 (yellow wire).

4. Rotating the Manual Control from max. heat to max. cold, the voltage reading should change 5 volts or more for a good amplifier.

5. If reading does not change, replace amplifier.

Test 4 - Transducer Test

With tester and leads same as in amplifier test, proceed as follows:

1. 11 in. hg. or more vacuum should be present on small transducer supply hose.

2. To check output regulated vacuum, pull checking relay from position and remove hose from transducer. Connect vacuum gauge to hose. Use large tee to make connection and seal extra port with thumb.

3. Rotate manual control to 10 volts on voltmeter. The vacuum should be (9 to 11) in. hg. Turning manual control to max. cold should make vacuum drop to 0.5 in. mercury for a good transducer. Reconnect hoses.

Test 5 - Feedback Potentiometer Adjustment

With Adapter Harness J-23678-77 installed and single connector attached to programmer test point, proceed as follows:

1. Using screwdriver, slip feedback pot shaft counterclockwise to stop. Programmer should move to full heat.

2. Place Manual-Automatic switch in manual position, Rotate manual control to max. heat.

3. Move Manual Control to 180. Do not overtravel.

4. Slip feedback pot shaft slowly clockwise looking for signs of vacuum motor mechanism movement and stop.

5. Check adjustment with Manual Control. Travel should start when 180 is reached as knob is turned counterclockwise from max. heat.

6. If feedback pot cannot be adjusted, replace amplifier assembly.

Programmer Moves But Vacuum Doors Do Not

If one of the doors does not operate, malfunction could be caused by plugged or pinched harness or plugged valve on programmer.

1. To check programmer valve, cut off sealed hose of dummy plug for circuit malfunctioning and connect the vacuum gauge to the plug.

2. Plug the dummy plug on the programmer vacuum valve. Connect dummy hose to vacuum supply hose (port 2) in car vacuum harness.

3. Monitor vacuum while operating programmer with Manual Control.

4. When completed, seal dummy plug hose with rivet. Do not use a screw. Refer to Fig. 1-38 for proper vacuum valve operation.

Temperature Door Check and Adjustment

A misadjusted temperature door link may not allow the programmer to travel fully to max. heat or to max. cold and could result in poor heating or poor cooling complaints. To check adjustment, attach tester electrical harness between

programmer and car harness using Adapter Harness J-23678-77. Connect single connector to programmer test point. Put Manual-Automatic switch in manual and control lever in "Auto." Put Voltmeter knob in 6. Rotate Manual Control from max. heat to max. cold. High blower (battery voltage) should be obtained in both extremes with control lever in "High". Recirc. operation should be obtained at max. cold (1 min. delay). With these conditions met, temperature door adjustment is correct to readjust.

1. Start engine and put control lever in "Def".
2. Remove threaded door link from programmer arm.
3. Disconnect single connector in light green wire of adapter harness J-23678-77. Programmer should go to full heat.
4. Move temperature door to full heat position by pulling door link.
5. Reinstall threaded door link to programmer arm and check as above.

ON-CAR SERVICE

HANDLING REFRIGERANT AND REFRIGERATION COMPONENTS

a. Maintaining Chemical Stability

The efficient operation of the air conditioning system is dependent on the pressure-temperature relationship of pure refrigerant 12. As long as the system contains pure refrigerant 12 (plus a certain amount of refrigeration oil which mixes with the refrigerant), it is considered to be chemically stable.

When foreign materials, such as dirt, air or moisture are allowed to get into the system, they will change the pressure-temperature relationship of the refrigerant. The system will no longer operate at the proper pressures and temperatures, and the efficiency of the system will decrease.

The following general practices should be observed to insure chemical stability in the system:

1. Whenever it becomes necessary to disconnect a refrigerant connection, wipe away any dirt or oil at or near the connection to eliminate the possibility of dirt entering the system. Both sides of the connection should be immediately capped or plugged to prevent the entrance of dirt, moisture, or foreign material. All air contains moisture. Air that enters any part of the system will carry moisture with it and the exposed surfaces will collect the moisture quickly.

2. Tools should be kept clean and dry. This includes the Charging Station and the Gage Set.

3. When adding oil, the container and the transfer tube through which the oil will flow should be exceptionally clean and dry in order to keep the refrigeration oil as moisture-free as possible. For this reason, the oil container should not be opened until ready for use, and should be capped immediately after use.

4. When it is necessary to open a system, have everything needed ready and handy so that as little time as possible will be required to perform the operation. Do not leave the system open any longer than is necessary.

5. Any time the system has been opened and sealed again, it must be properly evacuated, as described on page 1-51.

CAUTION: *Use only refrigerant from a reputable dealer, as contaminated refrigerant will not only lower the efficiency of the system, but may damage the unit. Use only refrigerant 12 since any other refrigerant may damage the compressor or other parts by incorrect pressure-temperature relationship.*

b. Precautions in Handling Refrigerant

Refrigerant 12 is stored and shipped as a liquid under pressure (in metal containers of various sizes and weights).

WARNING: IN HANDLING REFRIGERANT DRUMS, ALWAYS OBSERVE THE FOLLOWING SAFETY PRECAUTIONS.

1. DO NOT LEAVE DRUM UNCAPPED IF DRUM IS SO EQUIPPED. THE METAL CAP FURNISHED WITH THE DRUM WHEN IT IS SHIPPED IS TO PROTECT THE VALVE IN CASE THE DRUM IS ACCIDENTALLY KNOCKED OVER. THIS ELIMINATES THE POSSIBILITY OF THE DRUM FLYING THROUGH THE SHOP AND CAUSING SERIOUS DAMAGE TO PEOPLE AND PROPERTY. A SAFETY PLUG IS PROVIDED ON THE VALVE IN CASE THE TEMPERATURE EXCEEDS THE SAFE LIMITS OF THE DRUM. THE CAP IS DESIGNED SO THAT IF THE SAFETY PLUG AT THE VALVE SHOULD BLOW, THE REFRIGERANT WILL ESCAPE WITHOUT CAUSING THE DRUM TO MOVE.

2. DO NOT OVERFILL DRUM. A SAFETY PLUG IS PROVIDED IN CASE THE TEMPERATURE OF THE REFRIGERANT EXCEEDS THE SAFE LIMITS OF THE DRUM. HOWEVER, IF THE DRUM IS OVERFILLED, THE PRESSURE CREATED COULD CAUSE THE DRUM TO EXPLODE BEFORE THE TEMPERATURE RISES TO THE POINT WHERE THE SAFETY PLUG WOULD BURST AND ALLOW THE REFRIGERANT TO ESCAPE.

3. DO NOT CARRY THE DRUM IN THE PASSENGER COMPARTMENT OF A CAR. ALWAYS PLACE DRUM IN THE LUGGAGE COMPARTMENT OF CAR. IF A DRUM IS CARRIED IN AN OPEN TRUCK SHIELD IT FOR PROTECTION FROM THE SUN'S RAYS. THIS HEAT COULD INCREASE THE PRESSURE ENOUGH TO CAUSE SAFETY PLUG TO BURST.

4. DO NOT SUBJECT DRUM TO HIGH TEMPERATURE WHEN CHARGING SYSTEM - USE WATER NO WARMER THAN 52°C (125° F) TO HEAT DRUM. NEVER PLACE DRUM ON STEAM RADIATOR OR STOVE, OR USE TORCHES FOR HEATING DURING CHARGING.

5. DO NOT DISCHARGE REFRIGERANT 12 INTO AREAS WHERE THERE IS AN EXPOSED FLAME OR WHERE IT COULD BE DRAWN INTO THE

ENGINE AIR INTAKE WHEN THE ENGINE IS OPERATING. CONCENTRATIONS OF THIS GAS IN CONTACT WITH A FLAME MAY PRODUCE A POISONOUS GAS.

6. ALWAYS WEAR GOGGLES WHEN DOING WORK THAT INVOLVES OPENING THE REFRIGERANT LINES. AN ACCIDENT CAN EASILY CAUSE LIQUID REFRIGERANT TO STRIKE THE FACE. IF GOGGLES PROTECT THE EYES, THE LIKELIHOOD OF SERIOUS INJURY WILL BE REDUCED. SHOULD THE LIQUIFIED REFRIGERANT COME IN CONTACT WITH THE EYES, THE PERSON SUFFERING THE INJURY SHOULD IMMEDIATELY HAVE THE EYES RINSED WITH A GREAT AMOUNT OF COOL, CLEAN, WATER. AVOID RUBBING OR FURTHER IRRITATION OF THE EYES. THE PERSON SHOULD THEN BE TAKEN TO A QUALIFIED PHYSICIAN FOR EVALUATION.

FOR TREATMENT TO "FROST BITTEN" OR "FROZEN" SKIN DUE TO CONTACT WITH LIQUID REFRIGERANT, PROCEED AS FOLLOWS:

a. RAPID REWARMING OF AFFECTED AREAS BY MOIST HEAT. IMMERSE THE PART OR PARTS IN WATER AND MAINTAIN THE WATER TEMPERATURE BETWEEN 31°C (88°F.) TO 38°C (100°F).

b. AFTER REWARMING PROCESS THE EXPOSURE OF THE PART TO ROOM AIR TEMPERATURE IS PERMISSIBLE:

c. THE PERSON CAN THEN BE TAKEN TO A QUALIFIED PHYSICIAN FOR FURTHER EVALUATION.

d. TWO IMPORTANT THINGS TO REMEMBER:

1. DO NOT RUB OR COMPRESS THE AFFECTED PART WITH ICE, SNOW OR COLD WATER. MASSAGE OR FRICTION OF ANY TYPE IS HARMFUL TO FROZEN TISSUE.

2. DO NOT APPLY PRESSURE DRESSINGS OR OINTMENTS OF ANY TYPE.

c. Welding

Excessive heat applied to any section of the refrigerant lines will create excessively high pressures. For this reason, welding should not be performed on any portion of the car adjacent to the refrigerant units or lines.

d. Undercoating

To simplify service operations, undercoating should not be applied to any connections or rubber lines of the refrigeration system. While it is permissible to undercoat the metal refrigerant lines, all flare joints and connections should first be masked.

e. Collision Service

It is very important that the air conditioning system be inspected as soon as possible whenever a car has been involved in a collision. If the system has been opened as the result of a collision, it will permit the entry of air, moisture, and dirt that will cause internal damage. As the length of time the system has been open and the extent of damage to the components will govern the replacement of parts and the service operations required, a definite procedure cannot be recommended to cover all cases, The following, however, may be used as a guide:

1. Make certain clutch is disengaged, if car is to be operated before repairs are made.

2. Inspect all units and lines, noting any damage.

a. If condenser is damaged it should be replaced. No repairs such as soldering, brazing or welding should be attempted.

b. Replace accumulator if system was open for any period of time.

3. Check compressor and clutch pulley for cracks. If compressor does not show evidence of external damage, it may be used.

f. Handling Components

1. Lines should be kept sealed and dehydrated in stock. Do not remove shipping caps from lines until just before installation.

2. Always use two wrenches when tightening fittings to prevent twisting the hoses or soft aluminum tubing. Lubricate all fittings with refrigeration oil to allow the joint to be tightened without twisting the pipe.

3. Cap ends of lines that have been disconnected for any reason, to prevent entrance of moisture or dirt.

4. Gage set and lines should be kept clean and free from moisture.

5. Do not leave refrigeration oil container open any longer than necessary, as the special oil is moisture-free, but will rapidly absorb moisture from the air.

6. Use Vacuum Pump, J-5428, or Charging Station, J-23500, to remove any air or moisture that may have entered the system when it was opened to replace a part.

g. Replacing Components

When removing any components or lines from the system, they must be capped and plugged immediately to prevent exposing them to moisture.

All componens of the air conditioning system are shipped dehydrated and sealed. They are to remain sealed until just prior to making corrections and should be at room temperature before uncapping to prevent condensation of moisture from the air that enters the components. They should not be uncapped any longer than necessary to make a connection.

All precautions should be taken to prevent damage to the fitting and connections. Any fittings with grease or dirt on them should be cleaned prior to assembly, using a clean cloth dipped in alcohol. If dirt, grease or moisture gets inside lines and cannot be removed, lines must be replaced.

All blue O-rings for making closures for shipment should be discarded and new black O-rings used for making final refrigerant connections.

Use a small amount of refrigerant oil on all tubes and hose joints and lubricate the O-rings with this oil before assembly. Always slip the lubricated O-ring onto the flange tube to insure proper locating and sealing.

All O-ring connections should be tightened with a torque wrench and a crowfoot wrench (used at a 90° angle

to the torque wrench for accurate reading), in accordance with the table on page 1-55. Note that the torque specified for aluminum tubing is less than that specified for steel tubing.

If a connection is made with steel to aluminum, use torques for aluminum. In other words, use the lower torque specification. Use steel torques only when both ends of connection are steel.

Backing wrenches of the required size must be used during the final tightening of all O-ring and flare-type connections.

Pre-formed refrigeration system lines are not serviced; however, bulk tubing is available along with a selection of fittings so that a replacement hose may be assembled. Drawings (such as Fig. 1-54) are included several places in this service manual showing the routing and attachment of these lines. When assembling refrigerant lines extreme care is required to prevent dirt, rubber chips, etc. from entering the system. A short blast of refrigerant is recommended to clear the hose of contamination. Hoses may be lubricated with refrigeration oil to aid in assembly.

REPLACING DESSICANT

When the system has been open for any extended period of time, such as a result of an accident, the accumulator dessicant should be replaced. This is particularly true in hot, humid conditions. The colder and dryer the climate, the less critical this becomes.

CHECKING REFRIGERANT CHARGE

Since the C.C.O.T. refrigeration system does not contain a sight glass, if preliminary diagnosis indicates a low refrigerant charge, the following check can be performed:

1. Judge the temperatures of the evaporator inlet and outlet pipes with fingers. Both should be equal (cold).

2. If outlet pipe is warmer than inlet pipe, add a partial charge of refrigerant as described on page 1-52.

PURGING REFRIGERATION SYSTEM

When replacing any air conditioner component, the system must be purged (drained) of refrigerant. The purpose is to lower pressure inside the system so that a component part can be safely removed. Following is a simplified procedure for purging refrigerant from system.

WARNING: ALWAYS WEAR GOGGLES FOR EYE PROTECTION WHEN DOING WORK THAT INVOLVES OPENING THE REFRIGERATION SYSTEM.

1. Remove caps from pressure fittings on high pressure line and accumulator.

2. Install a length of 5/16″ diameter clear plastic hose over the threaded end of Gage Adapter, J-5420. Secure with a clamp.

3. Install hose from J-5420 into a graduated container such as an empty refrigerant oil bottle.

4. Loosely install Gage Adapter, J-5420, on low side pressure fitting.

5. Tighten gage adapter and allow system to discharge at a rapid rate into the container.

NOTE: Rapid discharge will cause oil loss; container is necessary to collect oil.

6. When the system is completely discharged (no vapor escaping with hose fully tightened down), measure, record and discard collected oil. This same quantity of oil plus any trapped in removed parts must be added to the system before recharging with refrigerant. Adding oil is described on page 1-52.

7. When the system is fully discharged, check high side fitting (on liquid line or muffler) for remaining pressure by connecting a downward directed 36 inch section charging link with attached J-25498 straight fitting down to depress fitting valve.

8. If pressure is *evident on high side,* discharge high side by same procedure as for low side using Adapter J-25498. This condition indicates a restriction on the high side, possibly that the orifice tube is plugged. Check this condition before reassembling the system.

9. Check accumulator for frost on lower portion. If evident, liquid refrigerant is still trapped in the system and may require heat for removal such as a warm, wet rag. Do not use any form of heat in excess of 52°C (125°F).

10. System is now ready for repair. Always use caution and wear goggles when first opening any connection of a refrigerant system due to the possibility of local refrigerant entrapment or an error in following this discharging procedure.

EVACUATING REFRIGERATION SYSTEM

Whenever the air conditioning system is opened for any reason, it should not be put into operation again until it has been evacuated several times. For this operation use Charging Station, J-23500, to remove air and moisture that may have entered the system.

1. Remove cap from low pressure fitting on accumulator.

2. Make certain that all valves on charging station are closed.

3. Purge system as described above.

4. Install Gage Adapter, J-5420, on low pressure line and connect low pressure line to gage fitting on accumulator.

5. Add refrigeration oil as described on page 1-52.

6. Plug in Charging Station to 110 volt outlet and turn on vacuum pump switch.

7. Open valve 1 (low pressure control), and valve 3 (vacuum control).

8. Operate to obtain 28 inches of mercury vacuum, then continue to operate pump for ten minutes.

NOTE: In all evacuating procedures specification of 28-29″ of mercury vacuum is used. This evacuation can only be attained at or near sea level. For each 1000 feet above sea level where this operation is being performed, specification should be lowered by one inch of mercury vacuum. At 5000 feet elevation only 23″ to 24″ of mercury vacuum can normally be obtained.

9. While evacuating the system, add refrigerant to cylinder on Charging Station by opening valves on refrigerant drum and at bottom of cylinder (valve 4 must be closed). Open valve on top of cylinder until approx. 2 pounds of liquid is obtained in sight tube, and then close both top and bottom valves on cylinder.

10. Close valves 1 and 3 and turn off vacuum pump switch. System should hold vacuum, unless there is a leak.

11. Slowly open valves 1 and 4, allowing 1/2 to 1 lbs. of refrigerant to enter system, then close valves.

12. Leak test system for major leaks as described, on page 1-53.

13. Purge system as described above.

14. Repeat steps 7, 8 and 10.

15. System is now ready for complete charge of refrigerant.

ADDING REFRIGERANT

a. Complete Charge

1. Evacuate refrigeration system as described above.

2. Connect heating element plug to a 110 volt outlet.

3. Disconnect low pressure cutoff switch and connect a jumper wire between the terminals of the harness.

4. Fill cylinder on Charging Station with refrigerant as follows:

a. Open valves on refrigerant drum and bottom of cylinder (valve 4 must be closed).

b. Open valve on top of cylinder until proper liquid level (3-3/4 pounds) is obtained in sight tube.

5. Fully open valves 1 and 4 to allow refrigerant to flow into system.

NOTE: If refrigerant does not flow freely into system, it is probably due to valve core in accumulator fitting not being depressed far enough. If this condition exists, try another Gage Adapter, J-5420 or build up adapter depressor tongue with solder to depress valve core further.

6. After liquid refrigerant has stopped flowing into system, start engine and run at approximately 1500 rpm with transmission in PARK position.

7. Move Automatic Climate Control lever to "Auto" position and set temperature dial to 18°C (65°F). This will allow refrigerant remaining in cylinder to be pulled into system.

8. Shut off engine, close all valves, disconnect Charging Station low pressure line and replace cap on fitting.

9. Remove jumper wire and reconnect lo pressure cutoff switch.

10. The system should never be overcharged because excessive head pressures result.

b. Partial Charge

A low refrigerant charge, indicated by warm discharge air, can be charged completely by adding small amounts of refrigerant. Since the C.C.O.T. refrigeration system has no sight glass, full refrigerant charge is determined by sensing the temperature of the evaporator inlet and outlet pipes and judging their relative temperatures. Both pipes should be the *same* temperature (cold). If the outlet pipe is warmer than the inlet pipe add a partial charge of refrigerant as described below. *After* the system has been leak tested and proven tight.

Refrigerant can be added to the air conditioning system using Charging Station, J-23500. The charging lines must be purged before any refrigerant is added.

1. Purge air from Charging Station low pressure line before connecting. To purge line, crack open valves 1 and 4, making certain that there is some refrigerant in cylinder, then install line to accumulator and close valve.

2. Connect Charging Station as described above.

3. Disconnect Lo pressure cutoff switch and install jumper wire between terminals of wiring harness.

4. Operate engine at 600 rpm with transmission in PARK position.

5. Move Automatic Climate Control lever to "Auto" position and set temperature dial to 65°F.

6. Fill cylinder on Charging Station with 1 or 2 pounds of refrigerant, as follows:

a. Open valves on refrigerant drum and bottom of cylinder (valve 4 must be closed).

b. Open valve on top of cylinder until proper liquid level is obtained in sight tube.

c. Close valve at bottom of cylinder.

7. Open valves 1 and 4 and allow 1 or 2 ounces of refrigerant to enter system, then close valves.

8. Allow compressor to cycle and judge temperature of evaporator inlet and outlet pipes with fingers. If temperatures are judged to be equal system is at full capacity. System must not be overcharged.

9. If temperatures are still unequal repeat steps 7 and 8 until temperatures are the same.

10. Shut off engine, close all valves, disconnect Charging Station and install gage fitting cap.

11. Remove jumper wire and reconnect low pressure cutoff switch.

ADDING OIL

The six-cylinder compressor uses 525 viscosity refrigeration oil. An oil charge of 10 fluid ounces is required.

It is important that only the specified type and quantity of oil be used in the compressor. If there is a surplus of oil in the system, too much oil will circulate with the refrigerant, causing the cooling capacity of the system to be reduced. Too little oil will result in poor lubrication of the compressor.

As the compressor is operated, oil gradually leaves the compressor and is circulated through the system with the refrigerant. Eventually a balanced condition is reached in which a certain amount of oil is retained in the compressor and a certain amount is continually circulated. When the system is discharged at a rapid rate or a component of the system is removed after the system has been operated, some oil will go with it. To maintain the original total oil charge, it is necessary to compensate for this by adding oil to the new replacement part.

The procedures for adding oil are as follows:

1. Replacing oil lost during discharge.

1. If system has been opened for other service, oil lost during rapid discharge (as measured on page 1-53) may be added directly to the component.

2. If this method is not practical, oil lost during rapid discharge *must* be replaced as follows:

a. Connect charging station *low* pressure line to fitting on accumulator.

b. Connect J-25498 to high pressure fitting.

c. Place hose from J-25498 into a container of fresh refrigeration oil.

NOTE: Container should have more oil than was drained from system to prevent trying to draw all oil from bottle into system.

CAUTION: *Care should be exercised during this operation to ensure that no dirt is drawn into the system. Dirt may damage system components.*

d. Start vacuum pump and draw from graduated container, as much oil as was lost during rapid discharge. Remove hose from container when this point is reached.

e. Elevate hose to allow oil in hose to be drawn into system.

f. Remove Adapter J-25498 and proceed with normal evacuation and charging.

2. Compressor Only (Oil Lost During Discharge)

1. Idle engine for 10 minutes at 1000 - 1500 rpm with control lever in "HI" and temperature dial at 65°F. to allow

oil to distribute itself in system in a normal manner.

2. Remove compressor from car and place it in a horizontal position with drain plug downward. Drain oil, measure, and discard it.

3. Drain oil from compressor that is to be installed in car.

4. If oil drained in step 2 is more than 4 fluid ounces, add to the new compressor the same amount of oil as drained from replaced unit plus the amount lost during rapid discharge.

5. If the oil drained in step 2 is less than 4 fluid ounces, add 6 ounces of oil to new compressor, plus the amount lost during rapid discharge.

3. Replacing Components (Oil Lost During Discharge)

If there is no evidence of excessive oil leakage, measured quantities of 525 viscosity refrigeration oil should be added to the component to assure that total oil charge in system is correct before unit is operated.

Oil should be added to replacement components as indicated below.

Evaporator	Add 3 fluid ozs.*
Condenser	Add 1 fluid oz.*
Accumulator or Compressor	Drain Oil, Measure, Add Same Amount Plus One Additional*

*Plus the amount lost during rapid discharge.

Oil should be poured directly into the replacement component. If an evaporator is installed, pour oil into inlet pipe with pipe held vertically so oil will drain into core.

If any other components, such as valves or hoses are replaced, no additional oil is necessary.

CAUTION: *If system has been operated and there is evidence of a major loss of oil, system has probably lost all or most of its refrigerant. If any refrigerant remains, discharge it from system. Do not operate compressor any more than is absolutely necessary to avoid damage from lack of oil.*

REPLACING OIL WITH NEW ACCUMULATOR INSTALLATION

1. Remove compressor and place in a horizontal position with drain plug downward. Drain oil from compressor, measure it and then discard it. To promote draining, have suction connector open and tilt compressor as required.

2. Repeat step 1 for accumulator and discard accumulator.

3. If more than 4 fluid ounces of oil was drained in steps 1 and 2, add same amount of new oil to compressor, plus one additional ounce to replace that captured in desiccant.

4. If less than 4 fluid ounces of oil was drained in steps 1 and 2, add 6 fluid ounces of oil, plus one additional ounce to replace that captured in desiccant of old accumulator.

LEAK TESTING REFRIGERATION SYSTEM

There are three methods that may be used for detecting leaks in the air conditioning system.

a. Leak Detector Fluid

Leak detector fluid (mixed with water per directions on bottle) may be used by daubing or squirting the liquid around joints to be tested. Ordinary leaks will form a cluster of bubbles almost immediately. Extremely small leaks will form a white foam which will materialize with a time limit from a few seconds to a minute, depending on size of leak.

In order to locate leaks with this fluid, it is essential that you see all of the surfaces you are checking with a good light; otherwise small leaks could easily be overlooked.

b. Electronic Leak Detector

Two types of electronic leak detectors are recommended: the more recently available Refrigerant Gun, J-23400; and Electronic Leak Detector, J-22235. Instructions for their use are included with the equipment.

c. Torch Type Leak Detector

Detecting a leak with the torch type detector is accomplished by observing the color of the flame in the head of the detector, when the sampling tube is close to a refrigerant leak.

The flame can be described as three different colors: green, blue, and purple. Green indicates a small leak, blue indicates a medium leak and purple indicates a large leak.

WARNING: AVOID BREATHING SMOKE AND FUMES PRODUCED BY THE BURNING OF THE REFRIGERANT. SUCH FUMES MAY BE HAZARDOUS.
DO NOT RELEASE REFRIGERANT IN AN AREA WHERE A FLAME IS EXPOSED.

To operate unit, open valve until a low hiss of gas is heard, then light the flame at opening in detector chimney. Adjust flame until blue flame is approximately 3/8 inches above reaction plate to make detector as sensitive as possible for small leaks.

When checking for leaks, always position sampling tube below fitting or area to be tested, as refrigerant 12 is a heavy vapor and will sink when exposed to air.

It is best to test low pressure side of system at drum pressure which is much higher than normal low side operating pressure.

In testing high pressure side for leaks, run system for a few minutes to build up pressure in high pressure side of system. Then stop engine and test high pressure side of system for leaks.

Do not attempt to leak test with the engine running in a drafty location as it will disperse the refrigerant 12 and be impossible to locate a leak.

CONTROL SYSTEM FUNCTIONAL TEST

The following procedure is used to assure correct functional operation and requires approximately two minutes to perform. The system is to be tested at room temperature with the hood down, the doors and windows closed and the engine operating. Engine coolant must be warm. Proceed as follows:

1. Operate car at 1000 RPM or better.
2. Place A/C outlets in wide-open position.
3. Install thermometer in center A/C outlet.
4. Set control lever at "DEF" and temperature dial at 85°F.
   a. Air should be delivered out of the defroster outlets.
   b. Blower should operate at high speed.
   c. Some air should come out heater outlet.
5. Set lever at "Bi-Level" and temperature dial at 75°F.

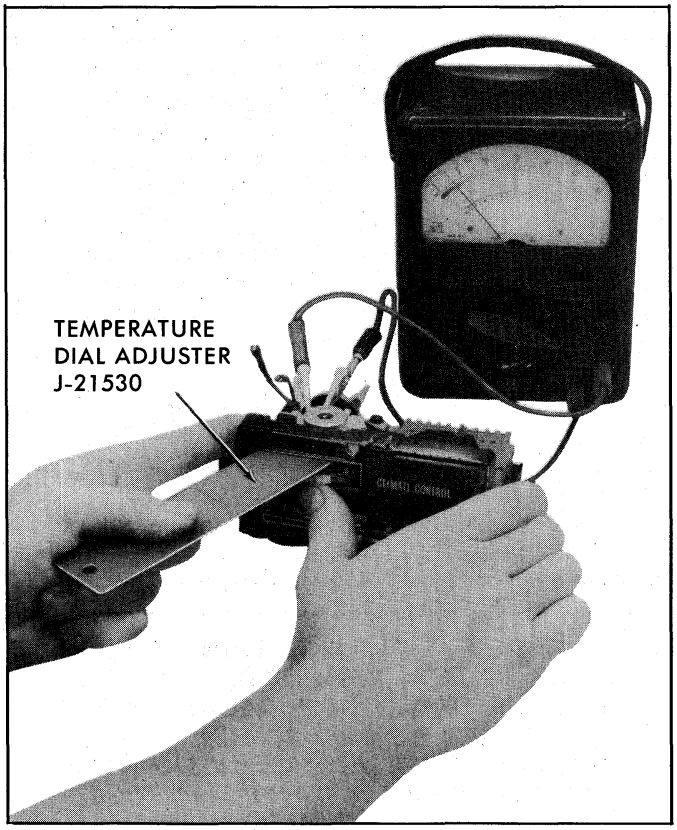


Fig. 1-45 Adjusting Temperature Dial

a. Air should be delivered from *both* the A/C and heater outlets.

b. Blower should operate at a lower speed.

c. Small airflow should come from defroster outlets.

6. Set lever at "HI" and temperature dial at 65°F.

a. Cool to cold air should be delivered from A/C outlets.

b. Blower should operate at high speed.

c. Recirc air door should open (will be slightly noisy).

7. Set lever at "AUTO" and temperature dial at 65°F. After 45 seconds, discharge air temperature should be 10°C (50°F) or lower. May be slightly higher in 32°C (90°F) or above ambient temperature.

8. Set lever at "AUTO" and temperature dial at 85°F.

a. Blower speeds should drop (HI - M3 - M2 - M1 - etc.).

b. Recirc door should close - noise level will drop.

c. Discharge air temperature should increase.

d. Air delivery may change from A/C outlets to bi-level

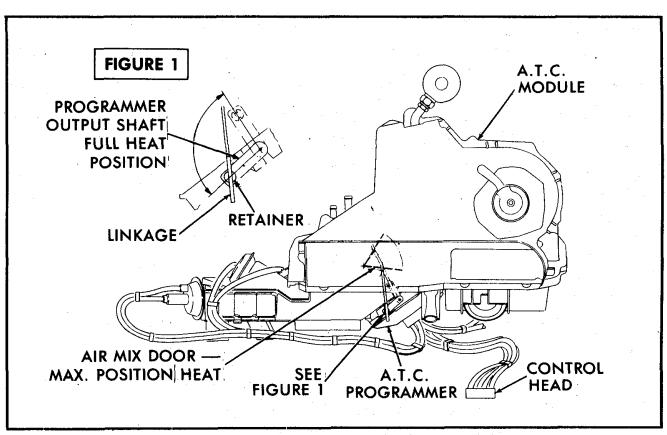


Fig. 1-46 Adjusting Air Mix Door Link

to heater outlet - depending upon ambient temperature.

9. Set lever at "LO" and temperature dial at 85°F. Air should be delivered at fixed low blower.

10. Set lever at "ECONOMY" and temperature dial at 65°F.

a. Air discharge should be from A/C outlets heater outlet or both (bi-level) depending on ambient temperature.

b. Blower speed may vary as in "AUTO".

c. A/C compressor should not operate.

11. Set lever at "OFF" and temperature dial at 65°F.

a. Air discharge should be from heater outlet.

b. Blower should operate at fixed Lo speed.

c. A/C compressor should not operate.

COMPONENT ADJUSTMENTS

Be sure to allow sufficient time for the car engine to "warm up" and for the system to "turn-on" before attempting calibration. Do not skip any steps in the Calibration Procedure.

a. Temperature Dial Calibration

1. Remove control head as described on page 1-59.

2. Disconnect two green wires from temperature dial rheostat and connect an ohmmeter to rheostat terminals, Fig. 1-45, or connect ohmmeter to board terminals J and H.

3. Set temperature dial at 75°F and read ohmmeter. Reading should be 36 ohms.

4. If reading is not correct, move temperature dial until ohmmeter reads 36 ohms and use tool J-21530 to hold the gear on top of the temperature dial while dial is moved to 75°F, Fig. 1-45.

b. Mix Door Link Adjustment

1. Remove air-mix door linkage from the plastic retainer on the output shaft of the programmer, Fig. 1-46.

2. Place the control head selector lever in the "DEF" position, and start engine.

3. Disconnect single connector in light green wire of Adapter Harness J-23678-77. This results in the proper position of the output shaft of the programmer (full heat position).

4. Pull on linkage and seat into plastic retainer on programmer crank arm.

5. To check the Mix Door Link Adjustment, proceed as follows.

a. Connect Tester J-23678 into the wiring harness and the programmer using Harness Adapter J-23678-77. Place the control head in "AUTO". Place the "MANUAL-AUTOMATIC" switch in the "MANUAL" position. Using the "MANUAL CONTROL," swing the programmer to "Max. Heat" then to "Max. Cold." Hi blower should be obtained in "Max Cold" and in "Max Heat."

b. Check for recirculation operation. Operate the system with the "MANUAL CONTROL" on "150" for 5 minutes so the restricted vacuum line can move the recirc door to the outside air position. With the control head in "HI", move the "MANUAL CONTROL" to "Max. Cold." *With all the car doors and windows closed, andthe blower noise level should increase when recirculation occurs (approximately 3 minutes delay due to the restrictor).*

c. Programmer Amplifier Calibration (Feedback "Pot" Adjustment)

1. Remove the plastic cover from the programmer while it is still mounted in the car.

2. Connect the Tester J-23678 into the wiring harness and the programmer using Harness Adapter J-23678-77. Connect single connector to programmer test point.

3. Place the control head selector lever in the "AUTO" position.

4. Place the "MANUAL-AUTOMATIC" switch on the tester in the "MANUAL" position.

5. Place the "TEMPERATURE DIAL CALIBRATOR" switch of the tester in the "OFF" position.

6. Rotate the "MANUAL CONTROL" knob on the tester to the "Max. Heat" position. The programmer should move to the full heat position.

7. Rotate the "MANUAL CONTROL" knob to 180 and STOP. DO NOT OVER-TRAVEL!

8. Using a blade type screwdriver, slip the shaft of the feedback potentiometer fully counterclockwise to its stop (see Figure 1-6 for location of the feedback potentiometer in the programmer). The vacuum motor mechanism will be "in" the vacuum motor indicating full heat operation.

TORQUE SPECIFICATIONS
METAL TUBING

Metal Tube O.D. (Inch Lbs.)	Steel Tubing Torque (Ft. Lbs.)	Alum. Tubing Torque (Ft. Lbs.*)
1/4"	15	7
3/8"	35	13
1/2"	35	13
5/8"	35	21
3/4"	35	28

*Torque taken with crow foot attachment at a 90° angle on torque wrench.

9. Using the screwdriver, very slowly slip the feedback potentiometer clockwise until the *first movement* of the vacuum motor mechanism can be seen. Stop the adjustment when the movement first occurs. (Do not watch the programmer output shaft.)

10. To check the adjustment, rotate the "MANUAL CONTROL" knob to the "Max. Heat" position. Then slowly rotate the "MANUAL CONTROL" knob counterclockwise and the vacuum motor mechanism should first start to move when the "MANUAL CONTROL" knob is exactly at 180±1. Touch up the feedback potentiometer adjustment in the programmer so that the mechanism movement occurs at exactly 180. If this adjustment *cannot* be made, the programmer is malfunctioning.

COMPRESSOR - COMPLETE REMOVAL AND INSTALLATION (Fig. 1-47)

a. Removal

1. Remove air cleaner.

2. Purge refrigerant from system as described on page 1-51.

3. Remove screw securing high and low pressure lines to compressor rear head.

4. Remove high and low pressure lines from compressor rear head and cap openings in both hoses and compressor. Test Plate, J-9625 may be used to seal compressor.

5. Disconnect electrical connector from clutch coil and from low pressure switch if compressor mounted type switch.

6. Loosen bolts securing power steering pump to mounting brackets, pivot pump toward engine and remove drive belt from compressor.

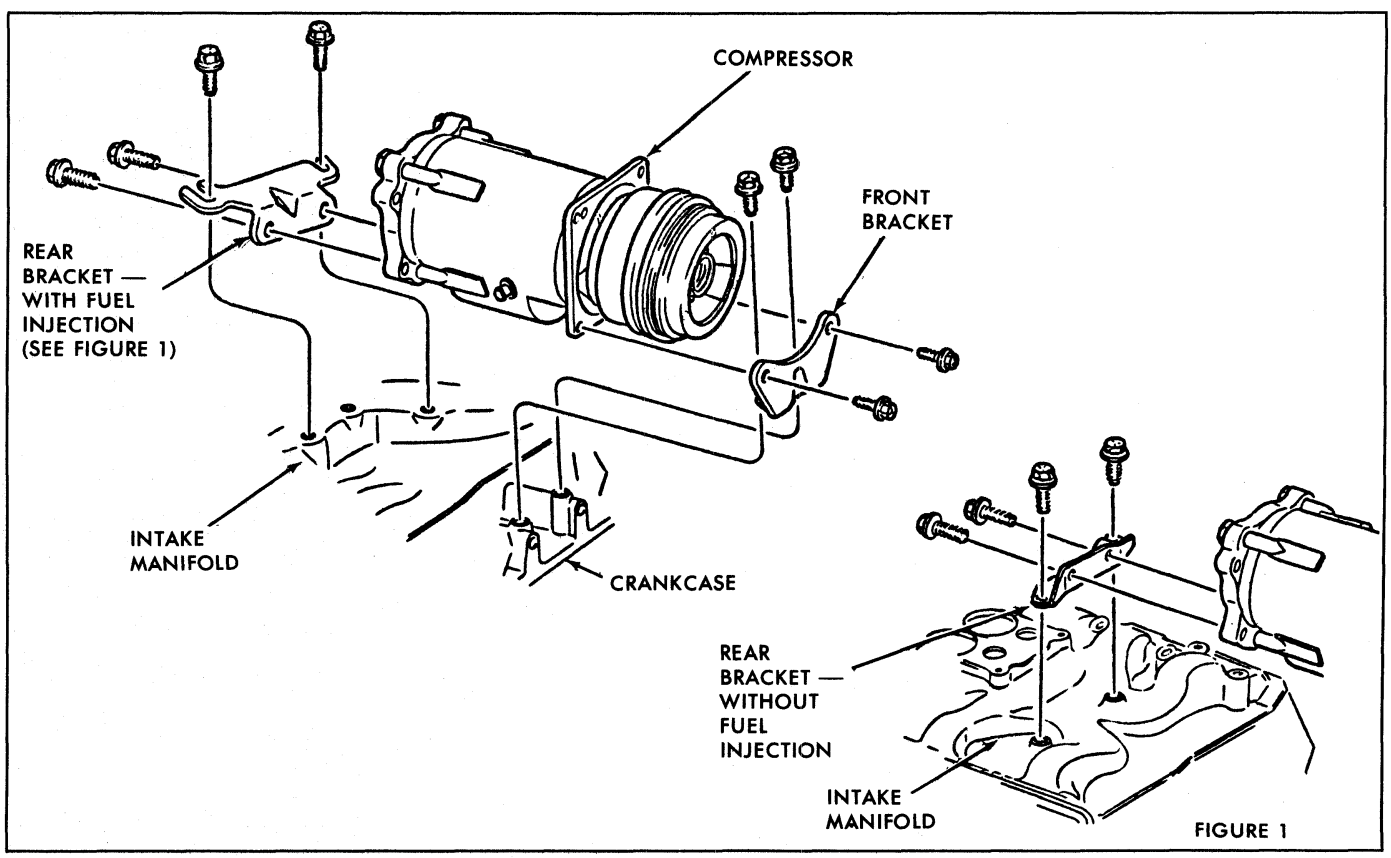


Fig. 1-47 Compressor Installation

7. Remove spark plug wires from right hand cylinder head and position wires out of way.

8. Remove two screws holding compressor to rear mounting bracket.

9. Remove two screws holding compressor to front mounting bracket.

10. Remove compressor by moving upward and out from under radiator hose.

b. Installation

NOTE: Before installing a replacement compressor, make certain the numerals 3-3/4 are stamped 1/8 inch high on blank space provided in lower right hand corner of compressor name plate, Fig. 1-11. If numeral is not evident, then stamp numeral as indicated. This numeral indicates the refrigerant capacity and must be shown on all compressors as required by law in some states.

1. Position compressor to engine and secure with two screws each to front and rear mounting brackets. Tighten front bolts to 25 ft. lbs. torque.

2. Install compressor drive belt on compressor and power steering pump and adjust belt tension as described in section 6.

3. Connect electrical connector to clutch coil and from low pressure switch if compressor mounted type switch.

4. Remove test plate J-9625 and using new O-rings, position high and low pressure lines and retainer plate to rear head and secure with one screw. Tighten screw to 30 ft. lbs.

NOTE: The O-rings in the compressor head should be oiled prior to placement in the cavity. Care should be taken not to damage these O-rings during installation.

5. Install spark plug wires to right hand cylinder head.

6. Evacuate and charge refrigeration system as described on page 1-51.

7. Leak test all compressor connections.

CAUTION: *All leaks must be repaired. Under no circumstances should a compressor be operated when a leak exists. Loss of refrigerant prevents oil return to the compressor and operating compressor may damage it.*

COMPRESSOR - PARTIAL REMOVAL AND INSTALLATION

In order to perform certain engine operations, it is necessary to move the compressor out of the way. This can be done without discharging the refrigeration system as follows:

a. Removal

1. Remove air cleaner.

2. Perform steps 5 thru 9 of compressor removal above.

3. Move complete assembly clear of work area, being careful not to kink hoses. Use rope or wire to hold compressor out of way.

b. Installation

1. Perform steps 1, 2, 3 and 5 of compressor installation above.

2. Check system operation to assure that no refrigerant was lost and system performs normally.

3. Install air cleaner.

EVAPORATOR

a. Removal

1. Discharge refrigeration system as described on page 1-51.

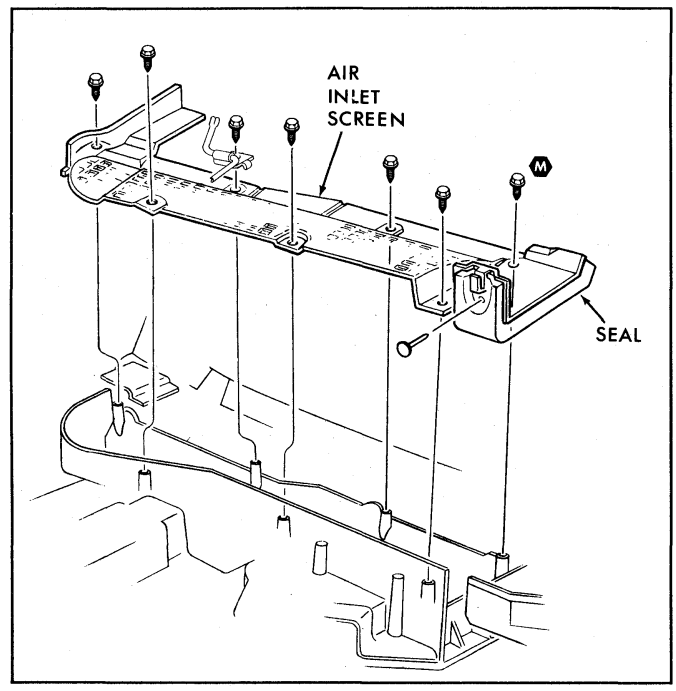


Fig. 1-48 Air Inlet Screen

2. Remove electrical connectors from blower motor, blower resistors and thermostatic cycling switch. Position wiring harness out of way.

3. Remove right hand windshield washer nozzle.

4. Remove right hand air inlet screen from plenum, Fig. 1-48.

5. Remove thermostatic cycling switch as described on page 1-57.

6. Remove 16 fasteners shown in Fig. 1-49 holding A/C module cover and remove cover.

7. When system is completely discharged, disconnect evaporator inlet and outlet pipes.

CAUTION: *All refrigeration system connections must be plugged or sealed immediately to prevent entry of dirt and moisture into system.*

8. Remove evaporator core by lifting straight up and out of A/C module.

b. Installation

1. Remove sealer from surfaces shown in Fig. 1-50 and install new sealer only in positions shown.

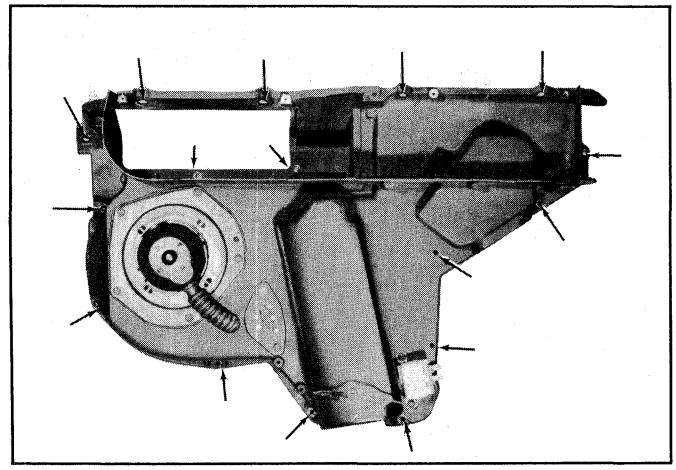


Fig. 1-49 A/C Module Cover Fasteners

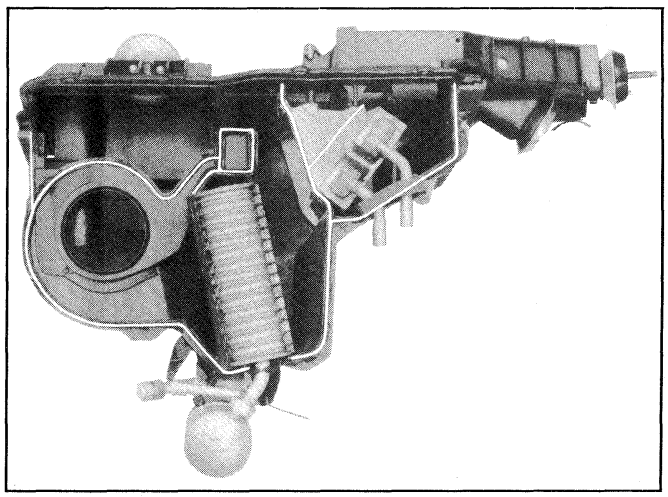


Fig. 1-50 A/C Module Cover Sealing

2. Position evaporator core in A/C module and connect upper and lower lines using new O-rings.

3. Install A/C module cover and secure with fasteners as shown in Fig. 1-49.

4. Install thermostatic-cycling switch as described on this page.

5. Install right hand air inlet screen, and windshield washer nozzle to plenum, Fig. 1-48.

6. Connect electrical connections to blower motor, blower resistors and thermostatic cycling switch.

7. Evacuate and charge refrigeration system as described on page 1-51. Leak test all connections.

HEATER CORE

a. Removal

1. Remove electrical connections from blower motor, blower resistors, and thermostatic-cycling switch. Position wiring harness out of way.

2. Remove right hand windshield washer nozzle.

3. Remove right hand air inlet screen from plenum, Fig. 1-48.

4. Remove two screws securing thermostatic-cycling switch to module and carefully reposition switch off of module cover.

5. Remove 16 fasteners shown in Fig. 1-49 holding A/C module cover and remove cover.

6. Clamp off heater hoses and remove hoses from heater core nipples.

7. Remove one screw and retainer holding heater core to frame at top.

8. With the temperature door in the max. hot position, reach through the temperature housing and push the lower forward corner of the heater core away from the housing. Then rotate the core parallel to the housing. This causes the core to snap out of the lower clamp. The core may not be removed in a vertical direction due to the configuration of the lower core tank, lower clamp and temperature housing.

b. Installation

1. Remove sealer from surfaces shown in Fig. 1-50 and install new sealer in positions shown.

2. Position heater core to frame and push core down firmly to seat in clip at bottom.

3. Secure heater core to frame at top with one screw and retainer.

4. Connect heater hoses to heater core nipples and secure with clamps.

5. Install A/C module cover and secure with fasteners as shown in Fig. 1-49.

6. Position thermostatic-cycling switch to module cover and secure with two screws.

7. Connect electrical connections to blower motor, blower resistors and compressor switch.

8. Install air inlet screen, and windshield washer nozzle to plenum.

9. Refill cooling system as required.

THERMOSTATIC-CYCLING SWITCH

a. Removal

1. Remove electrical connector and mounting screws.

2. Remove insulation from connection of capillary line and evaporator inlet pipe. Note location of line on pipe so that replacement capillary line can be installed in the same location.

3. Loosen clamps securing line to pipe and remove line. Clean evaporator outlet pipe with a suitable solvent.

b. Installation

1. Position switch to A/C module and secure with two screws. Connect electrical connector.

2. Position capillary line to evaporator inlet pipe *within 1/2 inch of original location.*

3. Position each clamp so that its width covers the capillary line and tighten clamps to 20 in.lb. Both rows of the capillary line must rest firmly against the clean pipe.

4. Cover connection with new insulation. Pack insulation tightly over pipe.

LOW PRESSURE SWITCH - LATER MODELS (Fig. 1-14)

Remove and Replace

1. Discharge refrigerant system as described on page 1-51.

2. Disconnect switch electrical connector.

3. When system is discharged completely, remove switch retaining ring, using internal snap ring pliers, tool J-5403.

4. Remove switch from compressor by pulling on terminal housing with conventional pliers.

5. Remove O-ring seal from switch cavity, using O-ring removal tool J-9553 or equivalent.

6. Check switch cavity and O-ring groove, Figure 1-14, in rear head for dirt or foreign material and clean as necessary.

7. Install new O-ring coated with clean refrigerant oil into O-ring groove of switch cavity.

8. Lubricate high side pressure switch housing with clean refrigerant oil and carefully insert switch into switch cavity until switch bottoms in cavity.

9. Using internal snap ring pliers J-5403, install switch retaining ring with high point of curved sides adjacent to switch housing. Be sure retaining ring is properly seated in switch cavity groove.

10. Pressurize system with refrigerant vapor to 170 kPa$\pm$35 kPa (925 psi$\pm$5 psi) and check for continuity through switch, terminal to switch housing. The switch contacts must close or open on pressure rise or pressure decrease between 135 kPa-205 kPa (20-30 psi).

11. Evacuate, recharge and leak test refrigerant system.

12. Check system operation.

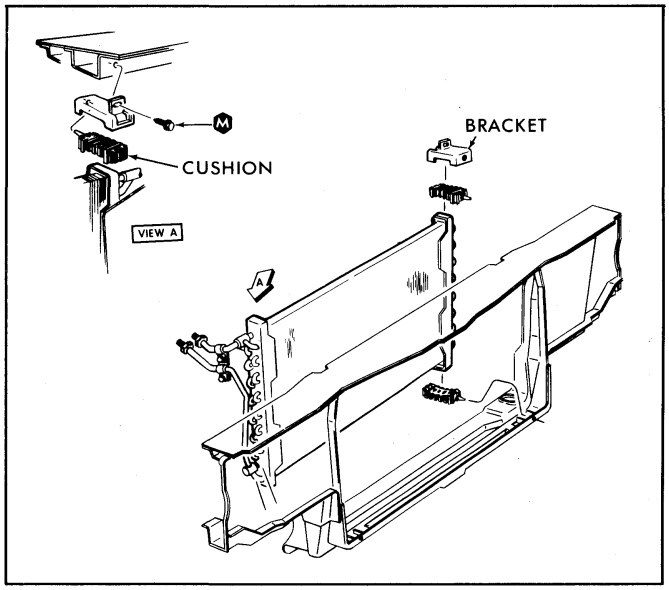


Fig. 1-51 Condenser Mounting

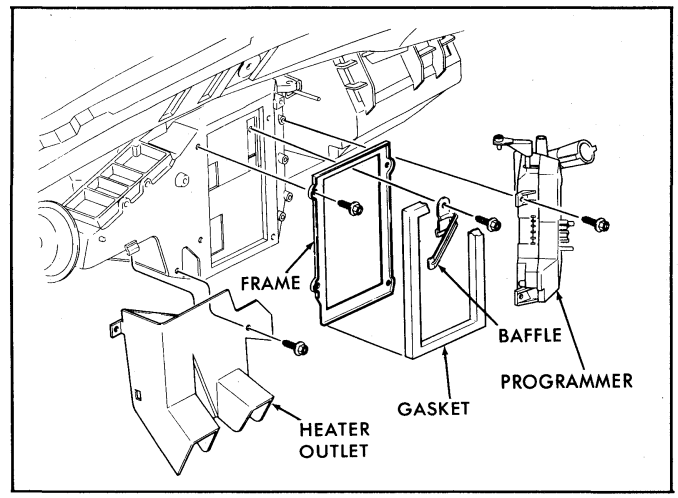


Fig. 1-52 Programmer Installation

LOW PRESSURE SWITCH - EARLY MODELS (Fig. 1-12)

Remove - Replace

1. Discharge refrigerant system as described on page 1-51.

2. Disconnect switch electrical connector.

3. When system is discharged completely, remove switch by rotating in a counterclockwise direction.

4. Check switch cavity for dirt or foreign material and clean as necessary.

5. Install new switch and electrical connector using new "O" ring.

6. Pressurize system with refrigerant vapor to 170 kPa ± 35 kPa (25 psi ± 5 psi) and check for continuity through switch, terminal to switch housing. The switch contacts must close or open on pressure rise or decrease between 135 kPa-205 kPa (20-30 psi).

7. Evacuate, recharge and leak test refrigerant system as described beginning on page 1-51.

8. Check system operation.

CONDENSER

a. Removal

1. Remove radiator as described on page 6B-9.

NOTE: In order to perform certain engine operations, it is necessary to move the condenser out of the way. This can be done by removing the two upper bracket mounting screws (metric) and pivoting the condenser out of the radiator support. Allow condenser to rest lightly on the lines and secure in this position by fastening to hood.

2. Purge refrigeration system as described on page 1-51.

3. Remove two upper mounting bracket screws (metric) and remove condenser from position in radiator support, Fig. 1-51.

b. Installation

1. Add refrigerant oil as described on page 1-52.

2. Position condenser over cushions in radiator support as shown in Fig. 1-51.

3. Position two upper mounting brackets and secure with two screws (metric).

4. Evacuate refrigeration system as described on page 1-51.

5. Charge system with refrigerant as described on page 1-52 and leak test condenser connections as described on page 1-53.

6. Install radiator as described on page 6B-9.

ACCUMULATOR

a. Removal

1. Discharge refrigeration system as described on page 1-51. While system is discharging, clean surface dirt from line connection areas. Blow any loose dirt away with an air hose.

2. When system is completely discharged (high and low sides), loosen evaporator inlet and outlet connection nuts at accumulator.

CAUTION: *All line connections and accumulator openings must be plugged or sealed immediately to prevent entry of dirt and moisture into system.*

3. Remove accumulator mounting clamp (1 screw) from module and remove accumulator.

b. Installation

1. Before installing accumulator, obtain set of new line connection O-rings. Lubricate all new O-rings liberally with clean refrigerant oil.

CAUTION: *When making connections use care to avoid nicking O-rings or cross threading connection threads.*

2. Remove plugs from evaporator inlet and outlet tubes and accumulator openings. Install new O-rings and position accumulator to evaporator tubes. Start evaporator tube nuts and install mounting clamp.

3. Tighten evaporator inlet connection to 20 ft.lbs. torque and evaporator outlet connection to 30 ft. lbs. torque.

4. Evacuate, leak check and charge refrigerant system, as described beginning on page 1-51.

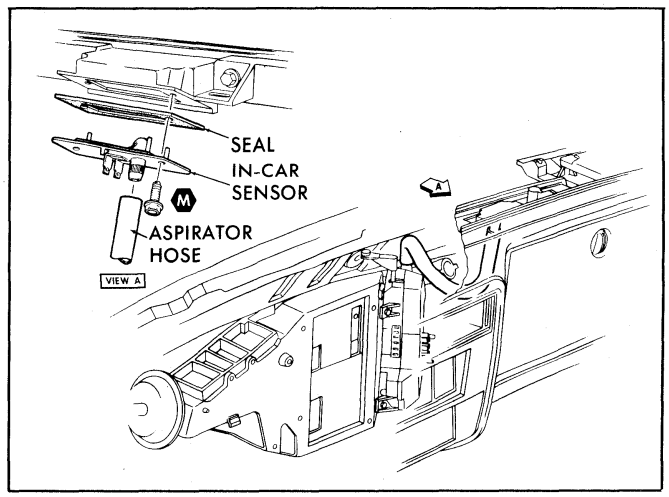


Fig. 1-53 In-Car Sensor Mounting

PROGRAMMER

a. Removal

1. Open glove compartment door and remove compartment liner as described on page 8-11. Remove programmer insulating cover by removing two attachment screws.

2. Disconnect vacuum harness from programmer vacuum valve.

3. Disconnect electrical connectors from programmer.

4. Disconnect door link from programmer output shaft by prying rod from retainer.

5. Remove three screws securing programmer to heater case and remove programmer, Fig. 1-52.

b. Installation

1. Position programmer to heater case - secure with three screws. Install insulating cover and secure with two screws.

2. Connect electrical connectors to programmer.

3. Connect vacuum harness to programmer vacuum valve. Secure harness with clips on pins of valve.

4. Adjust air mix door as described on page 1-54.

5. Install glove compartment liner as described on page 8-11.

BLOWER MOTOR

a. Removal

1. Disconnect negative battery cable.

2. Remove rubber cooling hose from nipple and blower motor.

3. Disconnect electrical connector at lead to motor.

4. Remove six screws securing blower to case and remove blower.

b. Installation

1. Place a bead of sealer around opening where blower will contact case.

2. Guide blower motor against cowl and place on locating dowel.

3. Install six screws securing blower to case.

4. Connect electrical connector at lead to motor.

5. Install cooling hose on motor and nipple.

IN-CAR SENSOR (Fig. 1-53)

a. Removal

1. Remove instrument panel top cover as described on page 8-2.

2. Remove right telltale housing as described on page 8-4.

3. Remove two screws securing sensor to housing.

4. Disconnect aspirator hose and electrical connector and remove sensor.

NOTE: Sensor must be reinstalled exactly as removed, see Fig. 1-53.

b. Installation

1. Connect aspirator hose and electrical connector.

2. Position sensor on housing (with electrical connector toward right side of car) and secure with two screws.

3. Install right telltale as described on page 8-4.

4. Install instrument panel top cover as described on page 8-2.

CONTROL HEAD

a. Removal

1. Disconnect negative battery cable.

2. Remove center instrument panel bezel as described on page 8-8.

3. Remove two control to instrument panel mounting screws.

4. Remove control from panel and disconnect vacuum connector, electrical connector and bulb.

b. Installation

1. Connect vacuum connector, electrical connector and bulb to control.

2. Install control to instrument panel and attach with two mounting screws.

3. Install center instrument panel bezel as described on page 8-8.

4. Connect negative battery cable. Tighten to 70 inch pounds.

EXPANSION TUBE

a. Removal

1. Purge the system as described on page 1-51.

2. Disconnect the evaporator inlet line.

3. Using needle nose pliers, grip the plastic tip of the expansion tube and remove the expansion tube and "O" ring from the inlet line.

b. Installation

1. Coat a new expansion tube "O" ring with clean 525 viscosity refrigeration oil and position on tube.

2. Insert the expansion tube into the inlet line with short end first and push until the tube reaches a firm stop. This indicates proper seating of the "O" ring.

REFERENCE DRAWINGS

The following drawings, Fig. 1-54 through Fig. 1-57, are presented to show proper assembly position, hose routing, etc. and may prove valuable for diagnosis as well as installation reference.

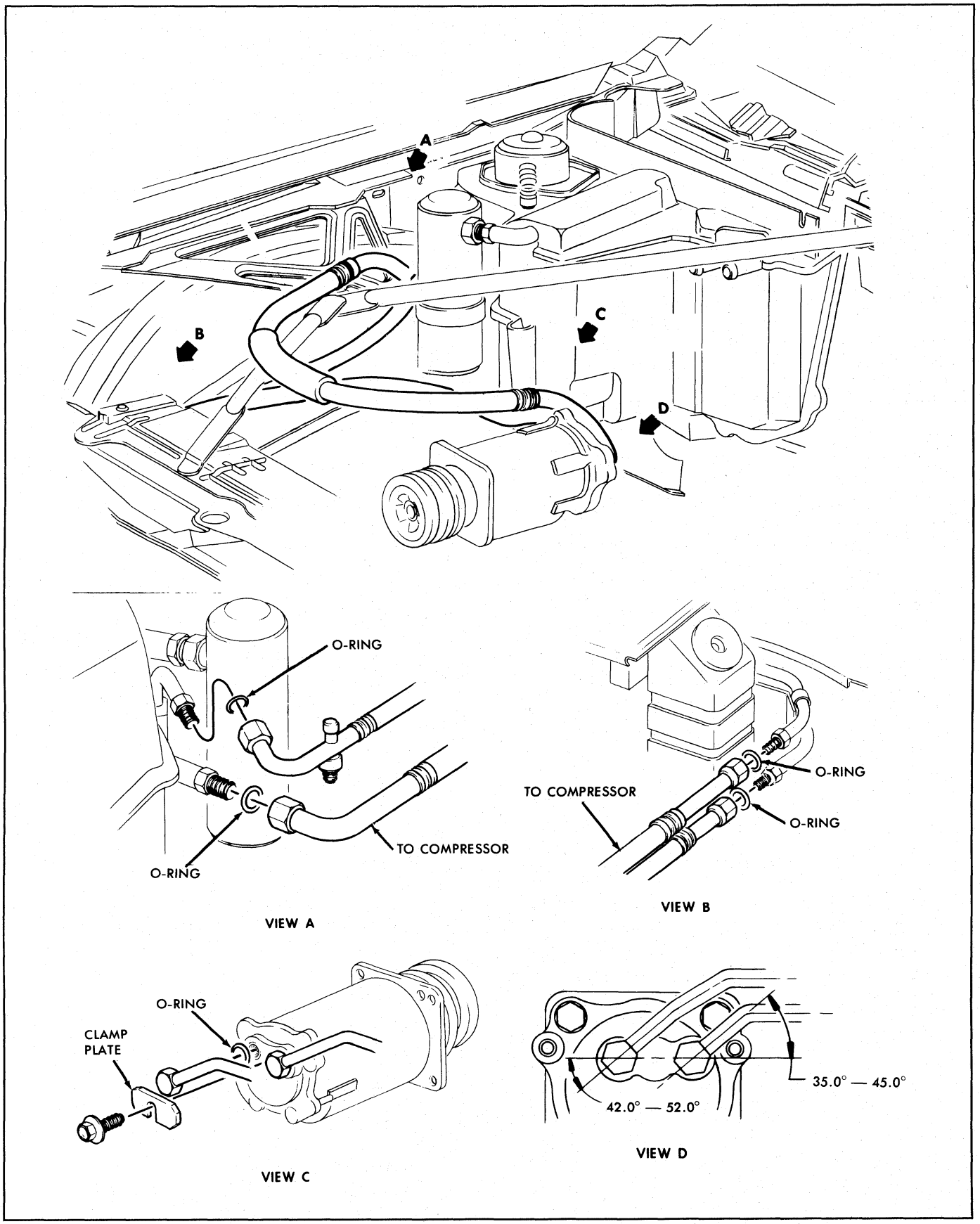


Fig. 1-54 Refrigerant Hose Routing

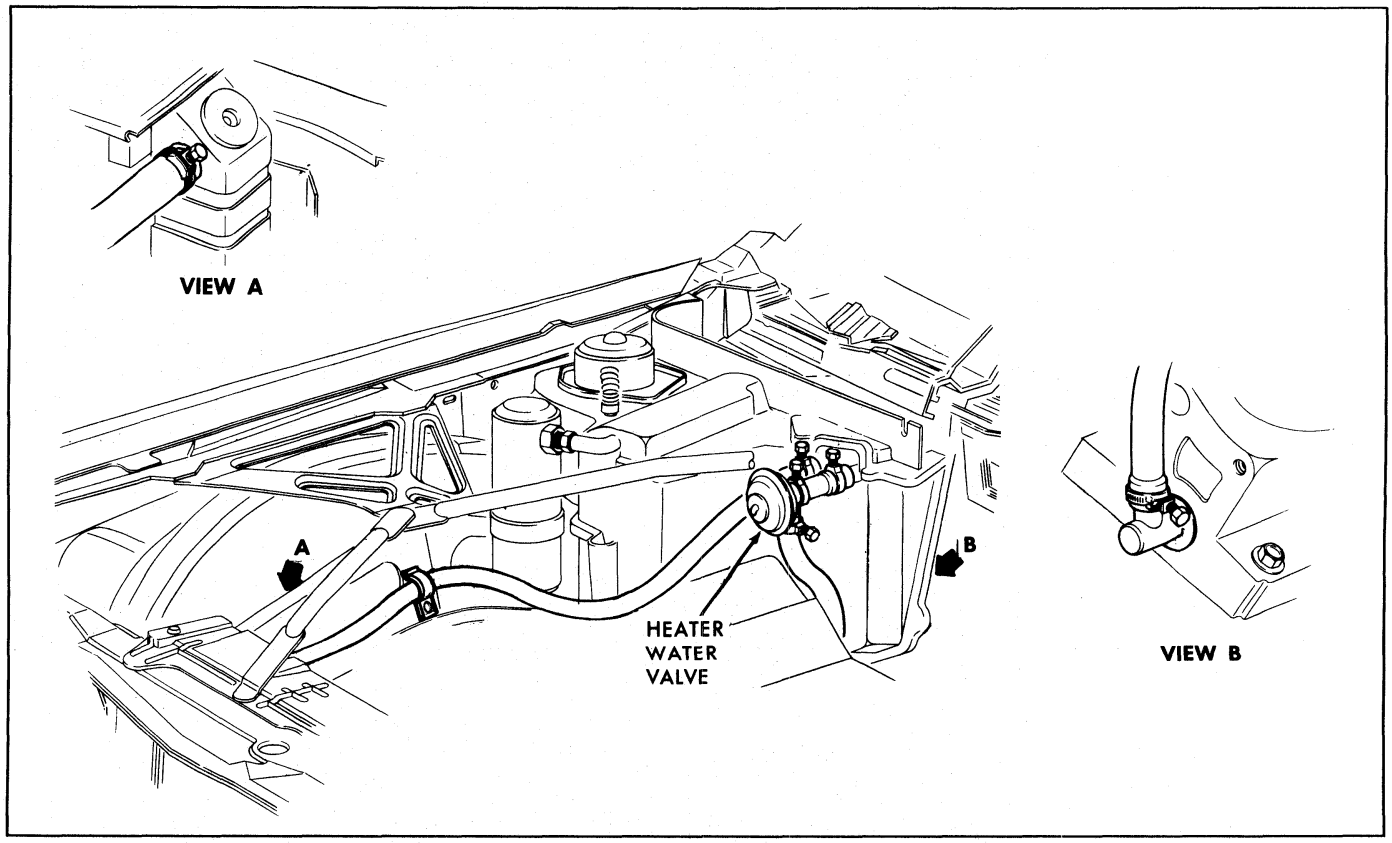


Fig. 1-55 Heater Hose Routing

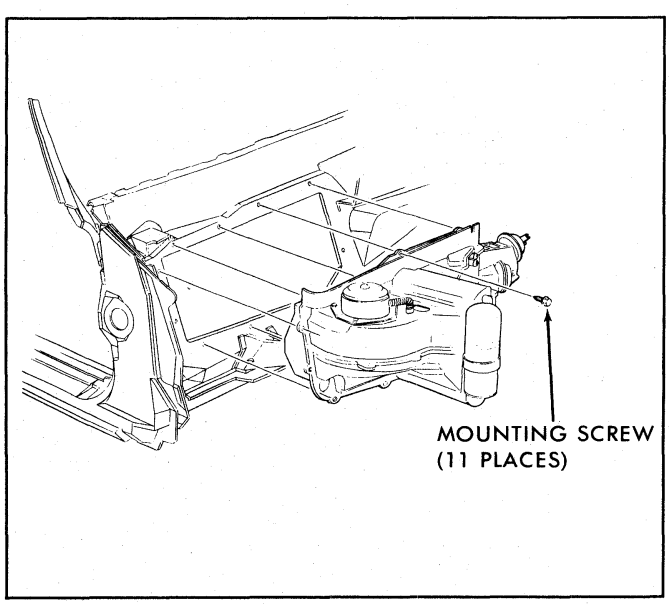


Fig. 1-56 ATC Module Installation

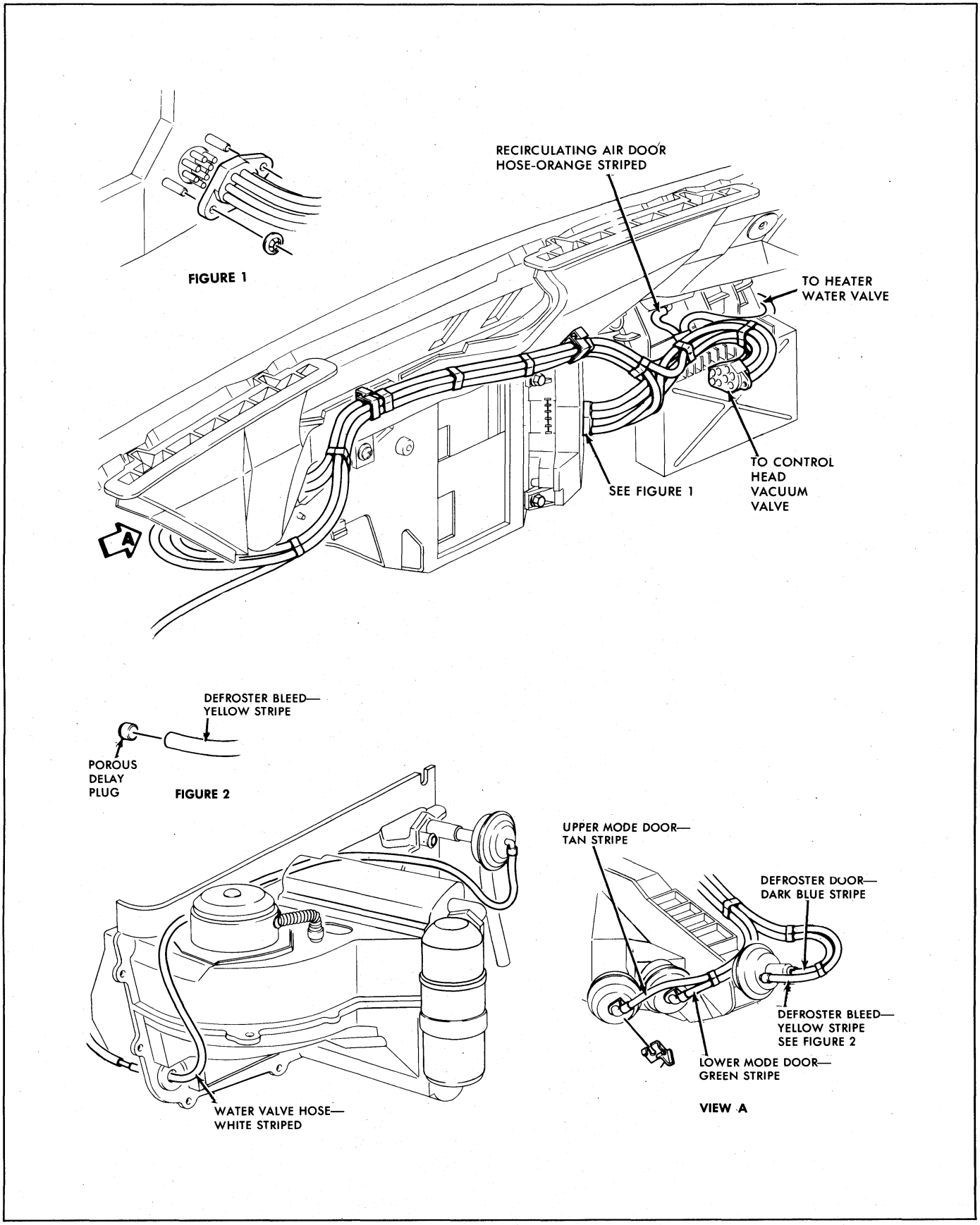


Fig. 1-57 Vacuum Harness Routing

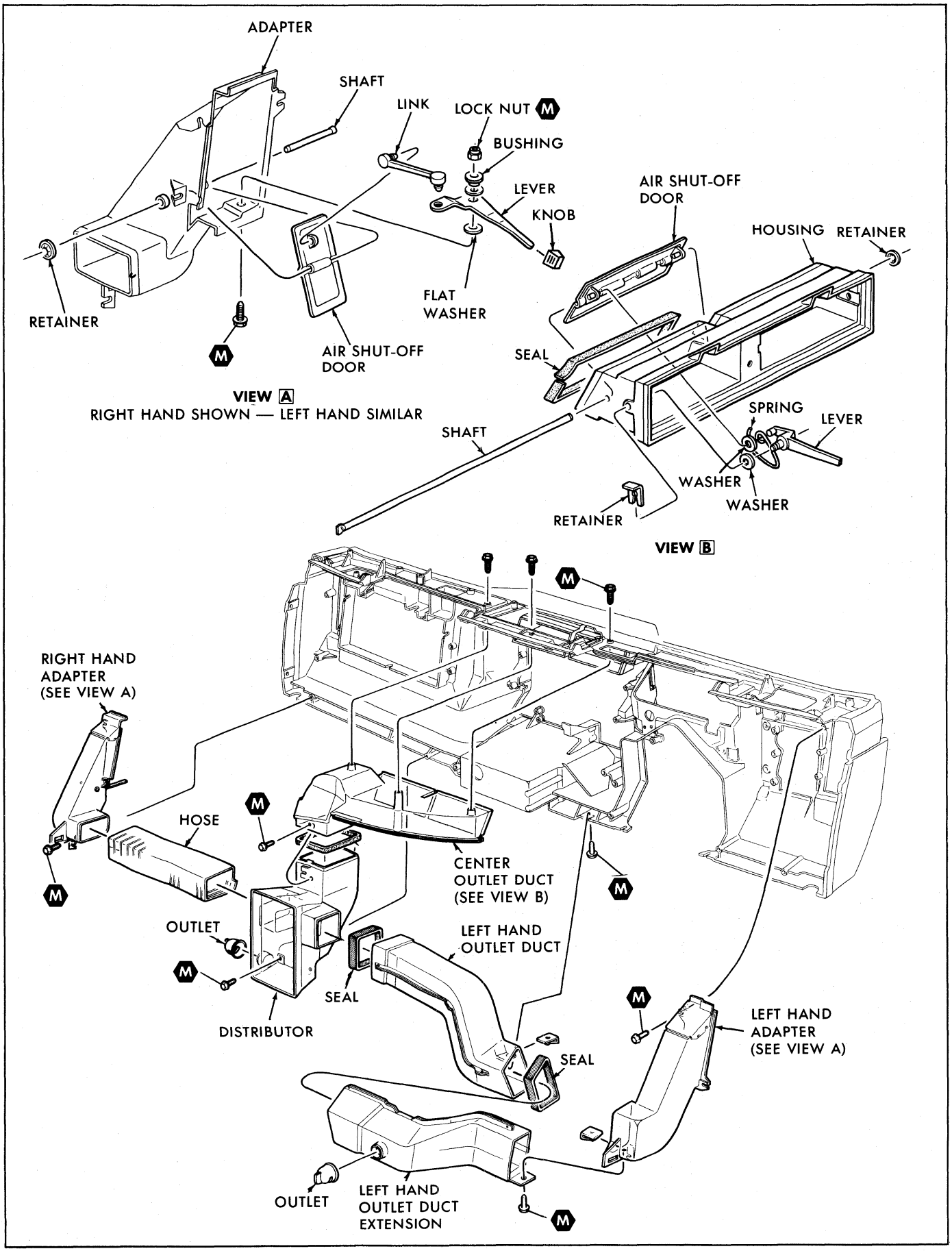


Fig. 1-58 A/C Ducts

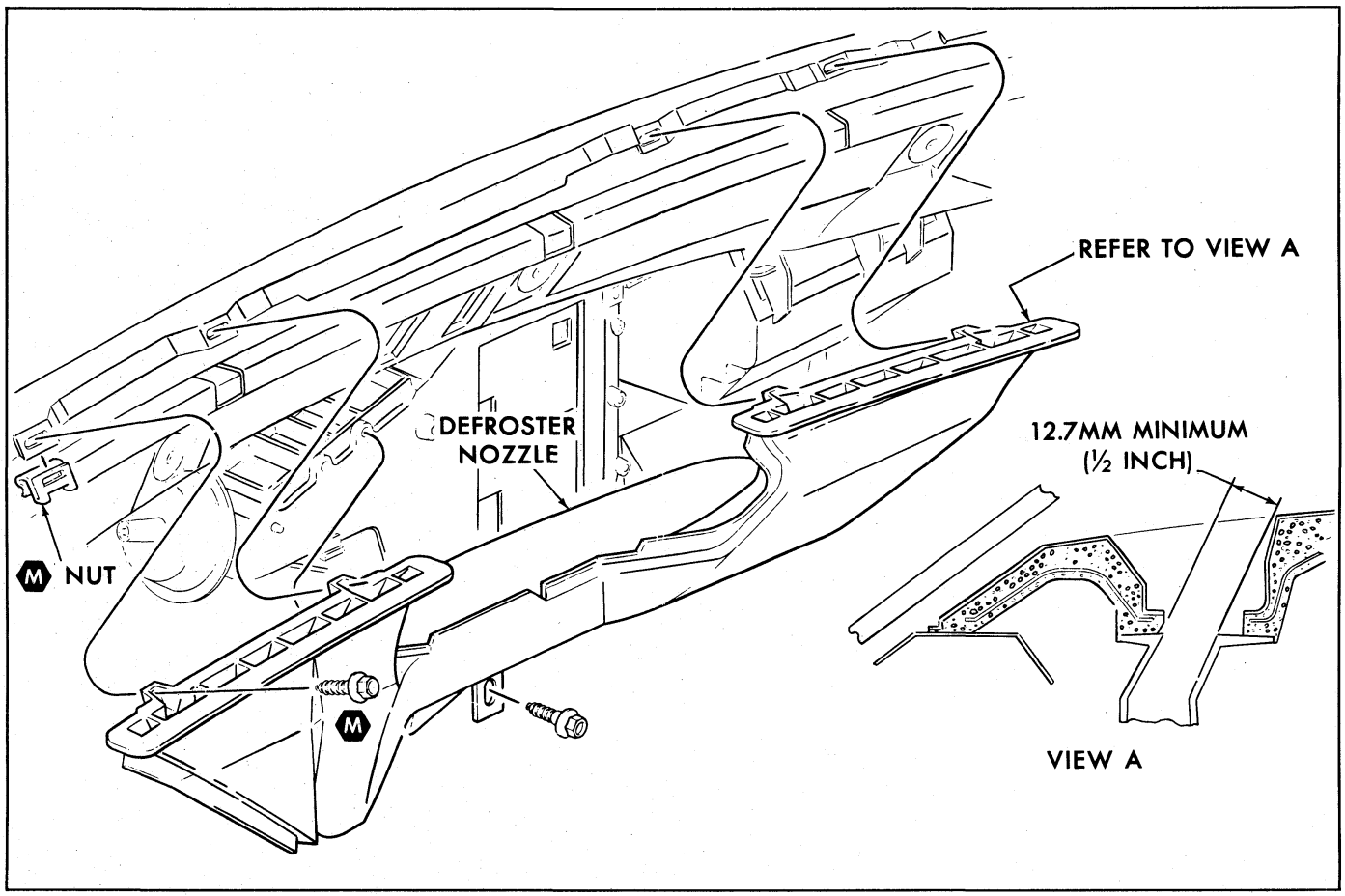


Fig. 1-59 Defroster Nozzle

UNIT REPAIR

PROGRAMMER

Fig. 1-60 shows the physical location of the components discussed in this procedure. This figure also illustrates correct vacuum hose routing. The following procedures assume that the programmer has been removed from the vehicle.

a. Checking Relay

The position of the checking relay is determined entirely by its vacuum hoses. Refer to Fig. 1-60 for proper hose routing and hose connections.

b. Vacuum Motor and Output Shaft Mechanism Removal

1. Remove programmer cover.
2. Remove two screw/studs securing vacuum valve and swing vacuum valve out of way with hoses still attached.
3. Remove vacuum valve actuating link and spring.4. Mark a tooth on the feedback pot and a corresponding notch on the blower circuit board gear.
5. Remove one screw securing blower circuit board to programmer case and remove blower circuit board.
6. Disconnect vacuum hose from vacuum motor.
7. Disconnect vacuum motor spring from notch in lower output shaft retainer.
8. Remove two screws securing upper output shaft retainer and remove retainer.
9. Remove two screws securing lower output shaft retainer.
10. Pull vacuum motor away from programmer chassis and remove vacuum-motor-output-shaft assembly and lower retainer.

c. Vacuum Motor and Output Shaft Mechanism Installation

1. Position vacuum-motor-output-shaft assembly to programmer chassis making sure that vacuum motor linkage pin engages output shaft lever.
2. Position lower output shaft retainer to programmer chassis so that it guides output shaft and engages pins on programmer chassis.
3. Position upper output shaft retainer to programmer chassis and secure both retainers with two screws.
4. Push vacuum motor into position by engaging tabs on programmer chassis.
5. Connect vacuum hose to vacuum motor and vacuum motor spring to lower output shaft retainer.
6. Position blower circuit board to programmer chassis so that reference marks made during disassembly are aligned. Secure with one screw.
7. Install spring and vacuum valve actuating link over

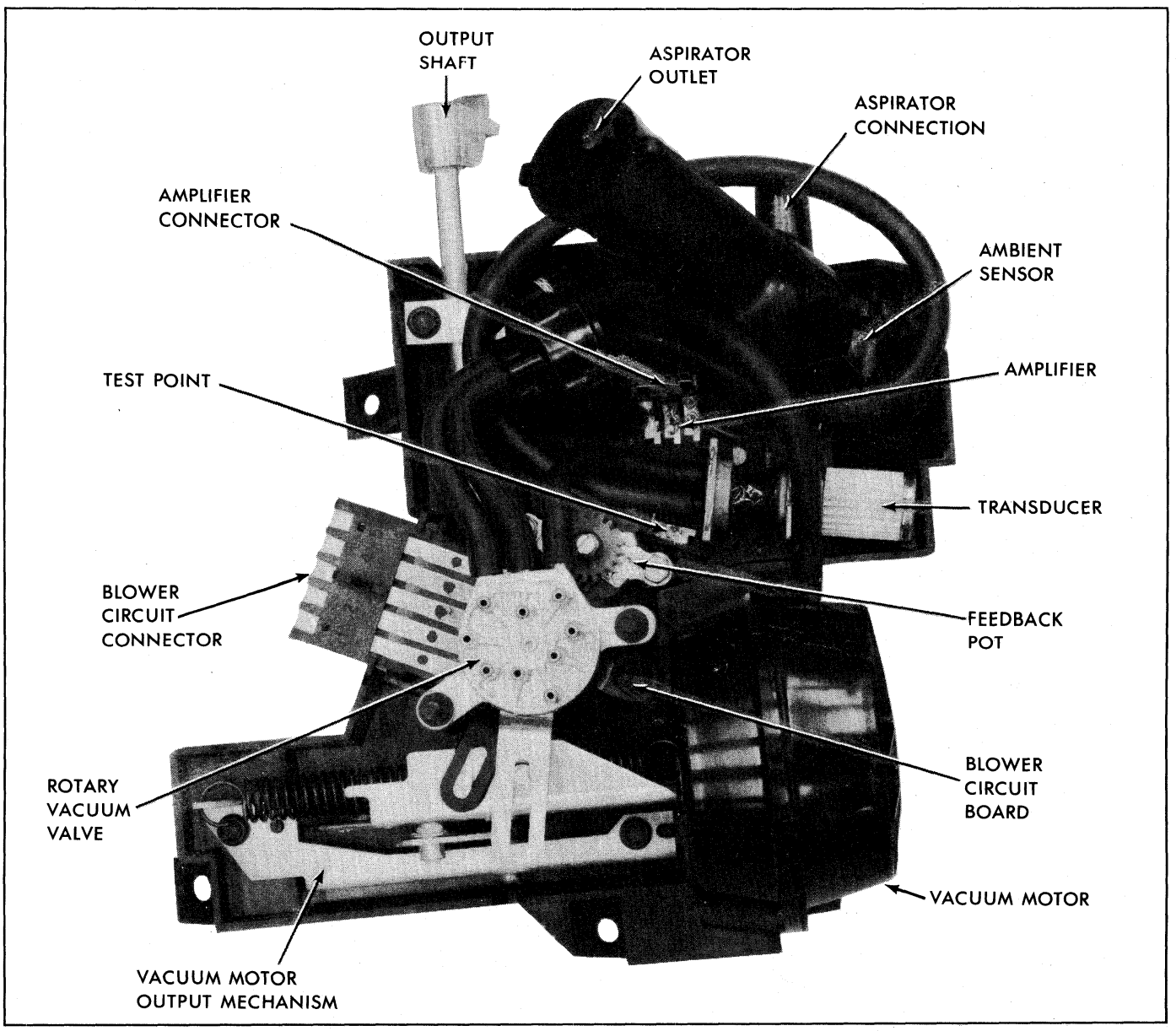


Fig. 1-60 Programmer

circuit board gear and swing vacuum valve into position so that actuating link engages both vacuum valve and vacuum motor linkage, Fig. 1-60.

8. Secure vacuum valve with two screws.

9. Install programmer cover.

d. Blower Circuit Board Removal

1. Remove programmer cover.

2. Remove two screw/studs securing vacuum valve and swing vacuum valve out of way with hoses still attached.

3. Remove vacuum valve actuating link and spring.

4. Mark a tooth on the feedback pot and a corresponding notch on the blower circuit board gear.

5. Remove one screw securing blower circuit board to programmer case and remove blower circuit board.

e. Blower Circuit Board Installation

1. Position blower circuit board to programmer chassis so that circuit board gear engages feedback pot at approximately the same position as reference mark made during disassembly.

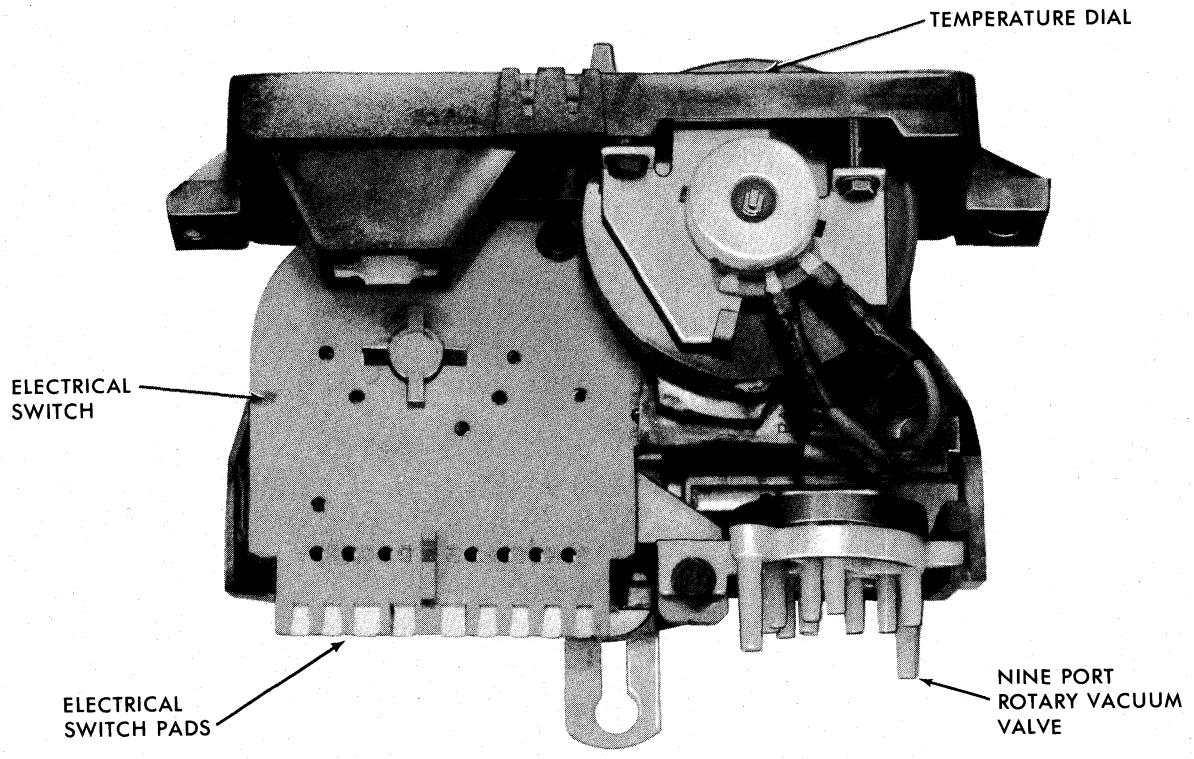
2. Install spring and vacuum valve actuating link over circuit board gear and swing vacuum valve into position so that actuating link engages both vacuum valve and vacuum motor linkage, Fig. 1-60.

3. Secure vacuum valve with two screws.

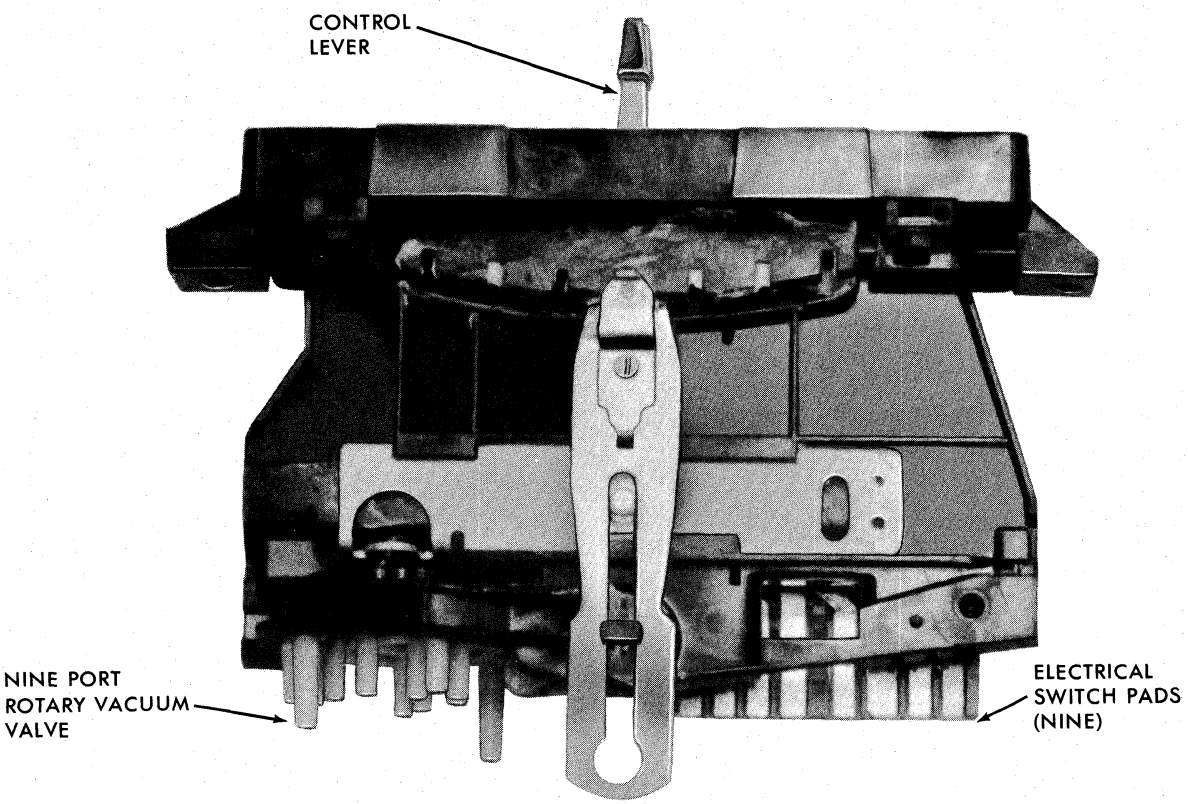
4. Install programmer to vehicle as described on page 1-59.

5. Adjust feedback pot as described on page 1-54.

6. Install programmer cover.



TOP VIEW



BOTTOM VIEW

Fig. 1-61 Control Panel

f. Programmer Vacuum Valve Removal

1. Remove programmer cover.
2. Remove three vacuum hoses from valve.

g. Programmer Vacuum Valve Installation

1. Position vacuum valve to programmer so that actuating link engage both valve and vacuum motor linkage, Fig. 1-60.
2. Secure vacuum valve with two screw/studs.
3. Install vacuum hoses to vacuum valve as shown in Fig. 1-60.
4. Install programmer cover.

h. Amplifier-Transducer-Ambient Sensor Removal

1. Remove programmer cover.
2. Remove vacuum hoses from transducer and vacuuum motor. Position checking relay out of way.
3. Remove programmer vacuum valve as described in part F.
4. Mark a tooth on the feedback pot and a corresponding notch on the blower circuit board gear.
5. Remove tape from ambient sensor opening in aspirator tube.
6. Remove three screws securing amplifier assembly and remove.
7. Remove connector from circuit board terminals.

i. Amplifier-Transducer-Ambient Sensor Installation

1. Position ambient sensor for insertion into aspirator.
2. Install electrical connector body over amplifier assembly terminals.
3. Position circuit board to programmer chassis with ambient sensor located in aspirator tube and secure with three screws.
4. Seal aspirator opening with tape.
5. Install programmer vacuum valve as described in part G.
6. Route vacuum hoses as shown in Fig. 1-60 and position checking relay.
7. Connect vacuum hoses at transducer and vacuum motor.
8. Install programmer as described on page 1-60.
9. Adjust feedback pot as described on page 1-54.
10. Install programmer cover.

CONTROL PANEL

Fig. 1-61 shows the components discussed in these procedures. All procedures assume that the control head is removed from the vehicle.

a. Temperature Dial

The temperature is secured to the panel face with two screws. Position of the wires on assembly is not significant.

b. Vacuum Valve

To remove vacuum valve remove retaining screw and with control lever in "Auto," work valve out of retainer.

c. In-Car Switch

The in-car switch is removed by depressing the connector lock handle after the circuit board is removed. The switch has soldered connections.

d. Circuit Board

Circuit board removal is accomplished after the vacuum valve is removed by removing one screw and working the circuit board away from the control head chassis.

COMPRESSOR SERVICE

Compressor Overhaul

For compressor removal and installation, see page 1-55. All vehicles use the same air conditioning 6 cylinder compressor. Actual differences between compressors are found in their system refrigerant charge label only which will not affect the following overhaul procedures.

MINOR REPAIR PROCEDURES

The following operations to the Compressor Clutch Plate and Hub, Pulley and Bearing, and Coil Housing are covered as "Minor" because they may be performed WITHOUT FIRST PURGING THE SYSTEM OR REMOVING THE COMPRESSOR from the vehicle.

The Compressor Shaft Seal assembly, Pressure Relief Valve and Low Pressure Switch may also be serviced WITHOUT REMOVING THE COMPRESSOR from the vehicle but these operations are covered later in this section as "Major Repair Procedures" because the system MUST FIRST BE PURGED of Refrigerant.

Illustrations used in describing these operations show the compressor removed from the vehicle only to more clearly illustrate the various operations.

When servicing the compressor, remove only the necessary components that preliminary diagnosis indicates are in need of service. Refer to Fig. 1-62 and Fig. 1-63 for information relative to parts nomenclature and location.

Removal and installation of external compressor components and disassembly and assembly of internal components must be performed on a clean workbench. The work area, tools, and parts must be kept clean at all times. Parts Tray J-9402 (Fig. 1-95) should be used for all parts being removed, as well as for replacement parts.

Although certain service operations can be performed without completely removing the compressor from the car, the operations described herein are based on bench over-haul with the compressor removed from the car. They have been prepared in sequence in order of accessibility of the components.

Remove compressor as described on page 1-55 and position out of way.

CAUTION: *Do not kink or place excessive tension on lines or hoses.*

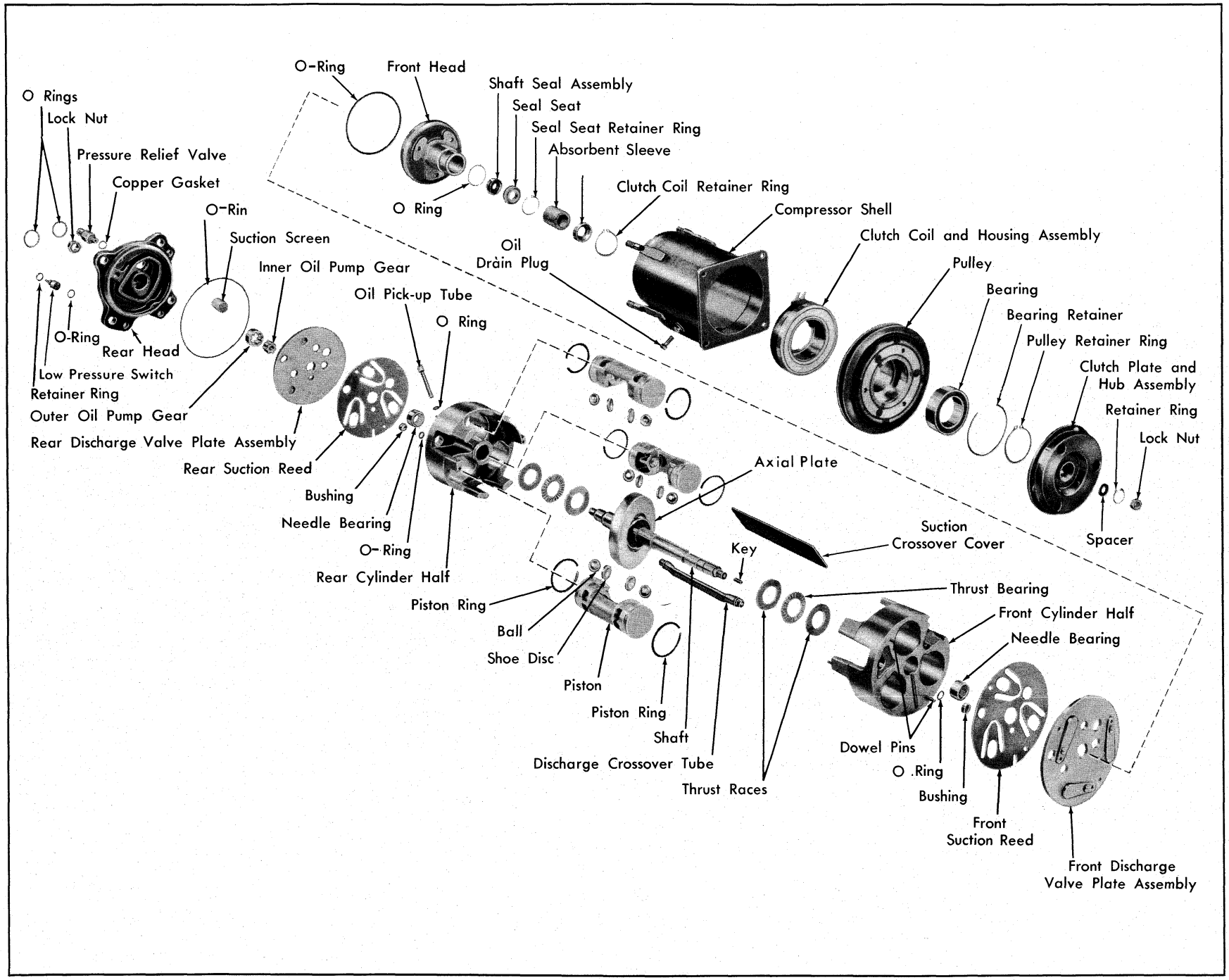


Fig. 1-62 Exploded View of Compressor

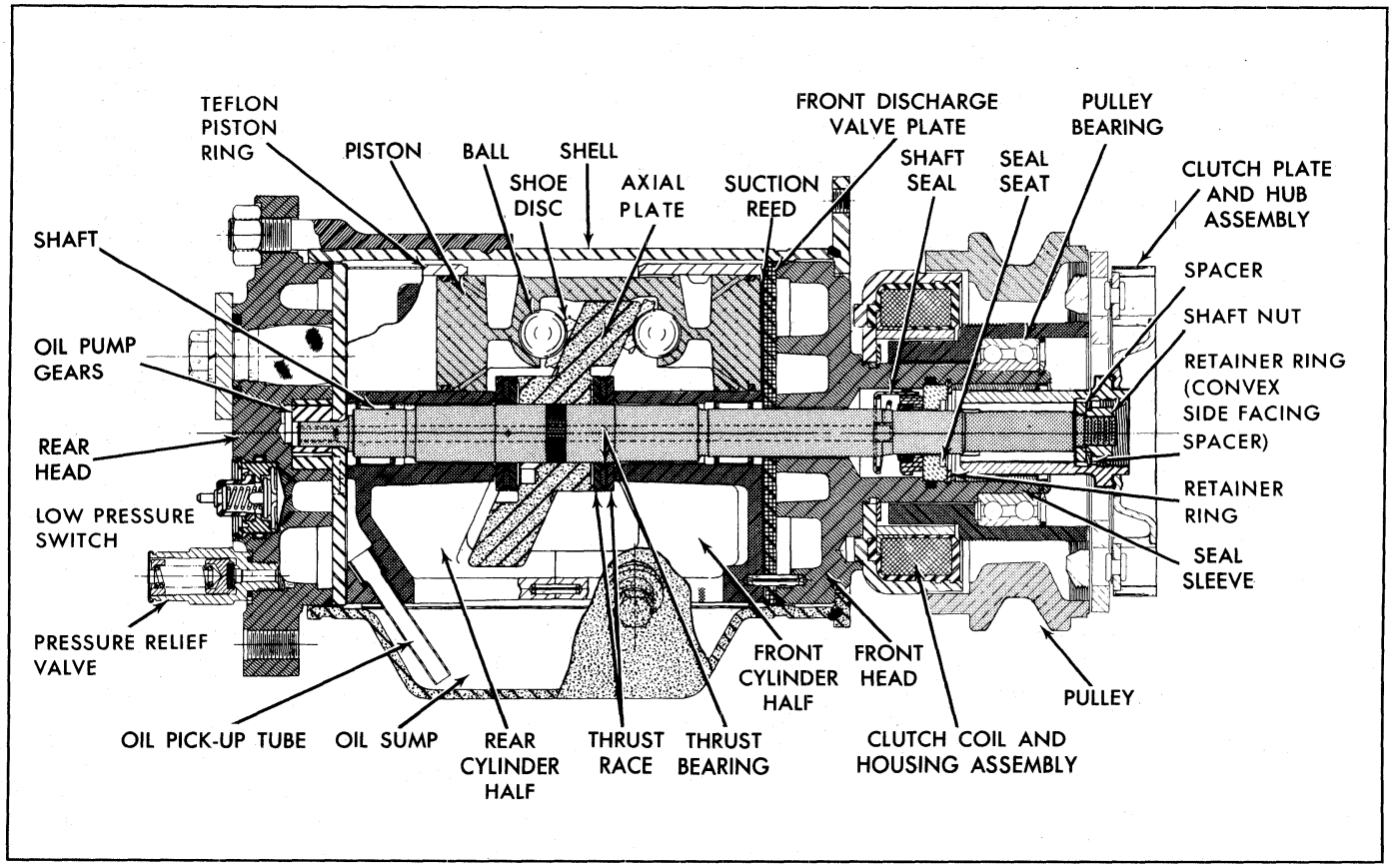


Fig. 1-63 Compressor Cross Section

Oil Replacement (Fig. 1-64)

When a compressor is removed from the car for servicing, the amount of oil remaining in the compressor should be drained and measured. This oil should then be discarded and new 525 viscosity refrigerant oil added to the compressor.

IF EITHER THE ACCUMULATOR OR THE COMPRESSOR IS TO BE REPLACED OR IF THERE ARE SIGNS OF ABUNDANT OIL LEAKAGE, THEN BOTH ACCUMULATOR AND COMPRESSOR must be removed -- oil drained --and measured to determine correct quantity of oil replacement for the system. If the amount of oil recovered is 4 oz. or more, replace with a like amount of new oil. If less than 4 oz. are recovered, add 6 oz. of new oil.

NOTE: A good system will have 6 ounces of oil found in the accumulator and/or compressor. Neither necessarily has 3 ounces - could be more or less. This is why BOTH have to be measured.

New compressors are shipped with 10 ounces of oil already inside. Therefore, when installing a new compressor, drain and measure the oil in both the new and old compressors and fill the new compressor with an amount of oil equal to what was drained from the old compressor.

Compressor Clutch Plate and Hub Assembly

a. Removal

1. Place Holding Fixture J-9396 in a vise and clamp the compressor in the holding Fixture.

2. Keep clutch hub from turning with Clutch Hub Holder J-25030 or J-9403, and remove locknut from end of shaft using Thin Wall Socket J-9399 (Fig. 1-65).

CAUTION: *To avoid internal damage to the compressor, DO NOT DRIVE OR POUND on the Clutch Plate and Hub assembly OR on the end of the shaft. If proper tools to remove and replace clutch parts are not used, it is possible to disturb the position of the axial plate (keyed to the main shaft), resulting in compressor damage and seal leakage due to shifting of the crankshaft.*

3. Thread Clutch Plate and Hub assembly Remover J-9401 into hub. Hold body of Remover with a wrench and tighten center screw to remove Clutch Plate and Hub Assembly (Fig. 1-66).

4. Remove square drive key from shaft or drive plate hub.

5. Remove hub spacer retainer ring using Snap-Ring Pliers J-5403 (#21), and then remove hub spacer (Fig. 1-67).

6. Inspect driven plate for cracks or stresses in the drive surface. Do not replace driven plate for a scoring condition (Fig. 1-68).

If the frictional surface shows signs of damage due to excessive heat, the clutch plate and hub and pulley and bearing should be replaced. Check further for the underlying cause of the damage (i.e. low coil voltage - coil should draw 3.2 amps at 12 volts - or binding of the compressor internal mechanism, clutch air gap too wide, broken drive plate to hub asm. springs), etc.

b. Installation

1. Insert the square drive key into the hub of driven plate: allow it to project approximately 3/16" out of the keyway.

UNIT	IF THERE ARE NO SIGNS OF EXCESSIVE OIL LEAKAGE, ADD OIL AS SHOWN FOR PART BEING REPLACED.	ADD OIL
CONDENSOR		1 OUNCE
EVAPORATOR		3 OUNCES
ACCUMULATOR		1 OUNCE

COMPRESSOR CONDITION	AMOUNT OF OIL DRAINED FROM COMPRESSOR AND ACCUMULATOR	AMOUNT OF OIL TO INSTALL
REPLACING COMPRESSOR WITH A NEW COMPRESSOR.	MORE THAN – 4 OZ.	*DRAIN NEW COMPRESSOR, REFILL WITH NEW OIL (SAME AMOUNT AS DRAINED FROM OLD COMPRESSOR AND ACCUMULATOR).
	LESS THAN – 4 OZ.	**DRAIN NEW COMPRESSOR. INSTALL NEW OIL IN NEW COMPRESSOR – 6 OZ.
REPLACING COMPRESSOR WITH A SERVICE REBUILT COMPRESSOR.	MORE THAN – 4 OZ.	*SAME AS ABOVE PLUS AN ADDITIONAL OUNCE (MORE OIL IS RETAINED IN A DRAINED COMPRESSOR THAN ONE THAT HAS BEEN REBUILT).
	LESS THAN – 4 OZ.	**SAME AS ABOVE PLUS AN ADDITIONAL OUNCE.
UNABLE TO RUN COMPRESSOR BEING REPLACED, PRIOR TO REMOVAL FROM CAR.	MORE THAN – 1-1/2 OZ. AND SYSTEM APPEARS TO HAVE LOST LITTLE OR NO OIL	*SAME AS ABOVE.
		**SAME AS ABOVE.
	LESS THAN – 1-1/2 OZ. OR SYSTEM APPEARS TO HAVE LOST MAJOR AMOUNT OF OIL.	
CONTAMINATED OIL DRAINED FROM SYSTEM.	ANY AMOUNT	DRAIN AS MUCH OIL AS POSSIBLE FROM SYSTEM. FLUSH SYSTEM WITH REFRIGERANT-11. REPLACE ACCUMULATOR AND INSTALL NEW 525 VISCOSITY OIL IN NEW COMPRESSOR: COMP. 10-1/2 OZS.

NOTE: ADD ONE ADDITIONAL FLUID OUNCE IF REPLACING AN ACCUMULATOR. THIS IS TO REPLACE AMOUNT CAPTURED IN OLD DESICCANT.

Fig. 1-64 Compressor Oil Charge for Compressor Unit Replacements

2. Line up the key in the hub with keyway in the shaft (Fig. 1-69).

3. Position the Drive Plate Installer J-9480-1 on the threaded end of the shaft. The Spacer J-9480-2 should be in place under the hex nut on the tool. This tool has a left hand thread on the body. (Fig. 1-70).

4. Press the driven plate onto the shaft until there is approximately 3/32″ space between the frictional faces of the clutch drive plate and pulley.

CAUTION: *Make certain key remains in place when pressing hub on shaft.*

A ZERO thrust race is approximately 3/32″ thick and may be used to roughly gage this operation. Use Clutch Hub Holder J-25030 or J-9403 to hold clutch plate and hub if necessary.

5. Install the hub spacer and, using Snap-Ring Pliers J-5403 (#21), install the retainer ring (see installed Retainer Ring in inset of Fig. 1-63), with convex side of ring facing spacer.

6. Use Thin Wall Socket J-9399 and Clutch Hub Holder J-25030 or J-9403 to install a new shaft locknut with shoulder or circular projection on the locknut facing towards retainer ring. Tighten the nut to 14-26 lb. ft. torque. Air gap between the frictional faces should now be .022″ to .057″ (Fig. 1-71). If not, check for mispositioned key or shaft.

7. The pulley should now rotate freely.

8. Operate the refrigeration system under MAXimum load conditions and engine speed at 2000 RPM. Rapidly cycle the clutch by turning the air conditioning on-and-off at least 15 times at approximately one second intervals to burnish the mating parts of the clutch.

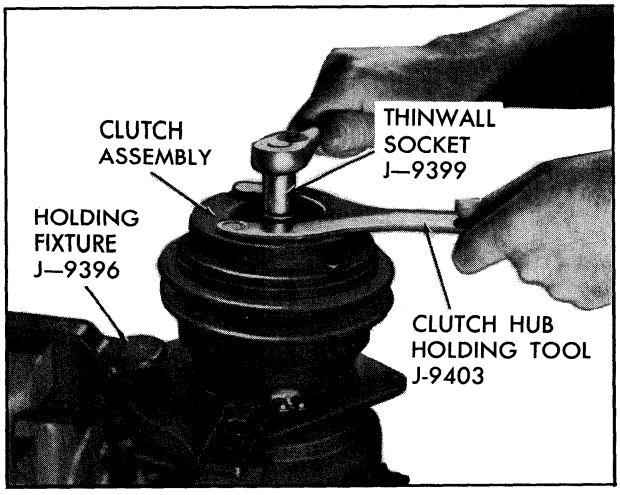


Fig. 1-65 Removing Shaft Lock Nut

Compressor Pulley and Bearing Assembly

a. Removal

1. Remove clutch plate and hub assembly as described above in "Compressor Clutch Plate and Hub Assembly" Removal procedure.

2. Remove pulley retainer ring using Snap-Ring Pliers J-6435 (#26), Fig. 1-72.

3. Pry out absorbent sleeve retainer, and remove absorbent sleeve from compressor neck.

4. Place Puller Pilot J-9395 over end of compressor shaft.

CAUTION: *It is important that Puller Pilot J-9395 be used to prevent internal damage to compressor when removing pulley. Under no circumstances should Puller be used DIRECTLY against drilled end of shaft.*

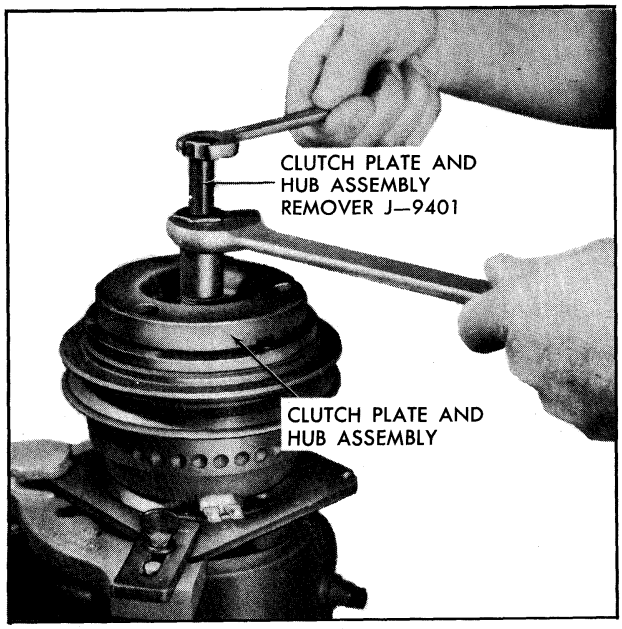


Fig. 1-66 Removing Clutch Plate and Hub Assembly

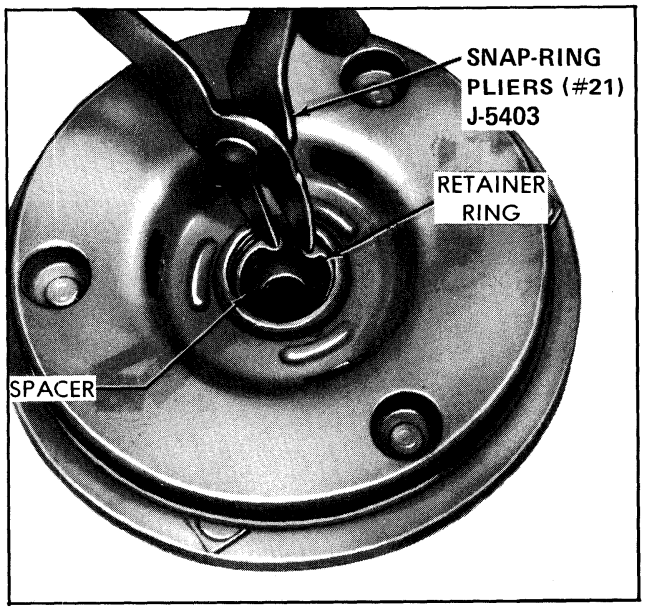


Fig. 1-67 Removing or Installing Retainer Ring In Clutch Drive Plate

5. Remove Pulley and Bearing Assembly using Pulley Puller J-8433 (Fig. 1-73).

Inspection

Check the appearance of the pulley and bearing assembly. See Fig. 1-68. The frictional surfaces of the pulley and bearing assembly should be cleaned with a suitable solvent before reinstallation.

b. Installation

1. If original pulley and bearing assembly is to be reinstalled, wipe frictional surface of pulley clean. If frictional surface of pulley shows any indication of damage due to overheating, the pulley and bearing should be replaced.

2. Check bearing for brinelling, excessive looseness, noise, and lubricant leakage. If any of these conditions exist, bearing should be replaced. See "Compressor Pulley Bearing" Replacement Procedure below.

3. Press or tap pulley and bearing assembly on neck of compressor until it seats, using Pulley and Bearing Installer J-9481 with Universal Handle J-8092 (Fig. 1-74). The Installer will apply force to inner race of bearing and prevent damage to bearing.

4. Check pulley for binding or roughness. Pulley should rotate freely.

5. Install retainer ring, using Snap Ring Pliers J-6435 (#26).

6. Install absorbent sleeve in compressor neck.

7. Install absorbent sleeve retainer in neck of compressor. Using sleeve from Seal Seat Remover-Installer J-23128, install retainer so that outer edge is recessed 1/32" from compressor neck face.

8. Install clutch plate and hub assembly as described above in "Compressor Clutch Plate and Hub Assembly" Replacement Procedure.

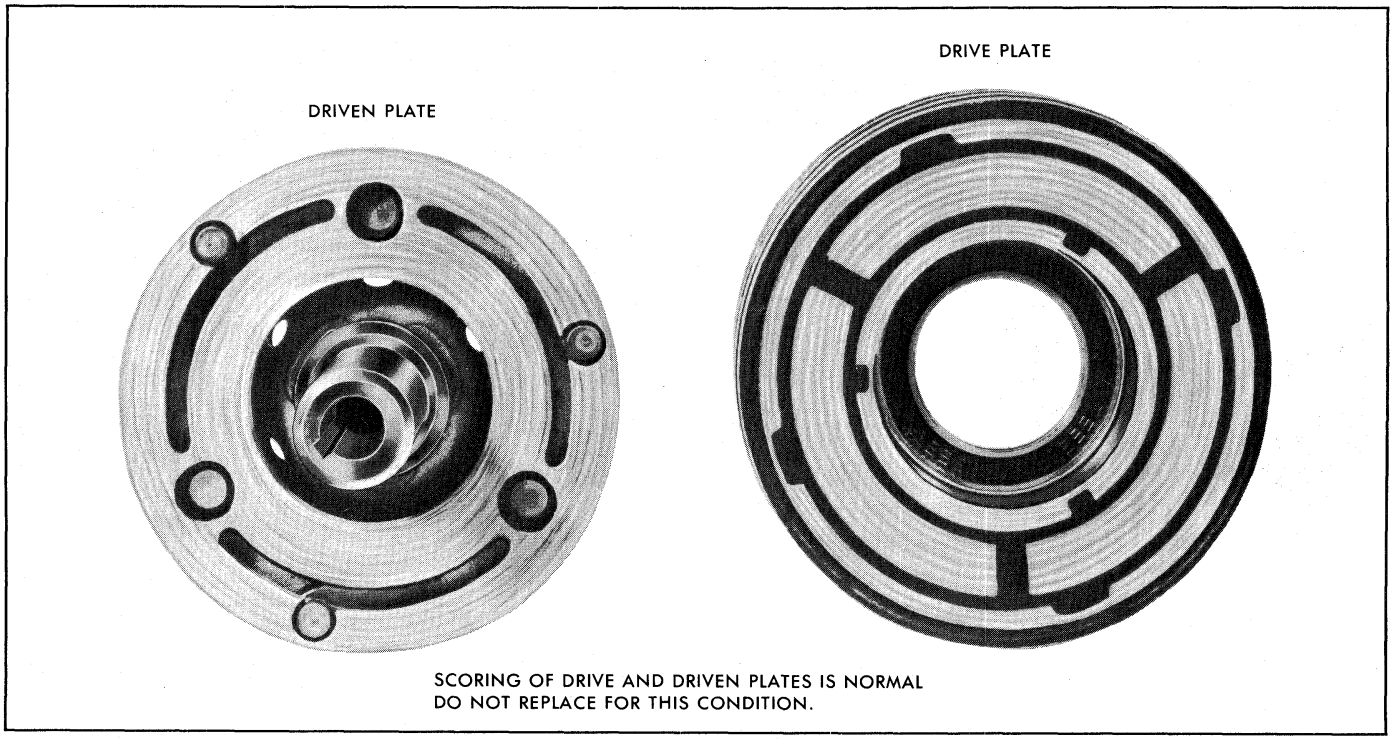


Fig. 1-68 Clutch Driven Plate and Drive Plate

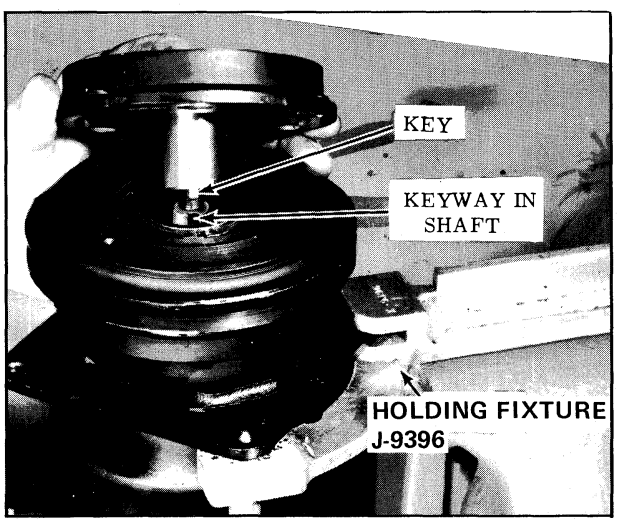


Fig. 1-69 Aligning Drive Plate Key

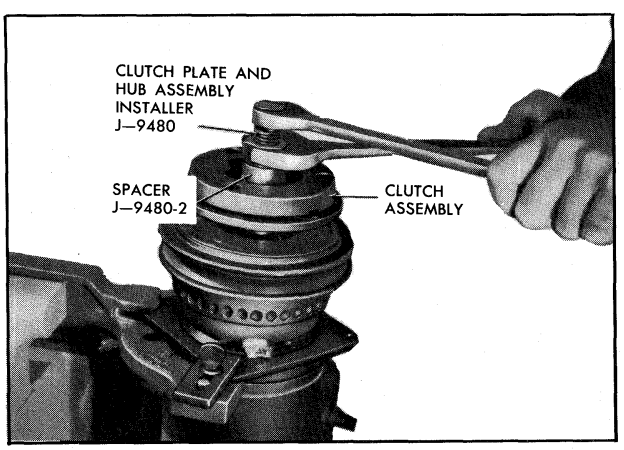


Fig. 1-70 Installing Drive Plate

Compressor Pulley Bearing

a. Removal

1. Remove clutch plate and hub assembly as described above in "Compressor Clutch Plate and Hub Assembly" Removal procedure.

2. Remove pulley and bearing assembly as described above in "Compressor Pulley and Bearing Assembly" Removal procedure.

3. Remove pulley bearing retainer ring with a small screwdriver or pointed tool (Fig. 1-75).

4. Place pulley and bearing assembly on inverted Support Block J-21352 and, using Pulley Bearing Remover J-9398 with Universal Handle J-8092, drive Bearing assembly out of pulley (Fig. 1-76).

b. Installation

Install new bearing in pulley using Pulley and Bearing Installer J-9481 with Universal Handle J-8092 (Fig. 1-77).

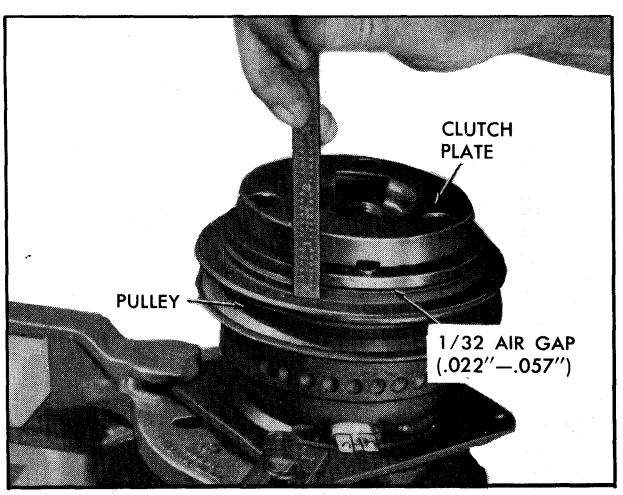


Fig. 1-71 Checking Air Gap

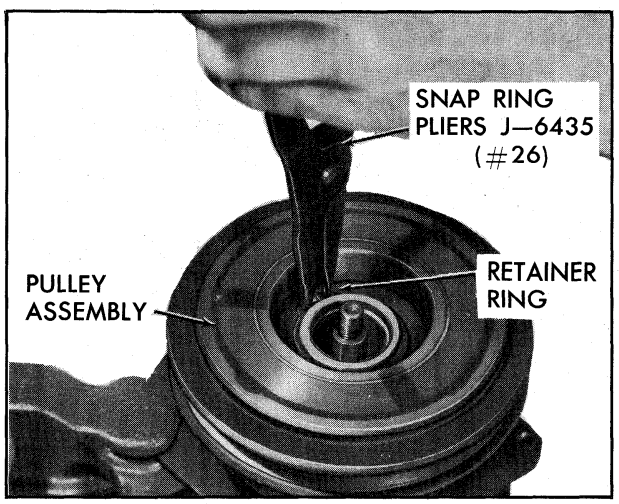


Fig. 1-72 Removing Pulley Retainer Ring

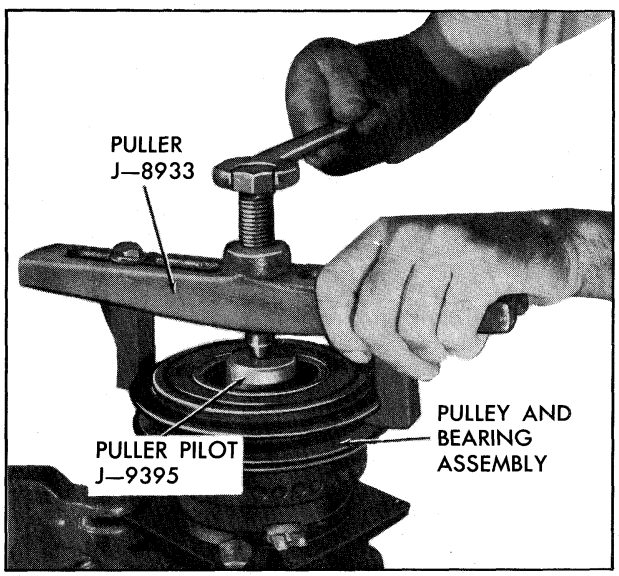


Fig. 1-73 Removing Pulley and Bearing Assembly

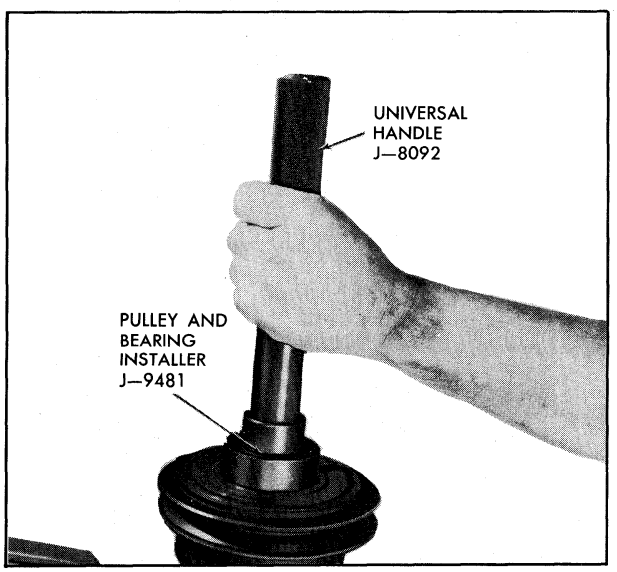


Fig. 1-74 Installing Pulley and Bearing Assembly

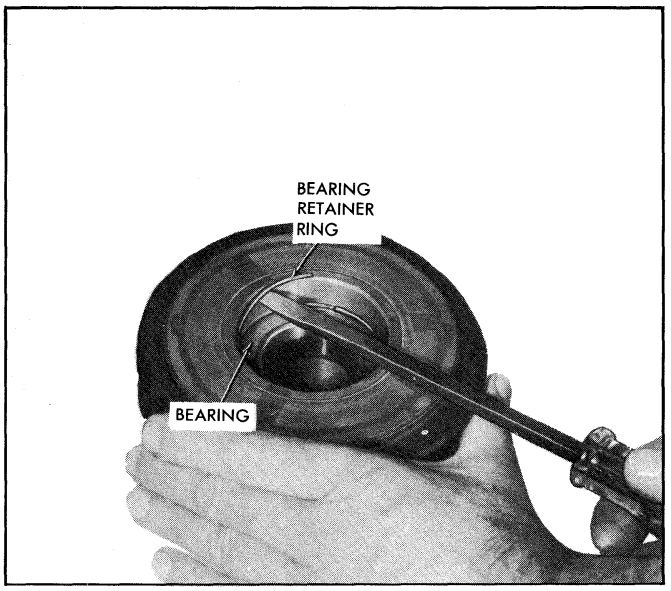


Fig. 1-75 Removing Pulley and Bearing Retainer Ring

The Installer will apply the force to the outer race of the bearing.

CAUTION: *DO NOT CLEAN NEW BEARING ASSEMBLY WITH ANY TYPE OF SOLVENT. Bearing is supplied with correct lubricant when assembled and requires no other lubricant at any time.*

2. Install bearing retainer ring, making certain that it is properly seated in ring groove.

3. Install pulley and bearing assembly as described above

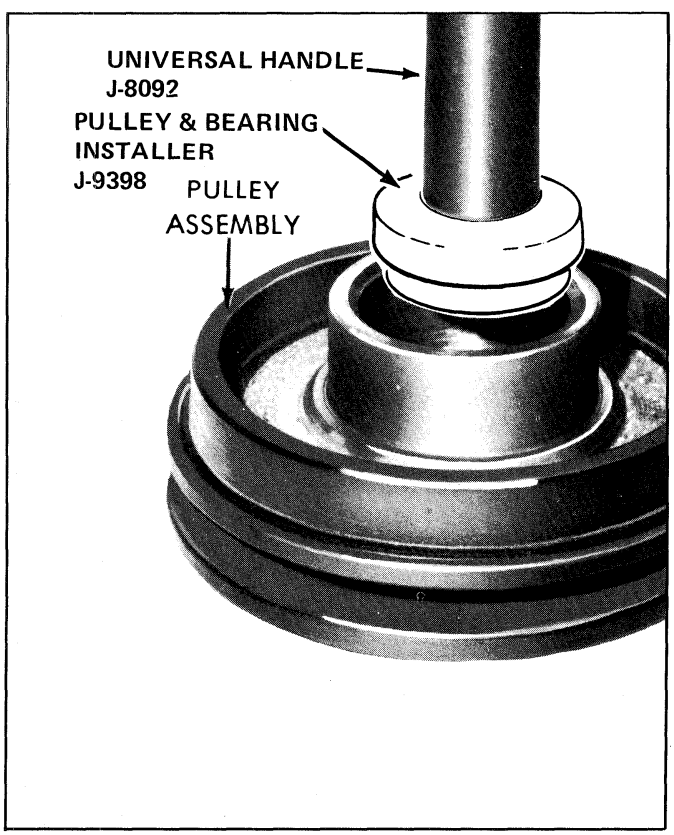


Fig. 1-76 Removing Bearing from Pulley Assembly

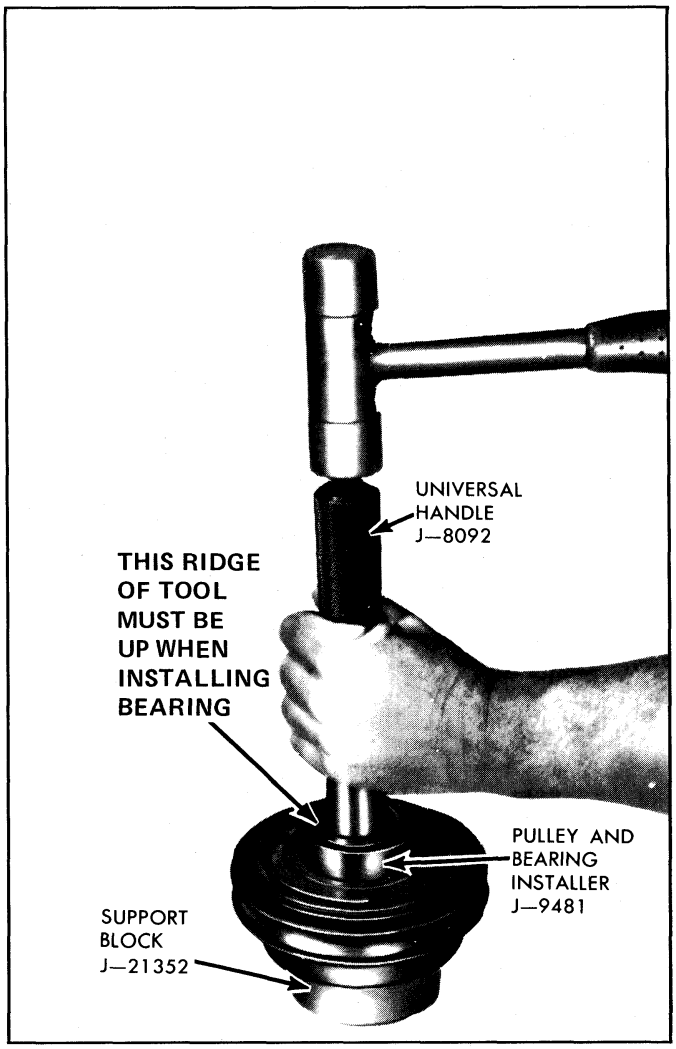


Fig. 1-77 Installing Bearing Onto Pulley

in "Compressor Pulley and Bearing Assembly" Replacement procedure.

4. Install clutch plate and hub assembly as described above in "Compressor Clutch Plate and Hub Assembly" Replacement procedure.

Compressor Clutch Coil and Housing Assembly

a. Removal

1. Remove clutch plate and hub assembly as described above in "Compressor Clutch Plate and Hub Assembly" Removal procedure.

2. Remove pulley and bearing assembly as above described above in "Compressor Pulley and Bearing Assembly" Removal procedure.

3. Note position of terminals on coil housing and scribe location on compressor front head castings.

4. Remove coil housing retaining ring using Snap-Ring Pliers J-6435 (#26) (Fig. 1-78).

5. Lift Coil and Housing assembly off compressor.

b. Installation

1. Position coil and housing assembly on compressor front head casting so that electrical terminals line up with marks previously scribed on compressor (Fig. 1-79).

2. Align locating extrusions on coil housing with holes in front head casting.

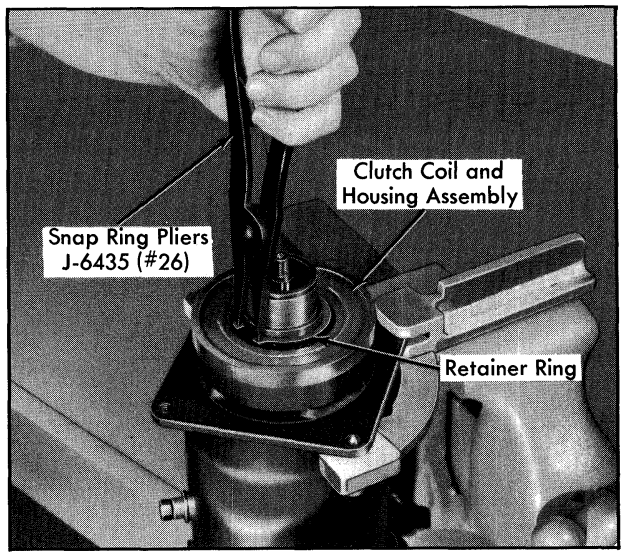


Fig. 1-78 Removing Coil Housing Retaining Ring

3. Install coil housing retainer ring with flat side of ring facing coil, using Snap-Ring Pliers J-6435 (#26).

4. Install pulley and bearing assembly as described above in "Compressor Pulley and Bearing Assembly" Replacement procedure.

5. Install clutch plate and hub assembly as described above in "Compressor Clutch Plate and Hub Assembly" Replacement Procedure.

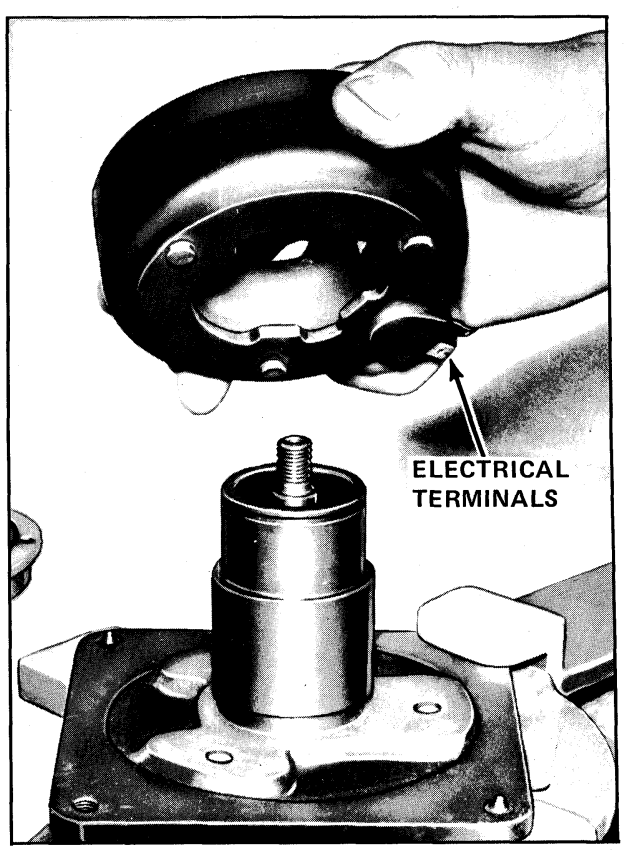


Fig. 1-79 Installing Coil Housing

MAJOR COMPRESSOR REPAIR PROCEDURES

Service repair procedures to the Compressor Shaft Seal, Pressur Relief Valve and Low Pressure Switch, or disassembly of the Internal Compressor Mechanism are considered "MAJOR" SINCE THE REFRIGERATION SYSTEM MUST BE COMPLETELY PURGED OF REFRIGERANT before proceeding and/or because major internal operating and sealing components of the compressor are being disassembled and serviced.

A clean workbench, preferably covered with a sheet of clean paper, orderliness in the work area and a place for all parts being removed and replaced is of great importance, as is the use of the proper, clean service tools. Any attempt to use make-shift or inadequate equipment may result in damage and/or improper compressor operation.

These procedures are based on the use of the proper service tools and the condition than an adequate stock of service parts is available.

All parts required for servicing a compressor are protected by a preservation process and packaged in a manner which will eliminate the necessity of cleaning, washing or flushing of the parts. The parts can be used in the assembly just as they are removed from the service package.

Piston shoe discs and shaft thrust races will be identified by "number" on the parts themselves for reference to determine their size and dimension (Fig. 1-103).

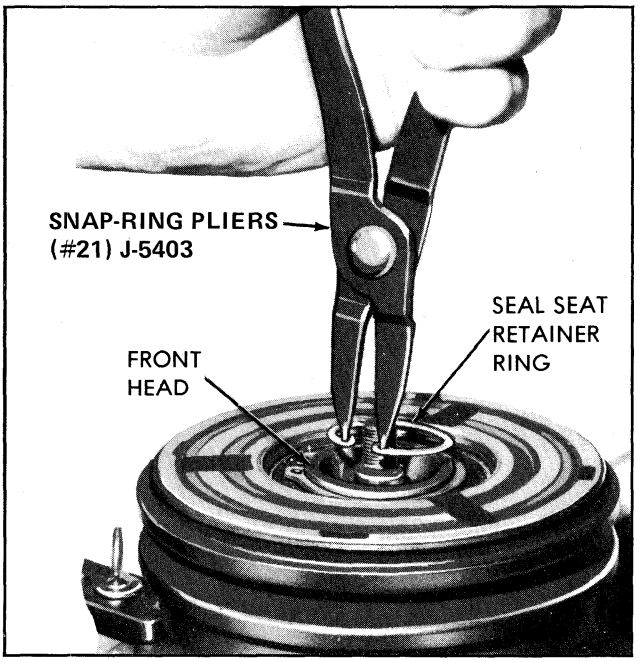


Fig. 1-80 Removing and Installing Shaft Seal Retaining Ring

Compressor Shaft Seal

a. Seal Leak Detection

A SHAFT SEAL SHOULD NOT BE CHANGED BECAUSE OF AN OIL-LINE ON THE HOOD INSULATOR. The seal is designed to seep some oil for lubrication purposes. Only change a shaft seal when a leak is detected by the following procedure.

When refrigerant system components other than the compressor are replaced, the compressor must be removed and oil drained from the compressor if oil was sprayed in large amounts due to leaks or a broken shaft seal.

Compressor shaft seals, unless replaced during a compressor overhaul, are to be replaced only on the basis of actual refrigerant leakage as determined by test with an electronic-type leak detector.

WHEN REPLACING THE SHAFT SEAL ASSEMBLY, even if the compressor remains on the vehicle during the operation, IT WILL BE NECESSARY TO PURGE THE SYSTEM OF REFRIGERANT as described on page 1-51.

b. Removal

1. After first purging the system of refrigerant, remove the clutch plate and hub assembly and shaft key as described above in "Compressor Clutch Plate and Hub Assembly" Removal procedure.

2. Pry out the sleeve retainer and remove the absorbent sleeve. Remove the shaft seal seat retaining ring using Snap-Ring Pliers J-5403 (#21) (Fig. 1-80).

3. Thoroughly clean inside of compressor neck area surrounding the shaft, the exposed portion of the seal seat and the shaft itself. This is absolutely necessary to prevent any dirt or foreign material from getting into compressor.

4. Place Seal Protector J-22974 over the end of the shaft to prevent chipping the ceramic seat. Fully engage the knurled tangs of Seal Seat Remover-Installer J-23128 into the recessed portion of the seal seat by turning the handle clockwise. Lift the seat from the compressor with a rotary motion (Fig. 1-81).

CAUTION: *DO NOT tighten the handle with a wrench or pliers; however, the handle must be hand-tightened securely to remove the seat.*

5. With Seal Protector J-22974 still over the end of the shaft, engage the tabs on the seal assembly with the tangs on Seal Installer J-9392 by twisting the tool clockwise, while

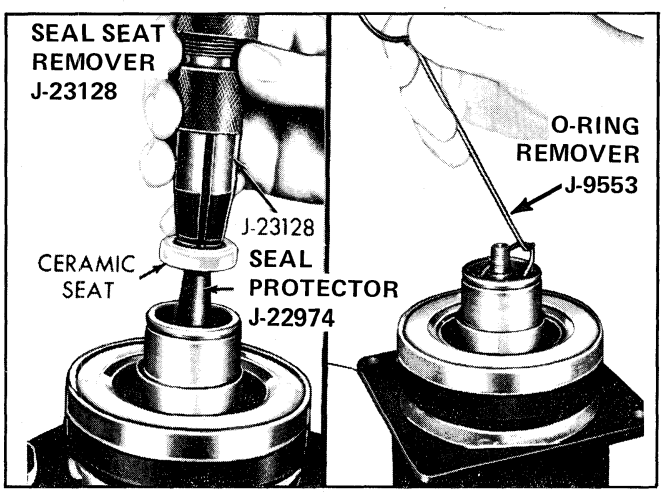


Fig. 1-81 Removing Shaft Seal Seat and O-Ring

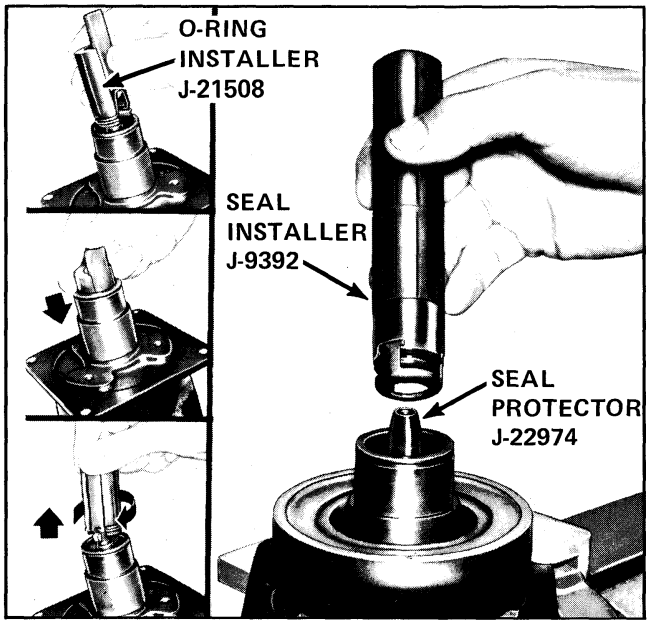


Fig. 1-82 Installing Shaft Seal and O-Ring

pressing the tool down. Then lift the seal assembly out (Fig. 1-82).

6. Remove the seal seat O-ring from the compressor neck using O-ring Remover J-9533 (Fig. 1-81).

7. Recheck the shaft and inside of the compressor neck for dirt or neck foreign material and be sure these areas are perfectly clean before installing new parts.

c. Inspection

SEALS SHOULD NOT BE REUSED. ALWAYS USE A NEW SEAL KIT ON REBUILD. Be extremely careful that the face of the seal to be installed is not scratched or damaged in any way. Make sure that the seal seat and seal are free of lint and dirt that could damage the seal surface or prevent sealing.

d. Installation

1. Coat new seal seat O-ring with clean 525 viscosity refrigerant oil and install in compressor neck, making certain it is installed in bottom groove (Fig. 1-82 and Fig. 1-83). Top groove is for retainer ring. Use O-ring Installer J-21508.

2. Coat the O-ring and seal face of the new seal assembly with clean 525 viscosity refrigerant oil. Carefully mount the seal assembly to Seal Installer J-9392 by engaging the tabs of the seal with the tangs of the tool (Fig. 1-82).

3. Place seal Protector J-22974 (Fig. 1-82) over end of shaft and carefully slide the new seal assembly onto the shaft. Gently twist the tool CLOCKWISE, while pushing the seal assembly down the shaft until the seal assembly engages the flats on the shaft and is seated in place. Disengage the tool by pressing downward and twisting tool counterclockwise.

4. Coat the seal face of the new seal seat with clean 525 ciscosity refrigerant oil. Mount the seal seat on Seal Seat Remover-Installer J-23128 and install it in the compressor neck, taking care not to dislodge the seal seat O-ring and being sure the seal seat makes a good seal with the O-ring. Remove Seal Protector J-22974 from the end of the shaft (see Fig. 1-81).

5. Install the new seal seat retainer ring with its flat side against the seal seat, using Snap-Ring Pliers J-5403 (#21)

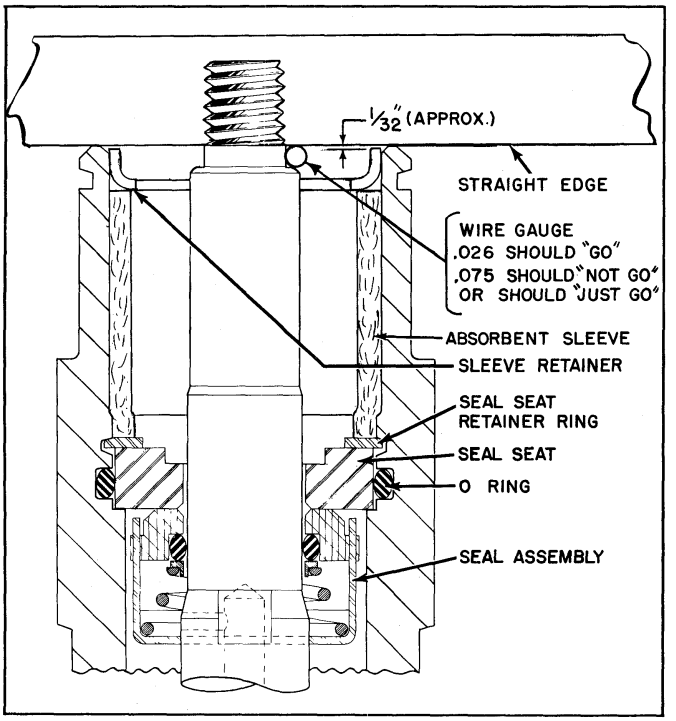


Fig. 1-83 Compressor Shaft and Seal

(Fig. 1-80). Use the sleeve from Seal Seat Remover-Installer J-23128 (Fig. 1-81) to press in on the seal seat retainer ring so that it snaps into its groove.

6. Install Compressor Leak Test Fixture J-9625 on rear head of compressor and connect gage charging lines as shown for bench test in Fig. 1-84 or pressurize SUCTION SIDE OF COMPRESSOR ON CAR WITH Refrigerant-12 vapor to equalize pressure to the drum pressure. Temporarily install the shaft nut and, with compressor in horizontal position and oil sump down, rotate the compressor shaft in normal direction of rotation several times by hand. Leak test the seal with an electronic-type Leak Detector. Correct any leak found. Remove and discard the shaft nut.

7. Remove any excess oil, resulting from installing the new seal parts, from the shaft and inside the compressor neck.

8. Install the new absorbent sleeve by rolling the material into a cylinder, overlapping the ends, and then slipping the sleeve into the compressor neck with the overlap towards the top of the compressor. With a small screwdriver or similar instrument, carefully spread the sleeve until the ends of the sleeve butt at the top vertical centerline.

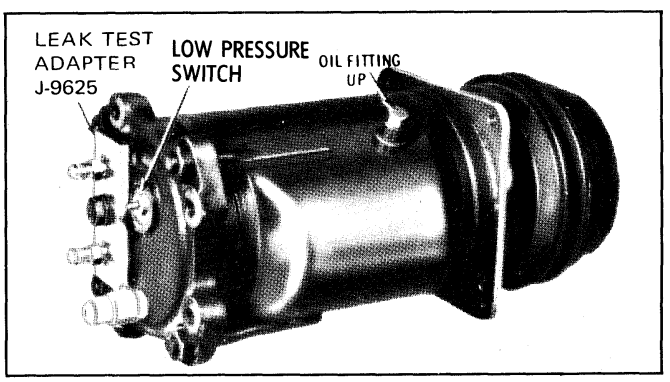


Fig. 1-84 Leak Testing Compressor

9. Position the new metal sleeve retainer so that its flange face will be against the front end of the sleeve. Pulley Puller Pilot J-9395 (Fig. 1-82) may be used to install the retainer. Press and tap with a mallet, setting the retainer and sleeve into place (retainer should be recessed approximately 1/32" from the face of the compressor neck) (Fig. 1-83).

10. Reinstall the clutch plate and hub assembly as described above "Compressor Clutch Plate and Hub Assembly" Replacement procedure.

Some compressor shaft seal leaks may be the result of mispositioning of the axial plate on the compressor shaft. The mispositioning of the axial plate may be caused by improper procedures used during pulley and driven plate removal, pounding, collisions or dropping the compressor. If the axial plate is mispositioned, the carbon face of the shaft seal assembly may not contact the seal seat and the rear thrust races and bearing may be damaged.

If there appears to be too much or insufficient air gap between the drive and driven plates, dislocation of the shaft should be suspected. If the ceramic seal is not seating against the seal seat, it will not be possible to completely evacuate the system as described on page 1-51, "Evacuating the Refrigeration System."

To check for proper positioning of the axial plate on the shaft, remove the clutch driven plate and measure the distance between the front head extension and the flat shoulder on the shaft as shown in Fig. 1-83. To measure this distance, use a wire gage (the clearance should be between .026" and .075"). If the shaft has been pushed back in the axial plate (measurement greater than .075"), disassemble the compressor and replace the shaft and axial plate assembly rear thrust race and thrust bearing.

11. Evacuate and charge system as described on page 1-51, "Depressurizing Evacuating and Charging the Refrigeration System".

Compressor Pressure Relief Valve

When necessary to replace the pressure relief valve, located in the compressor rear head casting, the valve assembly should be removed after PURGING THE SYSTEM OF REFRIGERANT and a new valve and gasket installed. The entire system should then be "Evacuated and Recharged," (Fig. 1-85).

Compressor Low Pressure Switch

If it becomes necessary to replace the low pressure switch, located in the compressor rear head casting, the switch assembly should be removed only after PURGING THE SYSTEM OF REFRIGERANT. After the switch has been replaced and a new O-ring seal installed, the system should be "Evacuated and Recharged" Fig. 1-85. See page 1-51.

Compressor Internal Mechanism

Service operations to the rear head or internal mechanism of the compressor should be performed with the compressor removed from the vehicle to insure that the necessary degree of cleanliness may be maintained. Clean hands, clean tools and a clean bench, preferably covered with clean paper, are of extreme importance.

An inspection should be made of the internal mechanism assembly to determine if any service operations should be performed. A detailed inspection of parts should be made to determine if it is economically feasible to replace them.

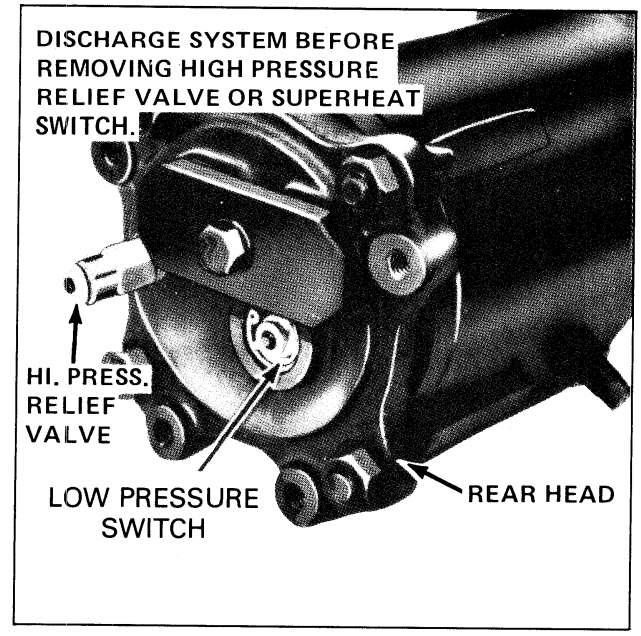


Fig. 1-85 High Pressure Relief Valve and Low Pressure Switch Locations

a. Removal from External Housing

1. Before proceeding with disassembly, wipe exterior surface of compressor clean.

2. All oil in compressor should be drained and measured. Assist draining by positioning compressor with oil drain plug down. Record the amount of oil drained from the compressor.

3. Invert compressor and Holding Fixture J-9396 with front end of compressor shaft facing downward (Fig. 1-86).

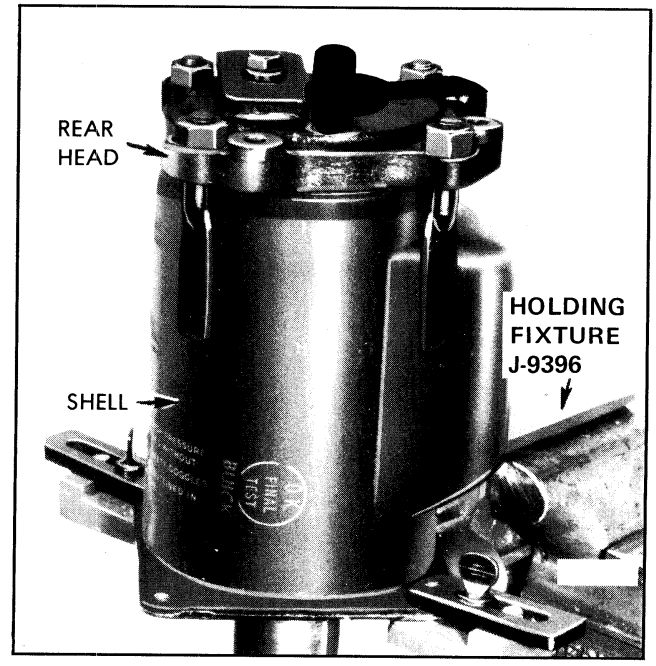


Fig. 1-86 Compressor Installed in Holding Fixture

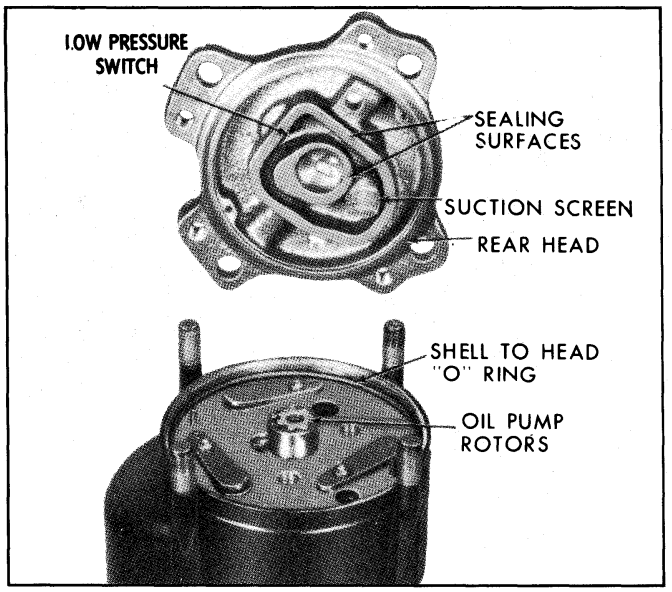


Fig. 1-87 Removing Rear Head

Additional oil may leak from compressor at this time. All oil must be drained into a container so that TOTAL amount can be measured. A liquid measuring cup may be used for this purpose. Drained oil should then be discarded.

4. Remove four locknuts from threaded studs on compressor shell and remove rear head. Tap uniformly around rear head if head is binding. (Fig. 1-86).

5. Wipe excess oil from all sealing surfaces on rear head casting webs, and examine sealing surfaces (Fig. 1-87). If any damage is observed, the head should be replaced.

6. Remove suction screen and examine for any damage or contamination. Clean or replace if necessary.

7. Paint an identifying mark on exposed face of inner and outer oil pump gears and then remove gears. Identifying marks are to assure that gears, if reused, will be installed on identical position.

8. Remove and discard rear head to shell O-ring.

9. Carefully remove rear discharge valve plate assembly. Use two small screwdrivers under reed retainers to pry up on assembly (Fig. 1-88). Do not position screwdrivers between reeds and reed seats.

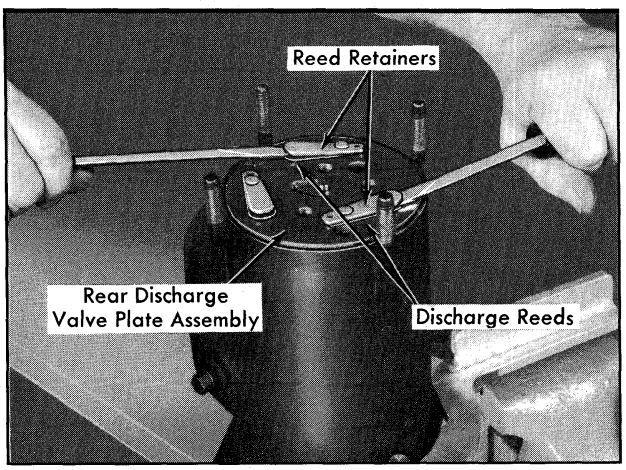


Fig. 1-88 Removing Rear Discharge Valve Plate

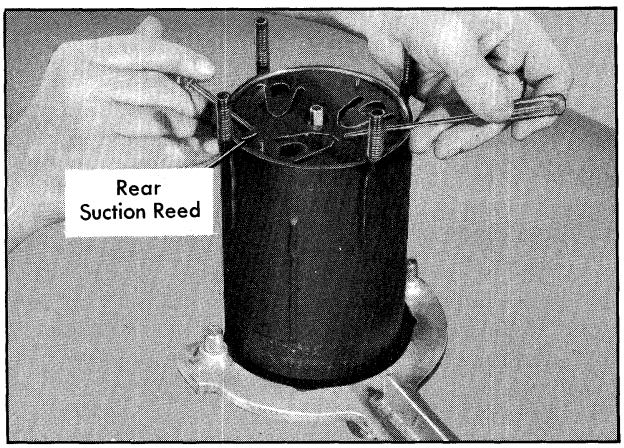


Fig. 1-89 Removing Rear Suction Reed

10. Examine valve reeds and seats. Replace entire assembly if any reeds or seats are damaged.

11. Using two small screwdrivers, carefully remove rear suction reed (Fig. 1-89). Do not pry up on horseshoe-shaped reed valves.

12. Examine reeds for damage, and replace if necessary.

13. Using Oil Pick-Up Tube Remover J-5139 (Fig. 1-90), remove all pick-up tube. Remove O-ring from oil inlet.

14. Loosen compressor from Holding Fixture J-9396, place Internal Assembly Support Block J-21352 over oil pump end of shaft and, holding Support Block in position with one hand, lift compressor from Holding Fixture with other hand. Invert compressor and position on bench with Internal Assembly Support Block resting on bench.

15. Lift front head and compressor shell assembly up, leaving internal mechanism resting on Internal Assembly Support Block.

CAUTION: *To prevent damage to shaft, DO NOT TAP ON END OF COMPRESSOR SHAFT to remove internal mechanism. If mechanism will not slide out of compressor shell, tap on front head with a plastic hammer.*

16. Rest compressor shell on its side and push front head assembly through compressor shell, being careful not to damage sealing areas on inner side of front head. Discard O-ring.

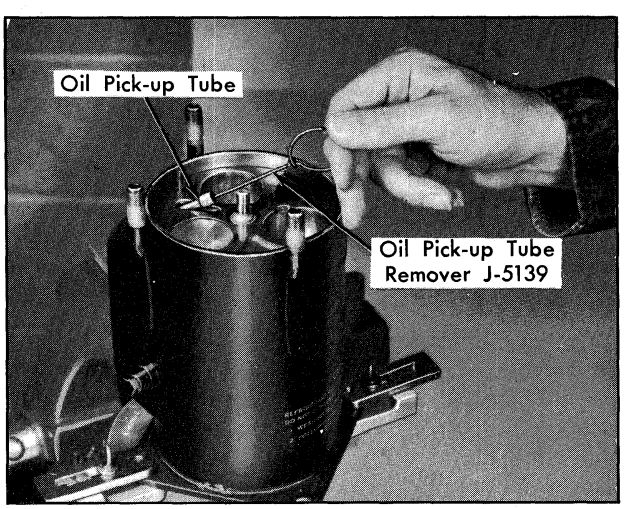


Fig. 1-90 Removing Oil Pick-Up Tube

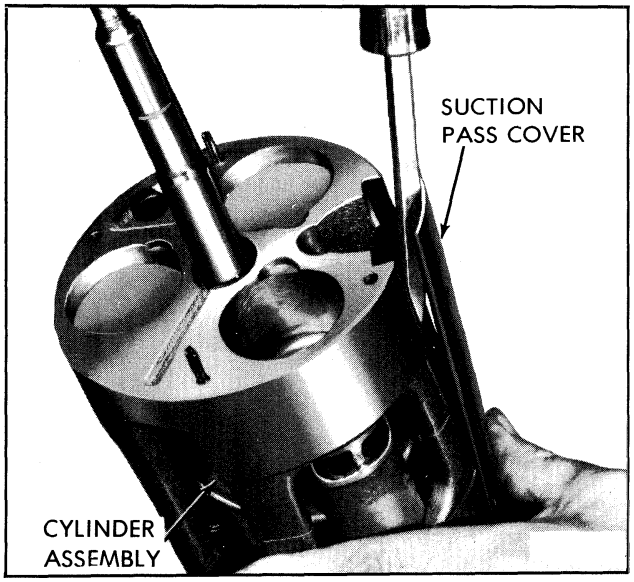


Fig. 1-91 Removing Suction Crossover Cover

It may be necessary to tap on outside of front head, using a plastic hammer, to overcome friction of O-ring seal between front head and compressor shell.

17. Wipe excess oil from sealing surfaces on front head casting webs and examine sealing surface. If any surface damage is observed, the head should be replaced.

18. Remove front discharge valve plate assembly and front suction reed plate. Examine reeds and seats. Replace necessary parts.

19. Remove suction crossover cover by prying with screwdriver between cylinder casting and cover (Fig. 1-91).

20. Examine internal mechanism for any ovbious damage. If internal mechanism has sustained major damage, due to loss of refrigerant or oil, it may be necessary to replace the complete internal mechanism Assembly rather than replace individual parts.

b. Disassembly

Use Parts Tray J-9402 (Fig. 1-95) to retain compressor parts during disassembly.

1. Remove internal mechanism from compressor as described above in "Compressor Internal Mechanism" Removal procedure.

2. Identify by pencil mark, or some other suitable means, each piston number them as 1, 2, and 3 (fig. 1-92).

Number the piston bores in the front cylinder half in like manner, so that pistons can be replaced in their original locations.

3. Separate cylinder halves, using a wood block and mallet (Fig. 1-93). Make certain that discharge cross-over tube does not contact axial plate when separating cylinder halves (a new Service discharge cross-over tube will be installed lager).

CAUTION: *UNDER NO CIRCUMSTANCES SHOULD SHAFT BE STRUCK AT EITHER END in an effort to separate upper and lower cylinder halves because the shaft and the axial plate could be damaged.*

4. Carefully remove the rear half of the cylinder from the pistons and set the front cylinder half, with the piston, shaft and axial plate in Compressing Fixture J-9397.

5. Pull up on compressor shaft and remove piston previously identified as No. 1, with balls and shoe discs, from axial plate.

a. Inspect the Teflon piston rings for nicks, cuts or metal particles imbedded in exposed ring surface and replace the piston rings as required if either condition exists. See "Teflon Piston Ring" Replacement procedure below.

6. Remove and discard the piston shoe discs.

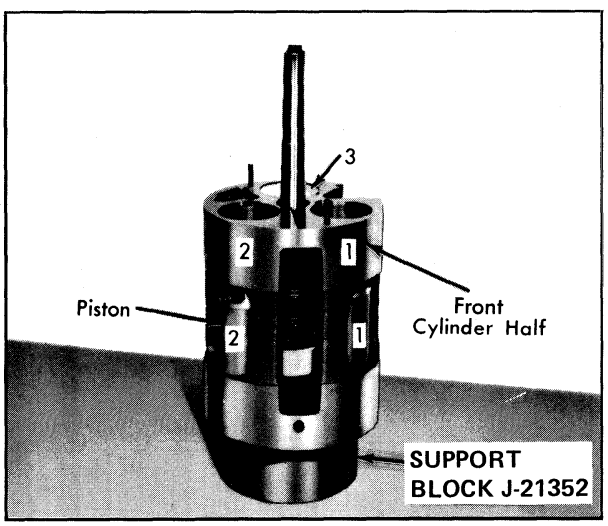


Fig. 1-92 Numbering Piston and Cylinder Bores

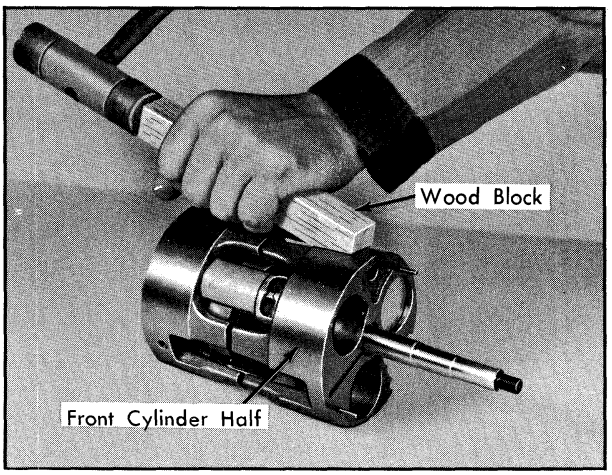


Fig. 1-93 Separating Cylinder Halves

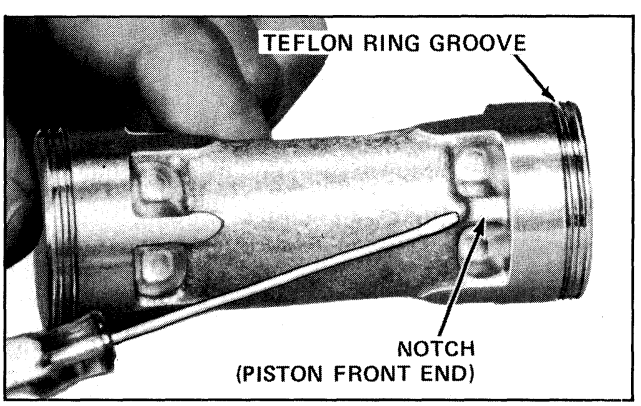


Fig. 1-94 Notch Identifying Front End of Piston

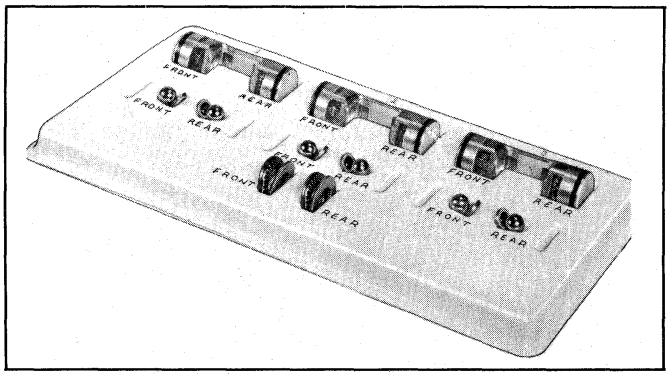


Fig. 1-95 Parts Tray

7. Remove and examine piston balls, and if satisfactory for re-use, place balls in No. 1 compartment of Parts Tray J-9402 (Fig. 1-95).

8. Place piston in No. 1 compartment of Parts Tray J-9402, with notch in casting web at front end of piston (Fig. 1-94) into the dimpled groove of Parts Tray compartment.

9. Repeat Steps 5 through 9 for Pistons No. 2 and No. 3.

10. Remove rear combination of thrust races and thrust bearing from shaft. Discard races and bearing.

11. Remove shaft assembly from front cylinder half. If the discharge cross-over tube remained in the front cylinder half, it may be necessary to bend discharge cross-over tube slightly in order to remove shaft.

12. Remove front combination of thrust races and bearing from shaft. Discard races and bearing.

13. Examine surface of axial plate and shaft. Replace as an assembly, if necessary.

A certain amount of shoe disc wear on axial plate is normal, as well as some markings indicating load of needle bearings on shaft.

14. Remove discharge cross-over tube from cylinder half, using self-clamping pliers.

This is necessary only on original factory equipment, as ends of the tube are swedged into cylinder halves. The discharge cross-over tube in internal mechanism assemblies that have been previously serviced have an O-ring and bushing at EACH END of the tube, and can be easily removed by hand (Fig. 1-115).

15. Examine piston bores and needle bearings in front and rear cylinder halves. Replace front and rear cylinders if any cylinder bore is deeply scored or damaged.

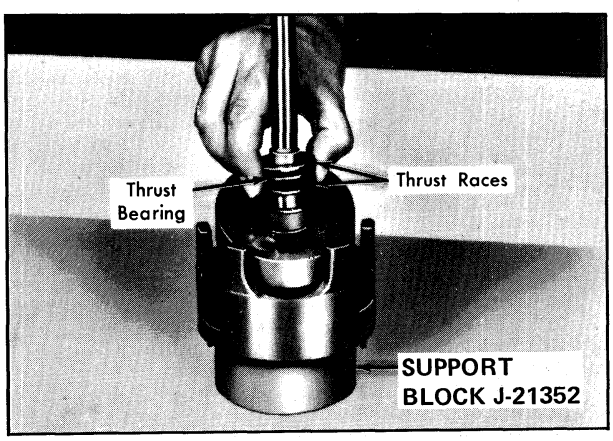


Fig. 1-96 Removing Front Thrust Races and Bearings

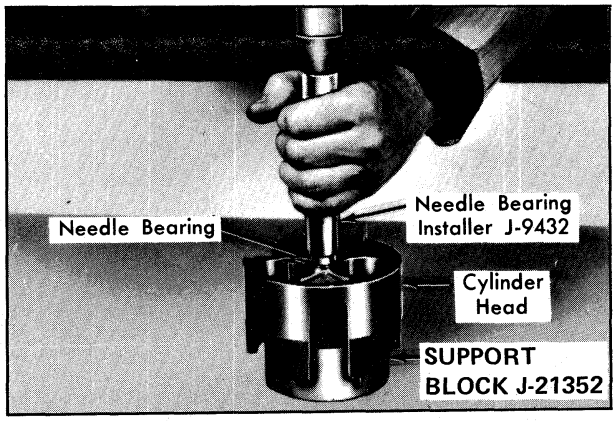


Fig. 1-97 Installing Needle Bearing

16. Needle bearings may be removed if necessary by driving them out with special Thin-Wall Socket J-9399. Insert socket in hub end (inner side) of cylinder head and drive bearing out. To install needle bearing, place cylinder half on Support Block J-21352, and insert bearing in end of cylinder head with bearing identifications marks UP. Use Needle Bearing Installer J-9432 and drive bearing into cylinder head (Fig. 1-97), until tool bottoms on the cylinder face.

Two different width needle bearings are used in Production compressors - a 1/2″ size and a 5/8″ size. The bearings ARE interchangeable. Service replacement bearings are all 1/2″.

17. Wash all parts to be re-used with trichlorethylene, naphtha, stoddard, kerosene, (in that order of preference) or a similar solvent. Air-dry parts using a source of clean, dry air.

Compressor internal components may be identified by referring to Fig. 1-62 and Fig. 1-63.

c. Gaging Operation

1. Install Compressing Fixture J-9397 on Holding Fixture J-9396 in vise. Place front cylinder half in Compressing Fixture, flat side down. Front cylinder half has long slot extending out from shaft hole.

2. Secure from Service parts stock four ZERO thrust races and three ZERO shoe discs.

3. Install a ZERO thrust race, thrust bearing, and a second ZERO thrust race on front end of compressor shaft.

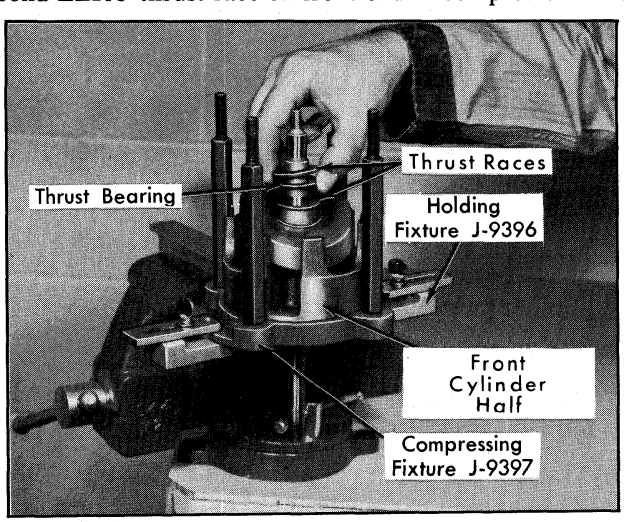


Fig. 1-98 Installing Rear Thrust Races and Bearings

Lubricate races and bearing with petrolatum.

4. Insert threaded end of shaft through needle bearing in front cylinder half, and allow thrust race and bearing assembly to rest on hub of cylinder.

5. Now install a ZERO thrust race on rear end of compressor shaft (Fig. 1-98), so that it rests on hub of axial plate. Then install thrust bearing and a secnd ZERO thrust race. Lubricate races and bearing with petrolatum.

6. Lubricate ball pockets of the No. 1 Piston with 525 viscosity refrigerant oil and place a ball in each socket. Use balls previously removed if they are to be re-used.

7. Lubricate cavity of a ZERO shoe disc with 525 viscosity refrigerant oil and place shoe disc over ball in front end of piston (Fig. 1-99). Front end of piston has an identifying notch in casting web (Fig. 1-94).

CAUTION: *Exercise care in handling the Piston and Ring Assembly, particularly during assembly into and removal from the cylinder bores to prevent damage to the Teflon piston rings.*

Shoe discs should not be installed on rear of piston during following "Gaging" operation.

8. Rotate shaft and axial plate until high point of axial plate is over the No. 1 Piston cylinder bore.

9. Lift shaft assembly up and hold fron thrust race and bearing assembly against axial plate hub.

10. Position piston over No. 1 cylinder bore (notched end of piston being on bottom and piston straddling axial plate) and lower the shaft to allow piston to drop into its bore (Fig. 1-100).

11. Repeat Steps 6 through 10 for Pistons No. 2 and No. 3.

12. Install rear cylinder half on pistons, aligning cylinder with discharge cross-over tube hole in front cylinder. Tap into place using a plastic mallet or piece of clean wood and hammer (Fig. 1-101).

13. Position discharge cross-over tube opening between a pair of Compressing Fixture bolts to permit access for feeler gage.

14. Install top plate on Compressing Fixture J-9397. Tighten nuts to 15 lb. ft. torque using a 0-25 lb. ft. torque wrench.

d. Gaging Procedure (Steps 15 thru 18)

The gaging operations which follow have been worked out on a simple basis to establish and provide necessary running tolerances. Two gaging procedures are necessary.

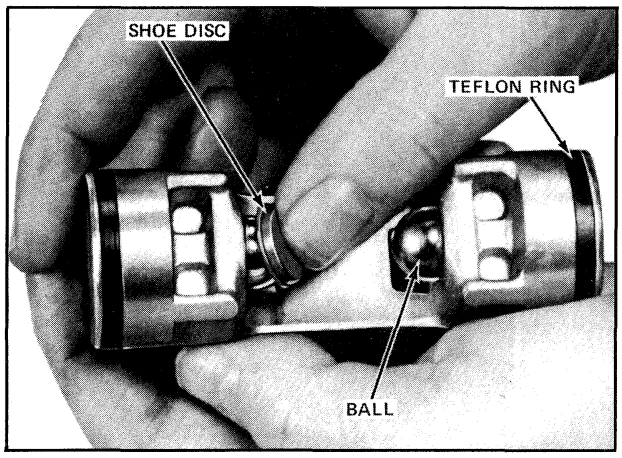


Fig. 1-99 Installing Front Shoe Disc

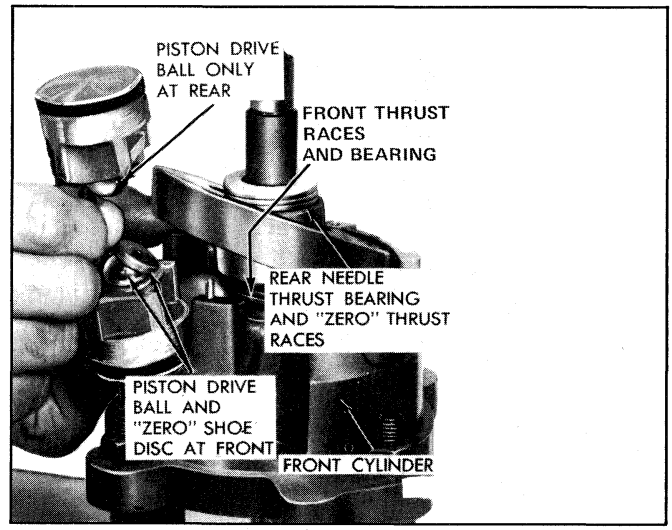


Fig. 1-100 Installing Piston During Gaging Operation

The first is made to choose the proper size shoe discs to provide, at each piston, a .0016" to .0024" total preload between the seats and the axial plate at the tightest place through the 360-degree rotation of the axial plate at the tightest plate. The bronze shoe discs are provided in .0005" variations, including a basic ZERO shoe.

The second, performed at the rear shaft thrust bearing and race pack, is designed to obtain .0025" to .0030" preload between the hub surfaces of the axial plate and the front and rear hubs of the cylinder. A total of 14 steel thrust races, including a basic ZERO race, are provided in increments of .0005" thickness to provide the required fit.

Feeler Gage Set J-9564 or J-9661-01 may be used for gaging proper shoe disc size. Feeler Gage Set J-9564-01 or Dial Indicator Set J-8001-3 may be used to determine proper thrust race size.

PROPER SELECTION OF THRUST RACES AND BALL SEATS IS OF EXTREME IMPORTANCE.

15. Measure clearance between rear ball of No. 1 Piston and axial plate, in following manner:

a. Select a suitable combination of well-oiled Feeler Gage leaves to fit snugly between ball and axial plate.

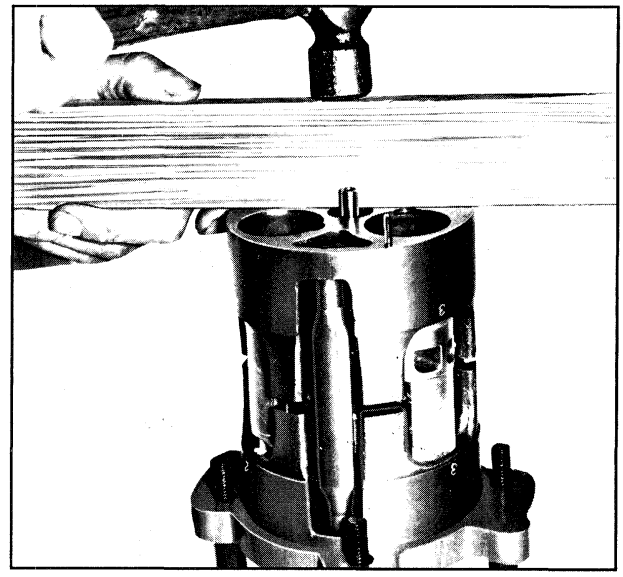


Fig. 101 Assembling Cylinder Halves

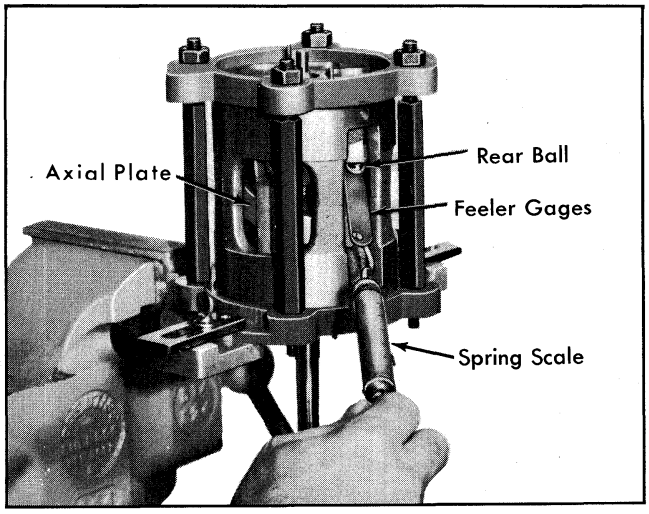


Fig. 102 Gaging Rear Piston Ball

b. Attach a spring scale, reading in 1-ounce increments, to the feeler gage. A distributor point checking scale may be used.

c. Pull on Spring Scale to slide Feeler Gage stock out from between ball and axial plate, and note reading on Spring Scale as Feeler Gage is removed (Fig. 1-102). Reading should be between 4 and 8 ounces.

d. If reading in Step c. above is under 4 OR over 8 ounces, reduce or increase thickness of Feeler Gage leaves and repeat Steps a. thruogh c. above until a reading of 4 to 8 ounces is obtained. Record clearance between ball and axial plate that results in the 4 to 8-ounce pull on Spring Scale.

16. Now rotate shaft 120° and repeat Step 15 between same ball and axial plate. Record this measurement.

If shaft is hard to rotate, install shaft nut onto shaft and turn shaft with wrench.

17. Rotate shaft another 120° and again repeat Step 15 between these same parts and record measurements.

Select a "numbered" shoe disc corresponding to minimize feeler gage reading recorded in the three checks above. (See example in Fig. 1-104). Place shoe discs in Parts Tray J-9402 compartment corresponding to Piston No. 1 and rear ball pocket position.

	POSITION 1	POSITION 2	POSITION 3	SELECT AND USE SHOE NO.
PISTON NO. 1	.019"	.0195"	.019"	19
PISTON NO. 2	.020"	.020"	.020"	20
PISTON NO. 3	.021"	.021"	.022"	21

Fig. 1-104 Selection of Correct Shoe Disc

Shoe discs are provided in .0005" (one-half thousandths) variations. There are a total of 11 sizes available for field servicing. All shoe discs are marked with the shoe size, which corresponds to the last three digits of the piece part number. (See Shoe Disc size Chart in Fig. 1-100 above.)

Once a proper selection of the shoe has been made, THE MATCHED COMBINATION OF SHOE DISC TO REAR BALL AND SPHERICAL CAVITY IN PISTON MUST BE KEPT IN PROPER RELATIONSHIP during disassembly after gaging operation, and during final assembly of internal mechanism.

19. Repeat in detail the same gaging procedure outlined in Steps 15 through 18 for Piston No. 2 and No. 3.

20. Mount Dial Indicator J-8001-3 on edge of Compressing Fixture J-9397 with Clamp J-8001-1 and Sleeve J-8001-2 (Fig. 1-102). Position Dial Indicator on rear end of shaft and adjust to "zero".

Apply full hand-force at end of mainshaft a few times before reading clearance. This will help squeeze the oil out from/between mating parts. Push upward and record measurement. Dial Indicator increments are 001"; therefore, reading must be estimated to nearest .0005".

An alternate method of selecting a proper race is to use Gage Set J-9661-01, selecting a suitable feeler gage leaf until

SHOE DISC			THRUST BEARING RACE		
PART NO. ENDING IN	IDENTIFICATION STAMP	MIN. FEELER GAGE READING	PART NO. ENDING IN	IDENTIFICATION STAMP	DIAL INDICATOR READING
000	0	.0000	000	0	.0000
175	17-1/2	.0175	050	5	.0050
180	18	.0180	055	5-1/2	.0055
185	18-1/2	.0185	060	6	.0060
190	19	.0190	065	6-1/2	.0065
195	19-1/2	.0195	070	7	.0070
200	20	.0200	075	7-1/2	.0075
205	20-1/2	.0205	080	8	.0080
210	21	.0210	085	8-1/2	.0085
215	21-1/2	.0215	090	9	.0090
220	22	.0220	095	9-1/2	.0095
			100	10	.0100
			105	10-1/2	.0105
			110	11	.0110
			115	11-1/2	.0115
			120	12	.0120

Fig. 1-103 Available Service Shoes and Thrust Races

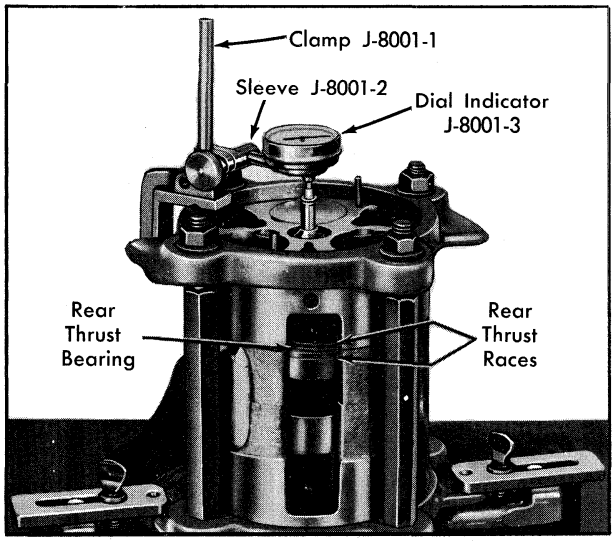


Fig. 1-105 Gaging Rear Thrust Race

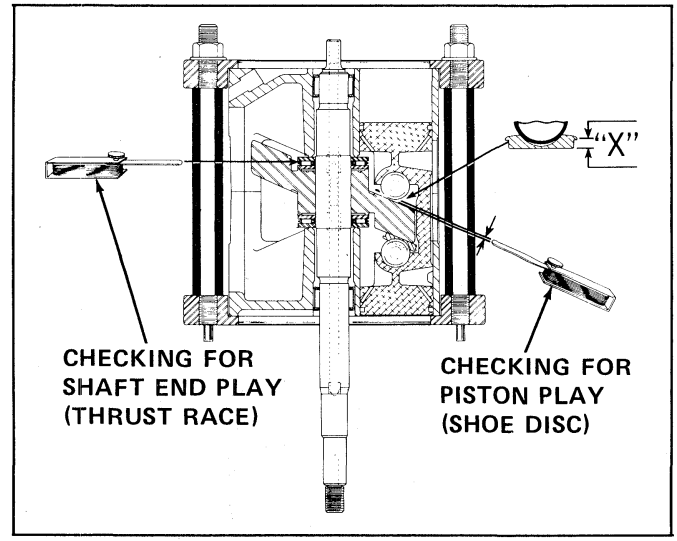


Fig. 1-106 Checking Piston and Shaft End Play

the result is a 4 to 8 ounce pull on the scale between the rear thrust bearing and upper (or outer rear) thrust race (Fig. 1-106). If the pull is just less than 4 ounces, add .0005" to the thickness of the feeler stock used to measure the clearance. If the pull on the scale reads just over 8 ounces, then subtract .0005" from the thickness of the feeler stock. Select a race TWO (2) FULL SIZES LARGER THAN FEELER GAGE THICKNESS (If feeler gage is .007", select a No. 9 or 090 race).

21. Select a thrust race with a "number" corresponding to TWO (2) FULL SIZES LARGER than Dial Indicator or feeler gage measurement of the amount of end play shown. (If measurement is .007", select a No. 9 or 090 race). Place thrust race in right-hand slot at bottom center of Parts Tray J-9402.

Fifteen (15) thrust races are provided in increments of .0005" (one-half thousandths) thickness and one ZERO gage thickness, providing a total of 16 sizes available for service. Thrust races are identified on the part by their thickness in thousandths, in excess of the thickness of the ZERO thrust race.

This "number" also corresponds to the last three digits of the piece part number. See Thrust Race size Chart in Fig. 1-100.

22. Remove nuts from top plate of Compressing Fixture J-9397, and remove top plate.

23. Separate cylinder halves while unit is in Fixture. It may be necessary to use a wood block and mallet.

24. Remove rear cylinder half and carefully remove one piston at a time from axial plate and front cylinder half. DO NOT LOSE THE RELATIONSHIP of the front ball and shoe disc and rear ball. Transfer each piston, ball, and shoe disc to its proper place in Parts Tray J-9402.

25. Remove rear outer ZERO thrust race from shaft and install thrust race just selected.

The ZERO thrust race may be put aside for re-use in additional gaging or rebuilding operations.

Teflon Piston Ring Replacement

The Teflon piston ring installing, sizing and gaging tools are shown in Fig. 1-107.

1. Remove the old piston rings by CAREFULLY slicing through the ring with a knife or sharp instrument, holding the blade almost flat with the piston surface. Be careful not to damage the aluminum piston OR piston groove in cutting to remove the ring.

Exercise personal care in cutting the piston ring for removal.

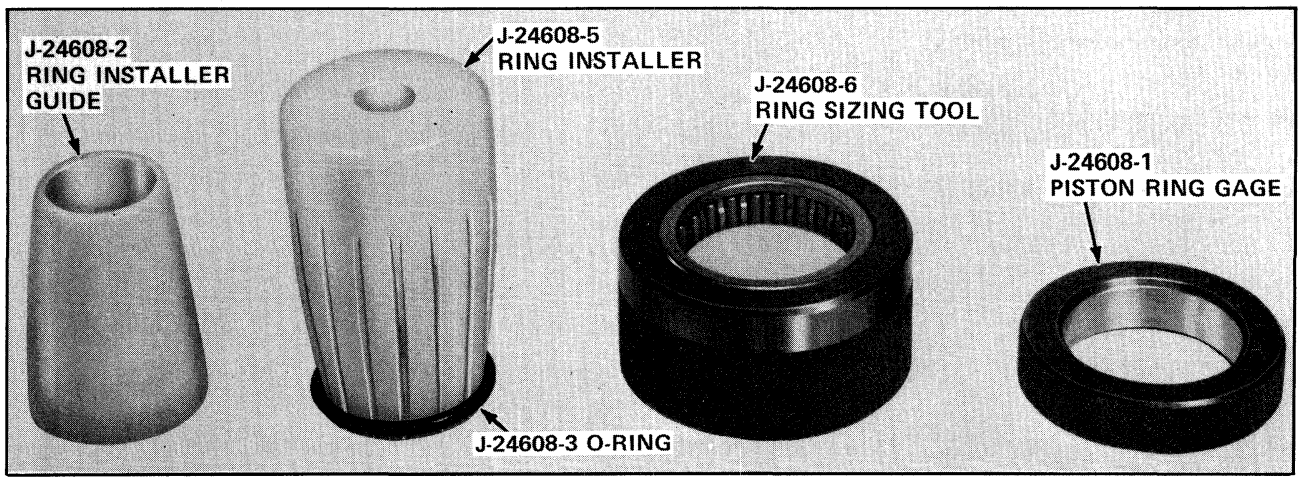


Fig. 1-107 Teflon Piston Ring Installing, Sizing and Gaging Tools

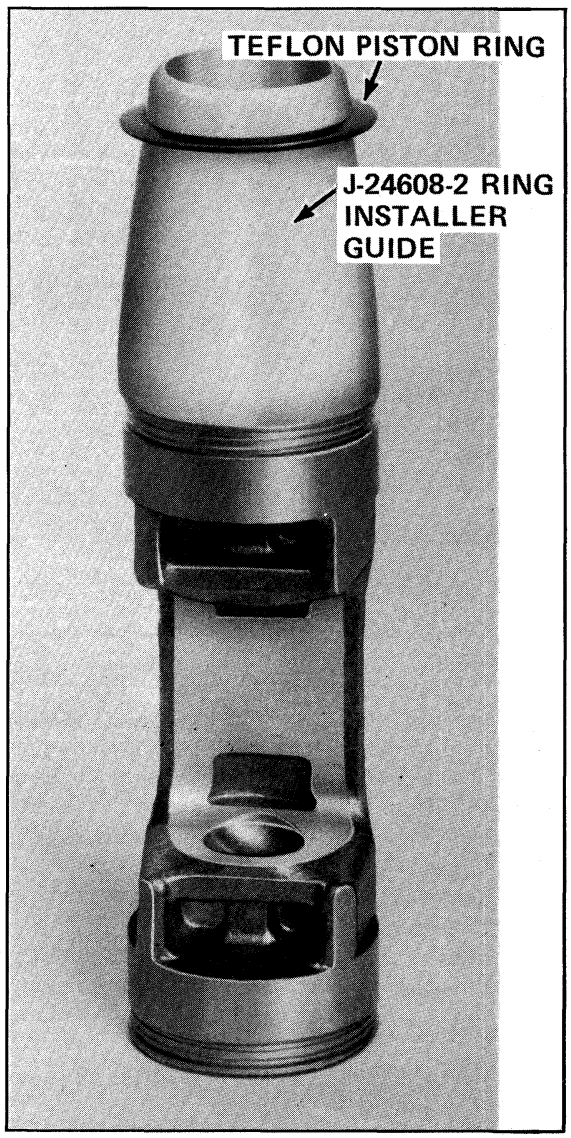


Fig. 1-108 Teflon Piston Ring Positioned on Ring Installer Guide

2. Clean the piston and piston ring grooves with a recommended cleaning solvent and blow the piston dry with dry air (Trichlorethylene, naphtha, stoddard solvent, kerosene, or equivalent in order of preference).

3. Set the piston on end on a clean, flat surface and install the Ring Installer Guide J-24608-2 on the end of the piston (Fig. 1-108).

4. Install a Teflon ring on the Ring Installer Guide J-24605-2 as shown in Fig. 1-108, with the dished or dull-side down and glossy-side up.

5. Push the Ring Installer J-24608-5 down over the Installer Guide J-24608-2 to install the Teflon ring in the piston ring groove (Fig. 1-109). If the Teflon ring is slightly off position in the ring groove, it can be positioned into place by fingernail or blunt-edged tool that will not damage the piston.

The Ring Installer J-24608-5 will retain the Installer Guide J-24608-2 Internally when the Teflon ring is installed on the piston. Remove the Installer Guide from the Ring Installer and DO NOT STORE THE INSTALLER GUIDE IN THE RING INSTALLER, as the Ring Installer Segment Retainer O-Ring J-24608-3 will be stretched and possibly

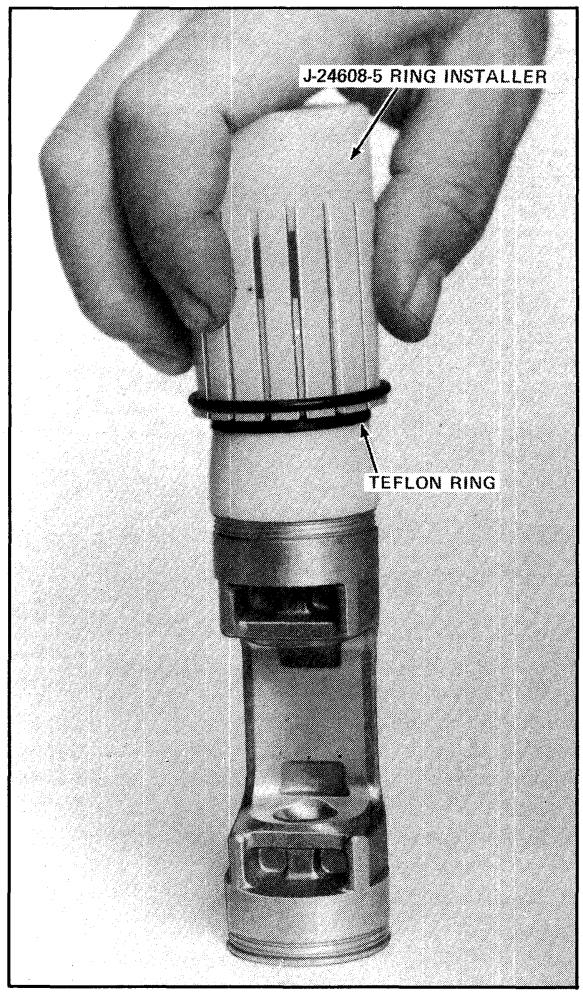


Fig. 1-109 Installing Teflon Piston Ring

weakened during storage. This could result in the O-Ring J-24608-3 not holding the Ring Installer segments tight enough to the Installer Guide J-24608-2 to properly install the Teflon ring on the piston.

6. Lubricate the piston ring area with 525 viscosity refrigerant oil and rotate the Piston and Ring Assembly into the Ring Sizer J-24608-6 at a slight angle (Fig. 1-111). Rotate the piston, while pushing inward, until the piston is inserted against the center stop of the Ring Sizer J-23608-6.

CAUTION: *DO NOT push the Piston and Ring Assembly into the Ring Sizer J-24608-6 without proper positioning and rotating as described above, as the ends of the needle bearings of the Ring Sizer may damage the end of the piston.*

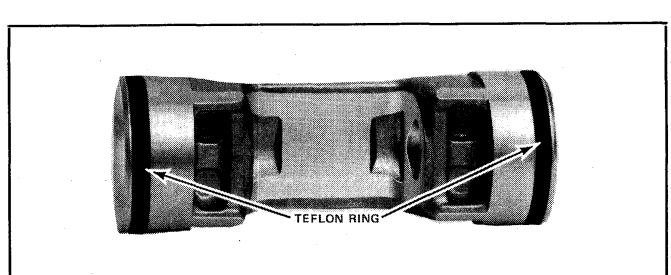


Fig. 1-110 Teflon Piston Ring Installed in Piston Groove

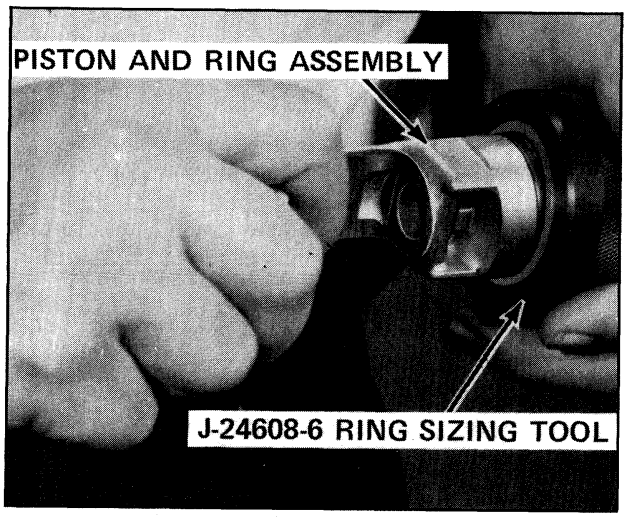


Fig. 1-111 Turning Piston and Ring Assembly into Ring Sizing Tool

7. Rotate the Piston and Ring Assembly in the Ring Sizer J-24608-6 several COMPLETE turns, until the Assembly rotates relatively free in the Ring Sizer (Fig. 1-111).

8. Remove the Piston and Ring assembly, wipe the end of the piston and ring area with a clean cloth and then push the Piston and Ring Assembly into the Ring Gage J-24608-1 (Fig. 1-112). The piston should go through the Ring Gage with a 6 lb. force or less without lubrication. If not, repeat Steps 6 and 7.

9. Repeat the procedure for the opposite end of the piston.

CAUTION: *DO NOT lay the piston down on a dirty surface where dirt or metal chips might become imbedded in the Teflon ring surface.*

10. Lubricate BOTH ENDS of the piston with 525 viscosity refrigerant oil before inserting the piston into the cylinder bore.

CAUTION: *Reasonable care should be exercised in installing the piston into the cylinder bore to prevent damage to the Teflon ring.*

Compressor-Assembly Procedure

NOTE: After properly performing the "Gaging Procedure", choosing the correct shoe discs and thrust races, and installing any needed Teflon Piston Rings, the cylinder assembly may now be reassembled. Be sure to install all NEW seals and O-rings. All are included in the compressor O-Ring Service Kit.

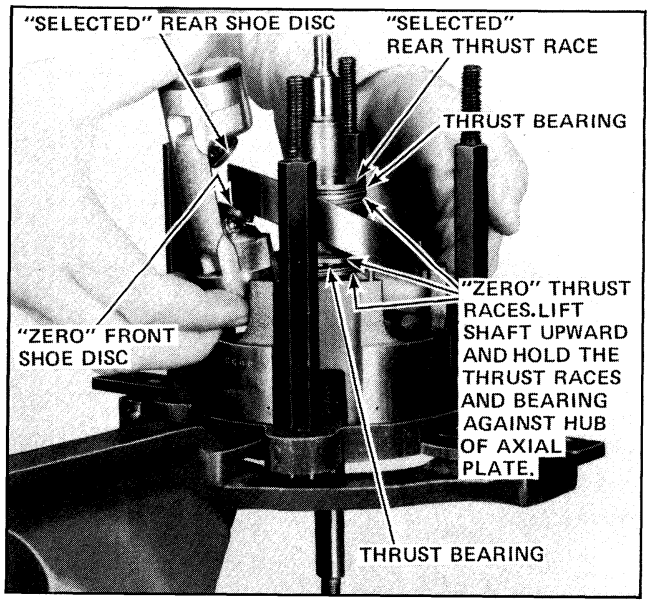


Fig. 1-113 Installing 1st Piston Assembly Into Front Cylinder Half

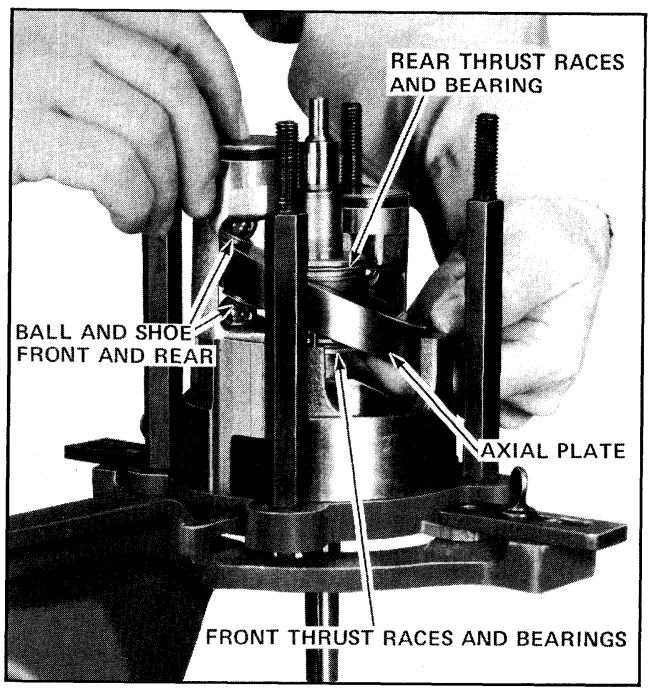


Fig. 1-114 Installing 2nd Piston

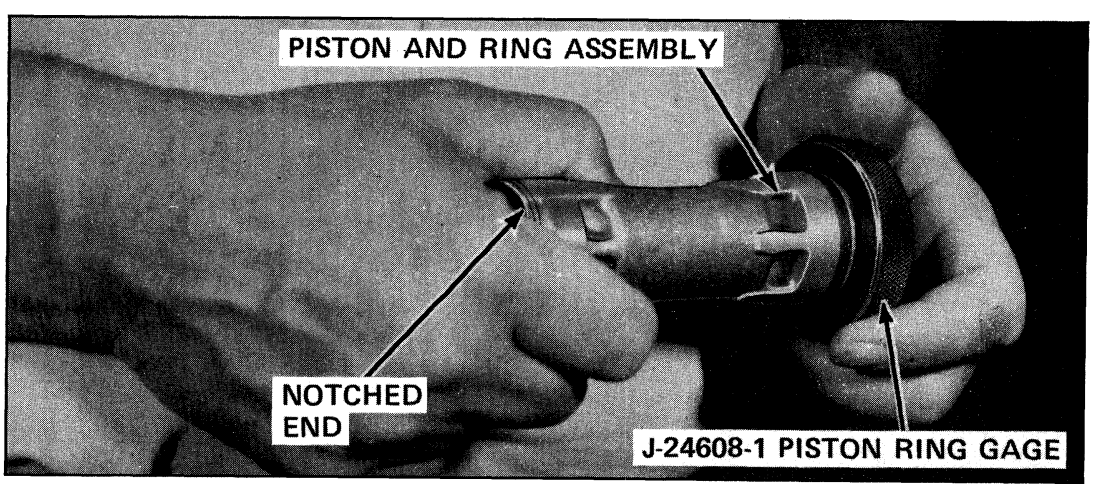


Fig. 1-112 Gaging Piston Ring Size

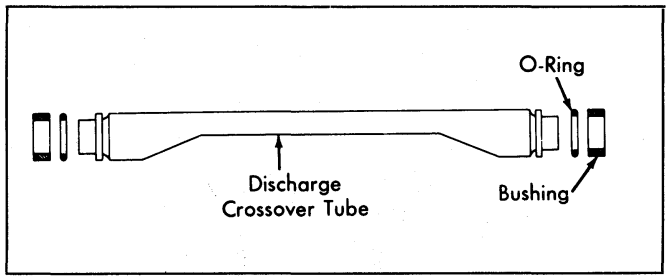


Fig. 1-115 Service Type Discharge Crossover Tube

1. Support the FRONT half of the cylinder assembly on Compressing Fixture J-9397. Install the shaft and axial plate, threaded end down, with its front bearing race pack (ZERO race, bearing NUMBERED race), if this was not already done at the end of the "Gaging Procedure".

2. Apply a light smear of petroleum jelly to the "numbered" shoe discs chosen in the gaging procedure and install all balls and shoe discs in their proper place in the piston assembly.

3. Rotate the axial plate so that the high point is above cylinder bore No. 1. Carefully assemble Piston No. 1, complete with ball and ZERO shoe disc on the front AND ball and NUMBERED shoe disc on the rear, over the axial plate. Hold front thrust bearing pack tightly against axial plate hub while lifting hub, Insert the Piston Assembly into the front cylinder half (Fig. 1-113).

4. Repeat this operation for Pistons No. 2 and No. 3 (Fig. 1-114).

5. Without installing any O-rings or bushings, assemble one end of the new Service discharge cross-over tube into the hole in the front cylinder half (Fig. 1-115 and 1-116).

Be sure the flattened portion of this tube faces the inside of the compressor to allow for axial plate clearance (Fig. 1-116).

6. Now rotate the shaft to position the pistons in a stair-step arrangement; then carefully place the rear cylinder half over the shaft and start the pistons into the cylinder bores (Fig. 1-117).

7. When all three Piston and Ring Assemblies are in their respective cylinders, align the end of the discharge cross-over tube with the hole in the rear half of the cylinder.

8. When all parts are in proper alignment, tap with a clean wood block and mallet to seat the rear half of the cylinder over the locating dowel pins. If necessary, clamp the cylinder in Compressing Fixture J-9397, to complete drawing the cylinder halves together.

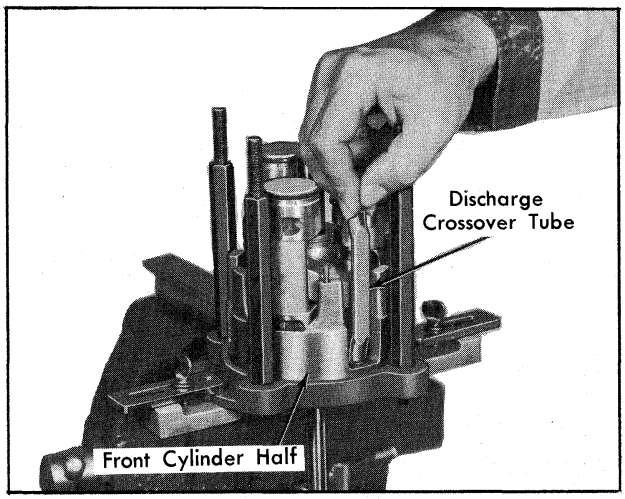


Fig. 1-116 Installing Discharge Crossover Tube

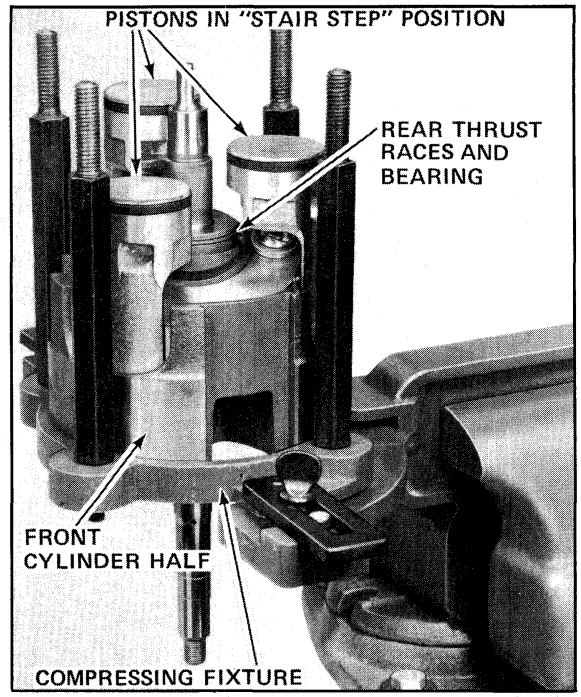


Fig. 1-117 Pistons Positioned in Stair Step Arrangement

9. Generously lubricate all moving parts with clean 525 viscosity refrigerant oil and check for free rotation of the parts.

10. Replace the suction cross-over cover (Fig. 1-118). Compress the cover as shown to start it into the slot, and then press or carefully tap it in until flush on both ends.

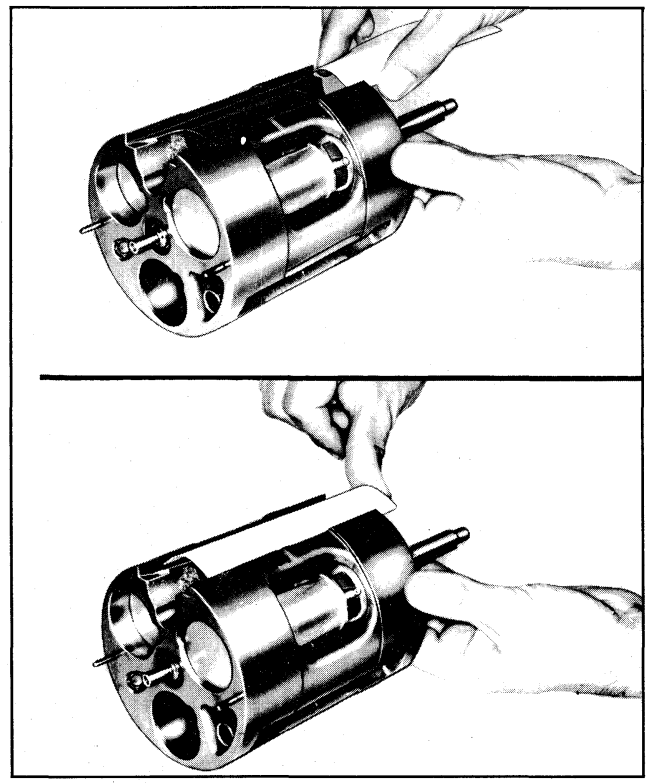


Fig. 1-118 Installing Suction Crossover Cover

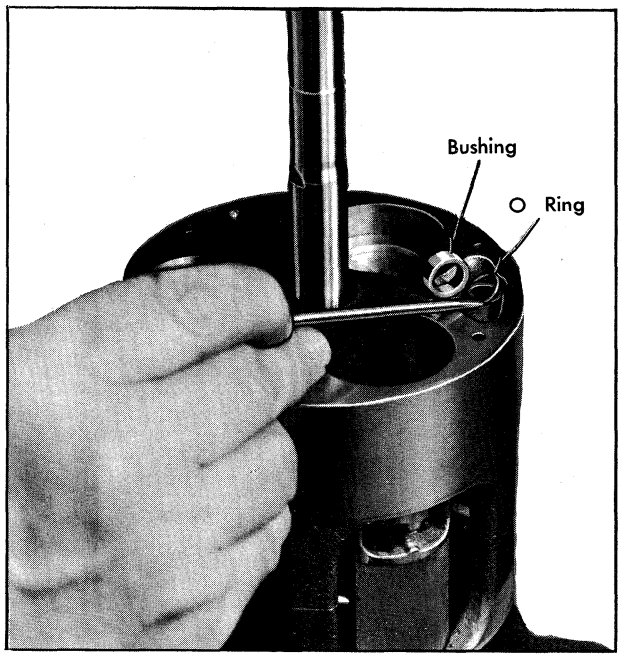


Fig. 1-119 Installing O-Ring Onto Discharge Crossover Tube

Compressor Internal Mechanism

1. Place internal mechanism on Internal Assembly Support Block J-21352, with rear end of shaft in block hole.

2. Now install new O-ring and bushing on front-end of discharge cross-over tube (Fig. 1-119). The O-ring and bushing are Service parts only for internal mechanisms that have been disassembled in the field (Fig. 1-115).

3. Install new dowel pins in front cylinder half, If previously removed.

4. Install front suction reed plate on front cylinder half. Align with dowel pins, suction ports, oil return slot, and discharge cross-over tube (Fig. 1-120).

5. Install front discharge valve plate assembly, aligning holes with dowel pins and proper openings in front suction reed plate (Fig. 1-121).

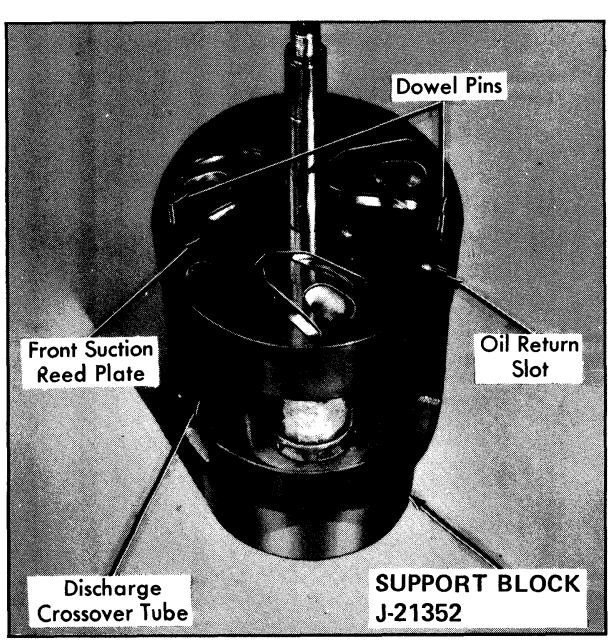


Fig. 1-120 Installing Front Suction Reed

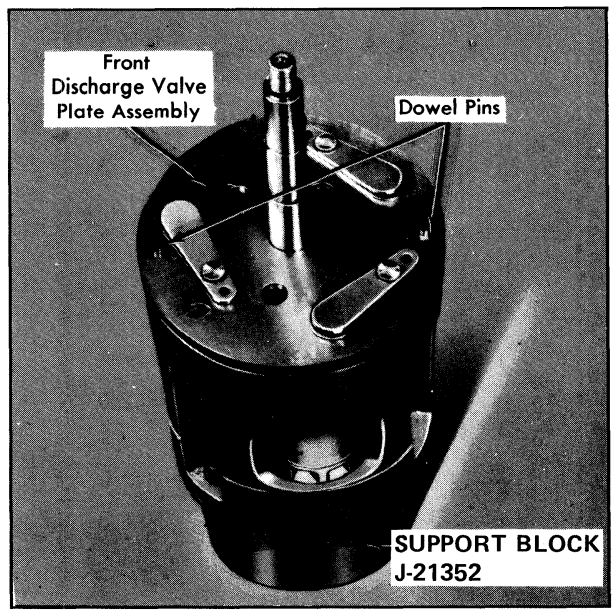


Fig. 1-121 Installing Front Discharge Valve Plate

Front discharge plate has a large diameter hole in the center (Fig. 1-122).

6. Coat sealing surfaces on webs of compressor front head casting with 525 viscosity refrigerant oil.

7. Determine exact position of front head casting in relation to dowel pins on internal mechanism. Mark position of dowel pins on sides of front head assembly and on sides of internal mechanism with a grease pencil. Carefully lower front head casting into position (Fig. 1-123), making certain that sealing area around center bore of head assembly does not contact shaft as head assembly is lowered. Do not rotate head assembly to line up with dowel pins, as the sealing areas would contact reed retainers.

8. Generously lubricate new O-ring and angled groove at lower edge of front head casting with 525 viscosity refrigerant oil and install new O-ring into groove (Fig. 1-124).

9. Coat inside machined surfaces of compressor shell with 525 viscosity refrigerant oil and position shell on internal mechanism, resting on O-ring seal.

10. Using flat-side of a small screwdriver, gently position

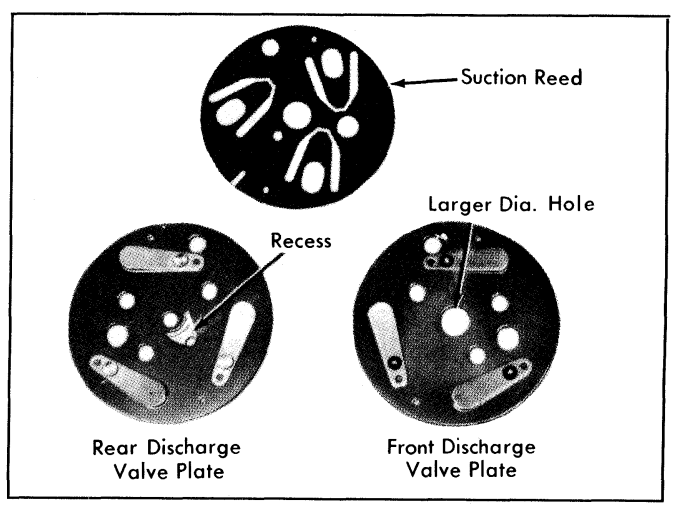


Fig. 1-122 Front and Rear Discharge Valve Plates

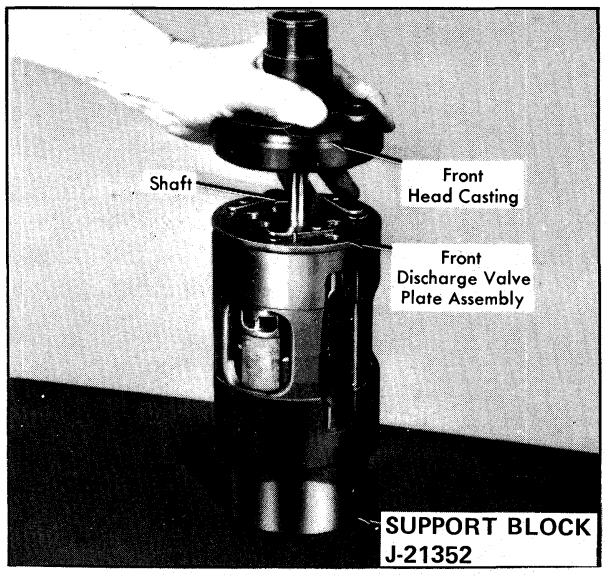


Fig. 1-123 Installing Front Head Casting

O-ring in around circumference of internal mechanism until compressor shell slides down over internal mechanism. As shell slides down, line up oil sump with oil intake tube hole (Fig. 1-125).

11. Holding support Block, invert assembly and place back into Holding Fixture with front end of shaft down. Remove Support Block.

12. Install new dowel pins in rear cylinder half, if previously removed.

13. Install new O-ring in oil pick-up tube cavity.

14. Lubricate oil pick-up tube with 525 viscosity refrigerant oil and install into cavity, rotating compressor mechanism to align tube with hole in shell baffle (Fig. 1-126).

15. Install new O-ring and bushing on rear-end of discharge cross-over tube (Fig. 1-115).

16. Install rear suction reed over dowel pins, with slot TOWARDS sump.

17. Install rear discharge valve plate assembly over dowel pins, with reed retainers UP.

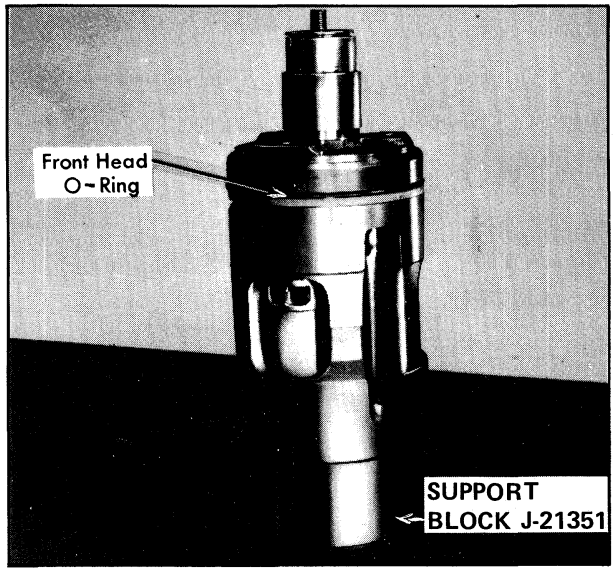


Fig. 1-124 Front Head O-Ring Installed

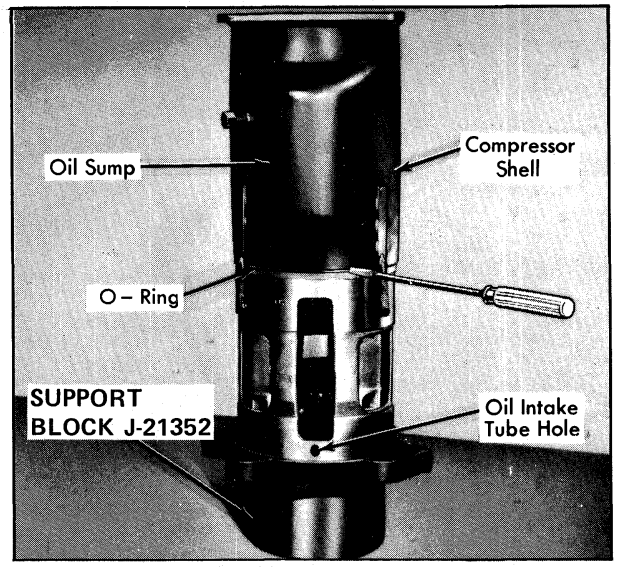


Fig. 1-125 Installing Compressor Shell

18. Position inner oil pump gear over shaft with previously applied identification mark UP.

19. Position outer oil pump gear over inner gear with previously applied identification mark UP and, when standing facing oil sump, position outer gear so that it meshes with inner gear at the 9-0'clock position, and resulting cavity between gear teeth is then at 3-o'clock position (Fig. 1-127).

20. Generously oil rear discharge valve plate assembly with 525 viscosity refrigerant oil around outer edge where large diameter O-ring will be placed. Oil the valve reeds, pump gears, and area where sealing surface will contact rear discharge valve plate.

21. Using the 525 oil, lubricate new head to-shell O-ring and install on rear discharge valve plate, in contact with shell (Fig. 1-128).

22. Install suction screen in rear head casting, using care not to damage screen.

23. Coat sealing surface on webs of compressor rear head casting with 525 viscosity refrigerant oil.

24. Install rear head assembly over studs on compressor shell. The two lower threaded compressor mounting holes should be in alignment with the compressor sump.

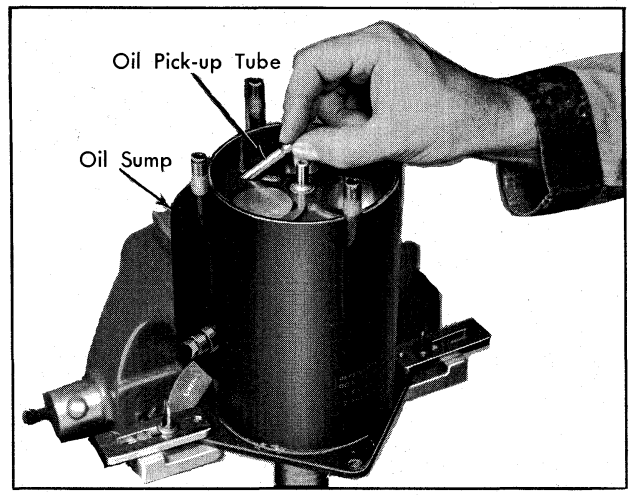


Fig. 1-126 Installing Oil Pick-Up Tube

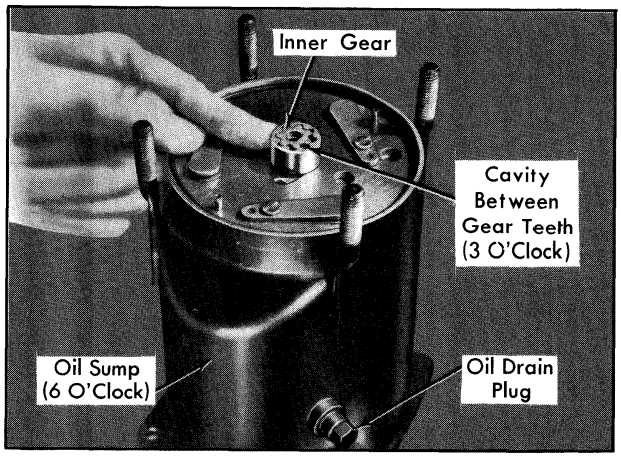


Fig. 1-127 Positioning Oil Pump Gears

Make certain that suction screen does not drop out of place when lowering rear head into position (Fig. 1-129).

If rear head assembly will not slide down over dowels in internal mechanism, twist front head assembly back-and-forth very slightly by-hand until rear head drops over dowel pins.

25. Install nuts on threaded shell studs and tighten evenly to 25 lb. ft. torque using a 0-50 lb. ft. torque wrench.

26. Invert compressor in Holding Fixture and Install compressor shaft seal as described above in "Compressor Shaft Seal" Replacement procedure.

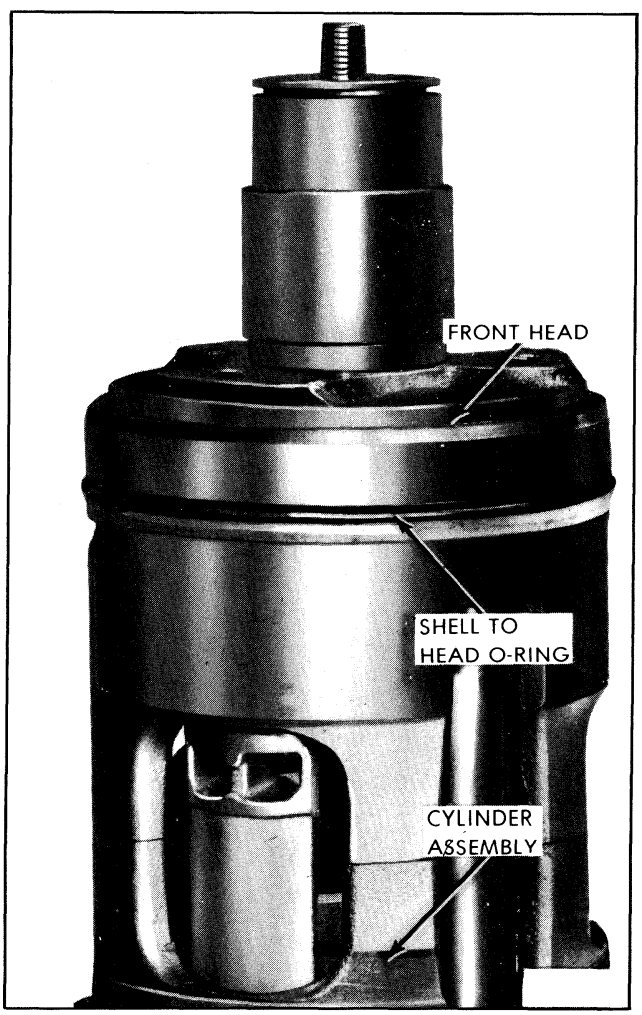


Fig. 1-128 Shell to Front Head O-Ring Installation

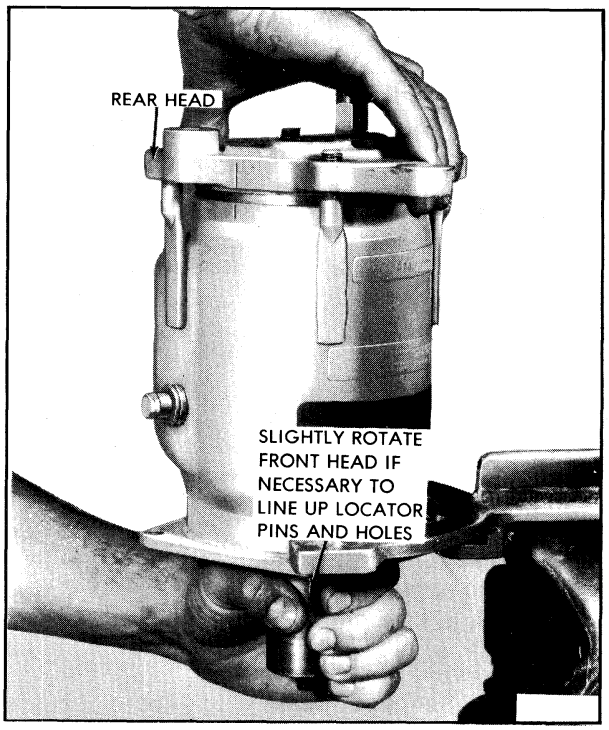


Fig. 1-129 Installing Rear Head

27. Install compressor clutch coil and housing assembly as described above in "Compressor Clutch Coil and Housing Assembly" Replacement procedure.

28. Install compressor pulley and bearing assembly as described above in "Compressor Pulley and Bearing" Replacement procedure.

29. Install compressor clutch plate and hub assembly as described above in "Compressor Clutch Plate and Hub Assembly" Replacement procedure.

30. Add required amount of 525 viscosity refrigerant oil (Fig. 1-64).

31. Check for external and internal leaks as described in the following "Compressor Leak Testing" procedure.

Compressor Leak Testing-External and Internal

Bench-Check Procedure

1. Install Test Plate J-9625 on rear head of compressor.

2. Attach center hose of gage manifold set on Charging Station to a refrigerant drum standing in an upright position and open valve on drum.

3. Connect Charging Station HIGH and LOW pressure lines to corresponding fittings on Test Plate J-9625, using J-25498 and J-5420 Gage Adapters.

Suction port of compressor has large internal opening. Discharge port has small internal opening into compressor.

4. Open LOW pressure control, HIGH pressure control and REFRIGERANT control on Charging Station to allow refrigerant vapor to flow into compressor.

5. Using electronic-type Leak Detector, check for leaks at pressure relief valve, low pressure switch, compressor shell to cylinder, compressor front head seal, rear head seal, oil charge port and compressor shaft seal. After checking, shut off LOW pressure control and HIGH pressure control on Charging Station.

6. If an external leak is present, perform the necessary corrective measures and recheck for leaks to make certain the leak has been corrected.

7. Loosen the manifold gage hose connections to the Gage Adapters J-5420 and J-25498 connected to the LOW and HIGH sides and allow the vapor pressure to release from the compressor.

8. Disconnect both Gage Adapters (J-5420 and J-25498) from the Test Plate J-9625.

9. Rotate the complete compressor assembly (not the crankshaft or drive plate hub) slowly several turns to distribute oil to all cylinder and piston areas.

10. Install a shaft nut on the compressor crankshaft if the drive plate and clutch assembly are not installed.

11. Using a box-end wrench or socket and handle, rotate the compressor crankshaft or clutch drive plate on the crankshaft several turns to ensure piston assembly to cylinder wall lubrication.

12. Connect the Charging Station HIGH pressure line or a HIGH pressure gage and Gage Adapter J-25498 to the Test Plate J-9625 HIGH side connector.

13. Attach a Adapter J-5420 to the suction or LOW pressure port of the Test Plate J-9625 to open the schrader-type valve.

NOTE: Oil will drain out of the compressor suction port adapter if the compressor is positioned with the suction port down.

14. Attach the compressor to the Holding Fixture J-9396 and clamp the fixture in a vise so that the compressor can be manually turned with a wrench.

15. Using a wrench, rotate the compressor crankshaft or drive plate hub 10 complete revolutions at a minimum speed of one revolution per second.

NOTE: Turning the compressor at less than one revolution per second can result in a lower pump-up pressure and disqualify a good pumping compressor.

16. Observe the reading on the HIGH pressure gage at the completion of the tenth revolution of the compressor. The pressure reading for a good pumping compressor should be a minimum of 414 kPa (60 psi).

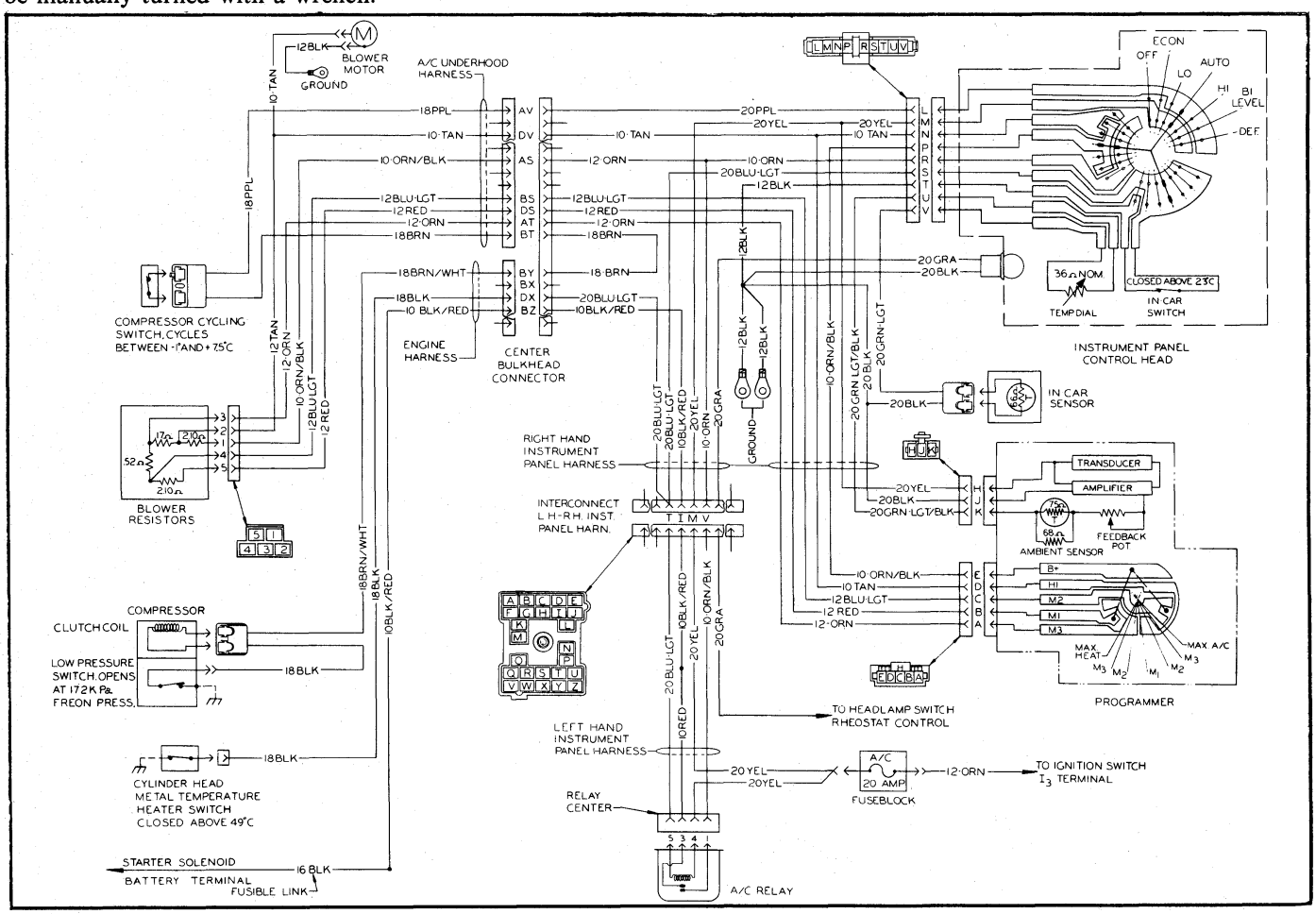
A pressure reading of less than 345 kPa (50 psi) would indicate one or more suction and/or discharge valves leaking, an internal leak, or an inoperative valve and the compressor should be disassembled and checked for cause of leak. Repair as needed, reassemble and repeat the pump-up test. Externally leak test with the electronic-type Leak Detector.

17. When the pressure pump-up test is completed, release the air pressure from the HIGH side and remove the Gage Adapters J-5420 and J-25498 and Test Plate J-9625.

Remove oil charge screw and drain the oil sump.

19. Allow the compressor to drain for 10 minutes, then charge with the proper amount of oil. The oil may be poured into the suction port.

NOTE: If further assembly or processing is required, a shipping plate or Test Plate J-9625 should be installed to keep out air, dirt and moisture until the compressor is installed.



Complete Electrical Circuit Diagram — DeVille, Brougham

LIMOUSINE

TABLE OF CONTENTS

LIMOUSINE
General Description 1-91
Diagnosis 1-104
On-Car Service 1-104
Unit Repair 1-64
Specifications 1-104
Special Tools 1-211

GENERAL DESCRIPTION

The Fleetwood Limousine (6DF23) and Fleetwood Formal Limousine (6DF33) air conditioner system incorporate the design features of the previously described DeVille and Brougham systems which have been modified to meet the needs of these vehicles.

AIR DELIVERY SYSTEM

Limousine (6DF23)

Air is delivered to the rear compartment on these models by a higher capacity blower motor. An additional mode door is used at the heater opening to provide proper airflow. Operation of this door is described later.

On this model, warm air for heating is provided to the rear compartment through a duct located above the driveshaft tunnel, Fig. 1-130. In summer operation, cool air from the instrument panel outlets provides cooling for both front and rear compartments. A small flow of cool air is delivered to both front and rear compartments from the heater outlets.

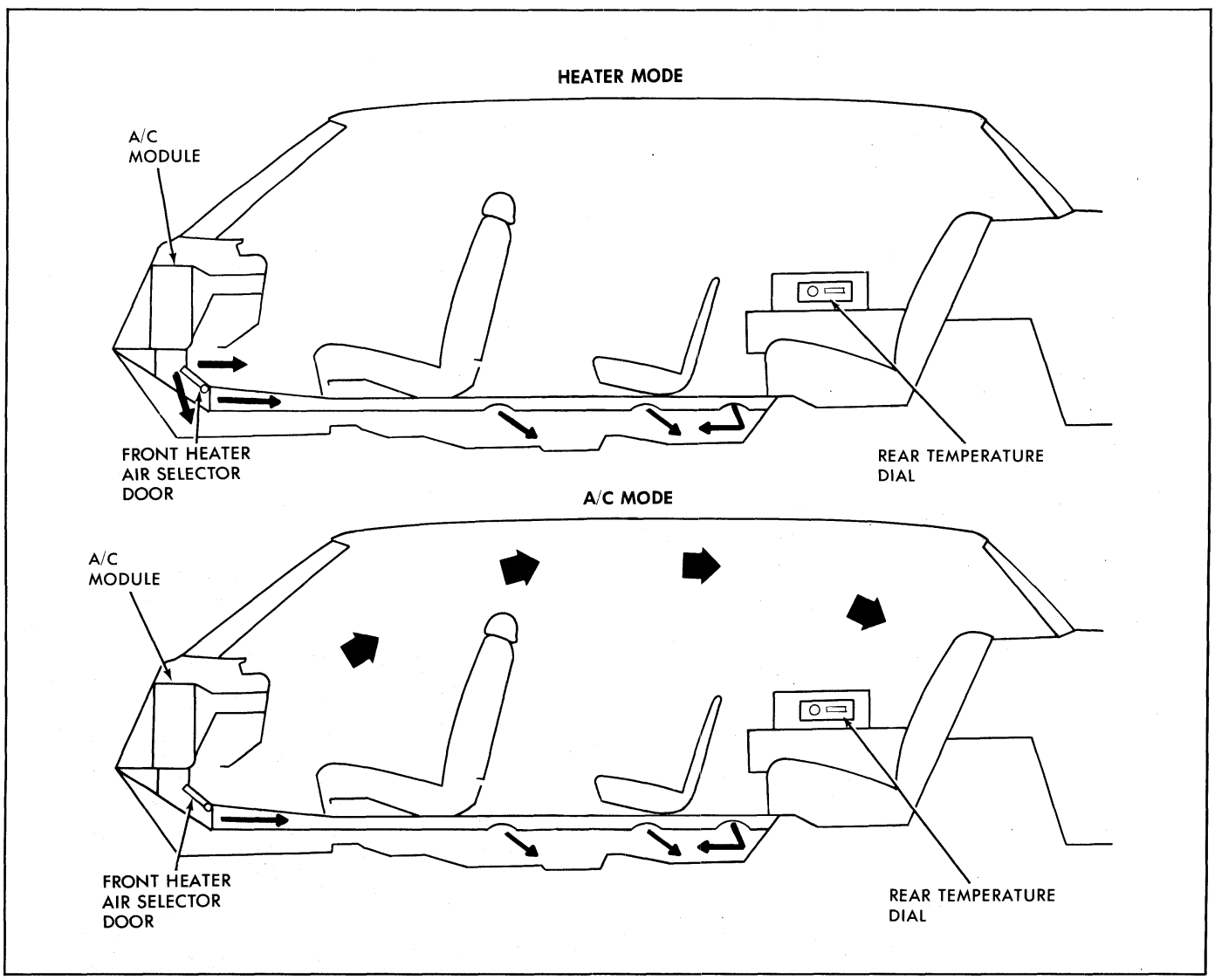


Fig. 1-130 Limousine Airflow

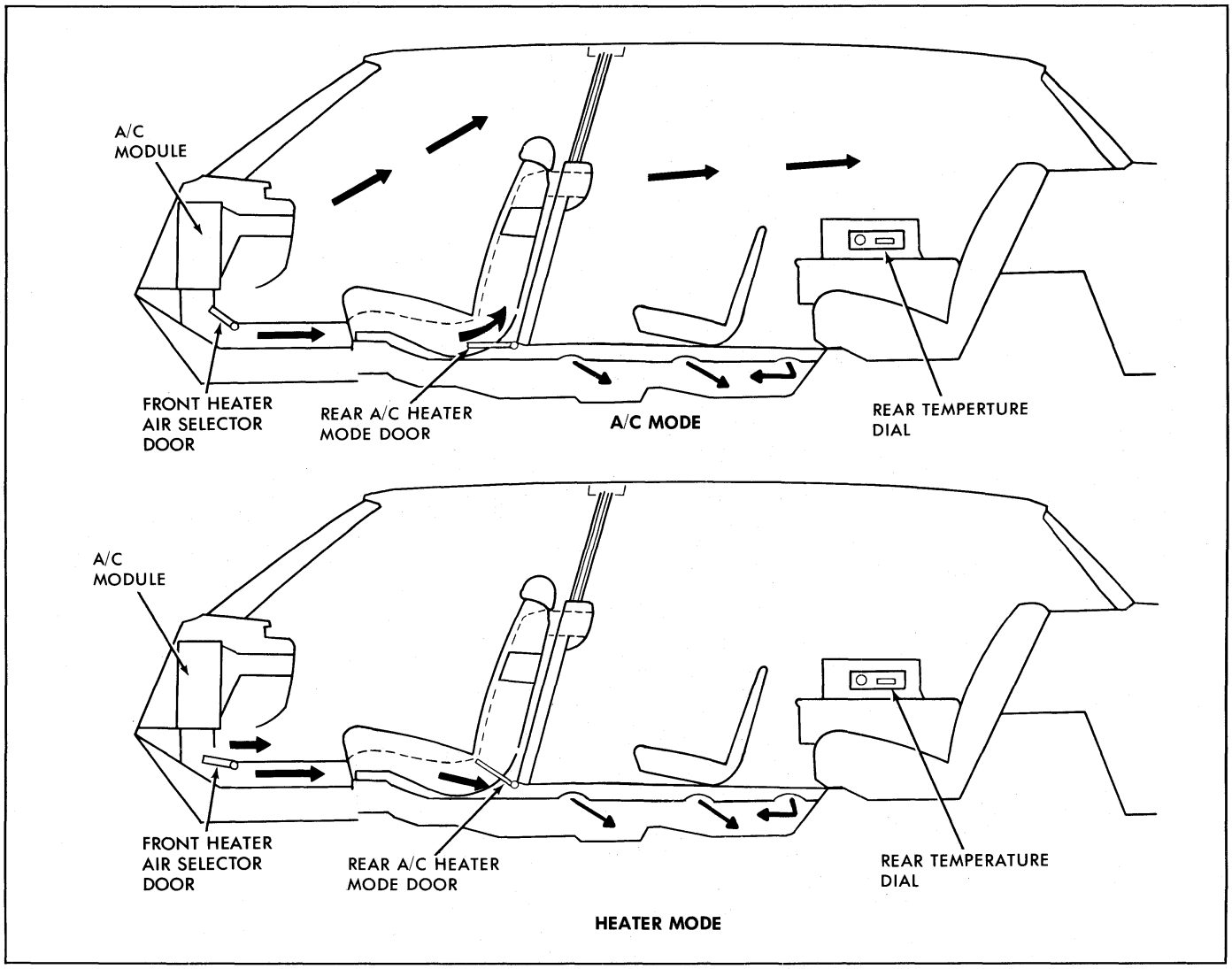


Fig. 1-131 Formal Limousine Airflow

b. Formal Limousine (6DF33)

On these models in cold weather, warm air is delivered to both front and rear compartments through the heater duct above the driveshaft tunnel by the high capacity blower motor, Fig. 1-131. A mode door at the rear of this duct is positioned to direct the airflow to the rear floor area. In warm weather, cool air flows through the duct, however, the mode door is positioned to direct the air stream to the two air conditioner outlets in the compartment partition. A small amount of cool air is also delivered to the rear floor outlets.

BLOWER CONTROL SYSTEM

The front air conditioner control is specific to limousine models and is used to operate the system in all modes of operation previously described except when the control lever is placed in the "Rear" position, Fig. 1-132. In this position, the rear temperature dial, located in the right rear armrest, Fig. 1-133, becomes operational and is used to determine in-car temperature. A full program of automatically selected blower speeds is available to maintain this temperature.

REFRIGERATION SYSTEM

The C.C.O.T. refrigeration system previously described is used without change on limousine and formal limousine applications. The commercial chassis refrigerant hoses



Fig. 1-132 Limousine Control Panel

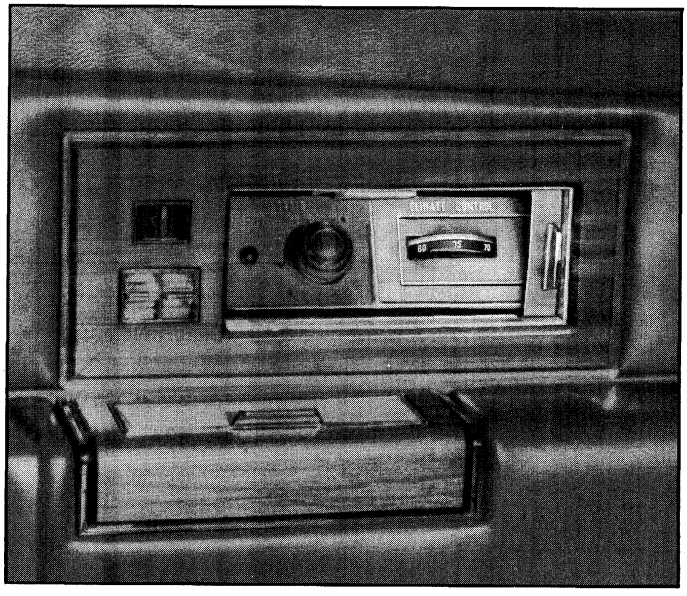


Fig. 1-133 Location of Rear Controls

incorporate fittings so that additional refrigeration components may be "teed-in."

SYSTEM OPERATION AT VARIOUS LEVER SETTINGS

The following vacuum circuits present the limousine and formal limousine operation at various lever settings. On both of these models an additional actuator is used to control the position of the front heater air selection door. This door controls airflow to the front compartment. The formal limousine (model 6DF33) uses one more actuator and door called the rear mode door. Located below the front seat, the door is used to direct airflow to the rear heater or rear A/C outlets as required. The front and rear air selector doors are connected into the upper-lower mode door vacuum circuit and are all actuated together. The formal limousine does not have a vacuum connection at the lower mode door which results in this door being closed at all times.

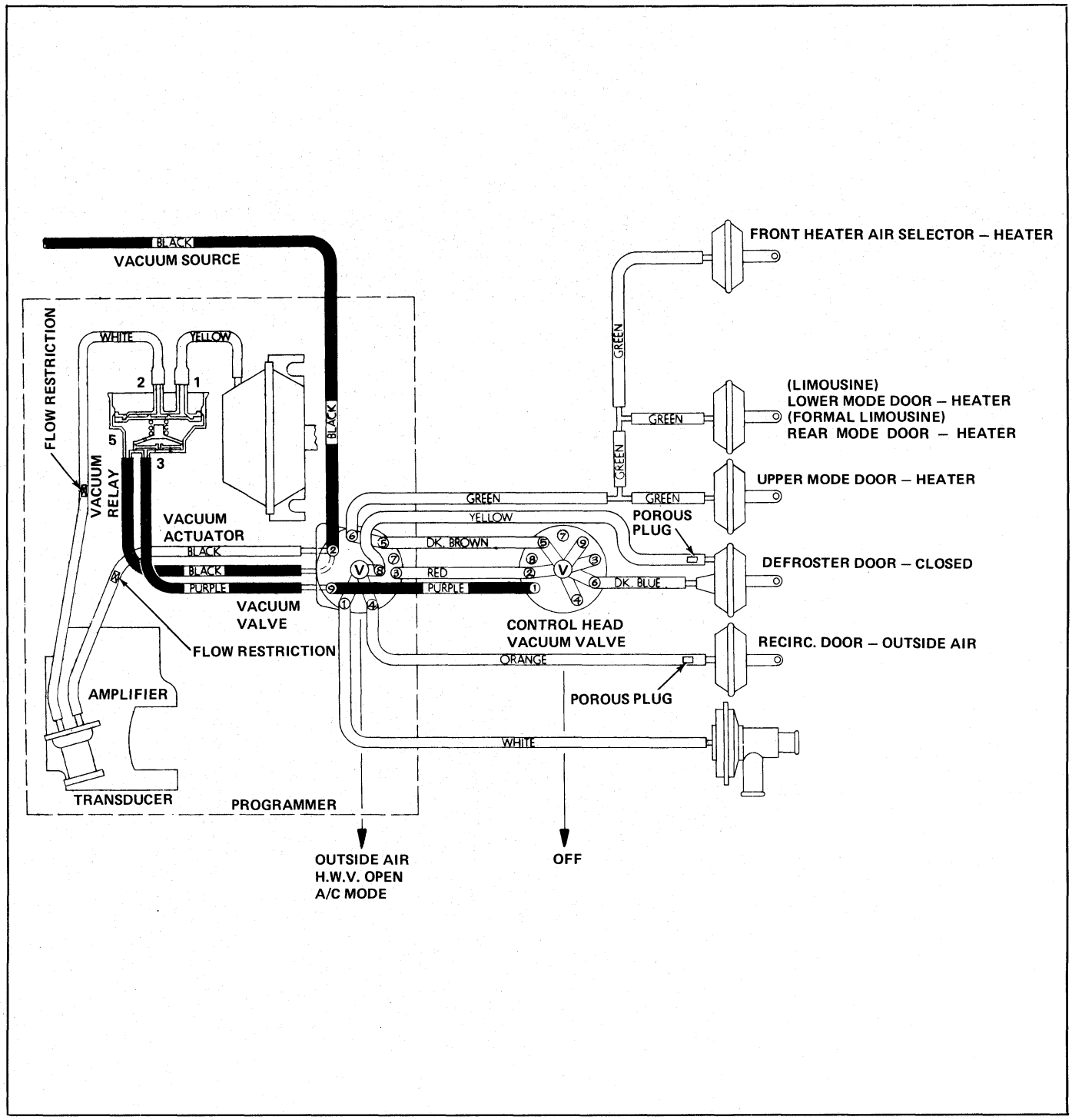


Fig. 1-134 Vacuum Circuit at "Off"

SYSTEM OPERATION AT OFF (Fig. 1-134)

With the control head at "Off" and the programmer set in the A/C mode, the vacuum valve connections shown in Fig. 1-134 are provided. With no vacuum applied to any vacuum actuators the following conditions exist: The water valve is open to provide water flow through the heater core allowing temperature modulated air if required; the recirc door is in the outside air position; the defroster door is completely closed which results in no windshield airflow; the upper, lower, front and rear mode doors provide heater airflow. This is accomplished by the closed position of the upper and lower mode doors which prevents airflow from the A/C outlets and allows the air to pass to the heater duct and front air selector door. With no vacuum on the actuator, the door is open which allows some of the air to be intercepted and delivered out the front heater outlet. The remainder (and majority) of the air is passed through the driveshaft tunnel duct to the rear compartment. The rear mode door on formal limousine models is in its heater position and allows the air to continue and be discharged from the heater outlets.

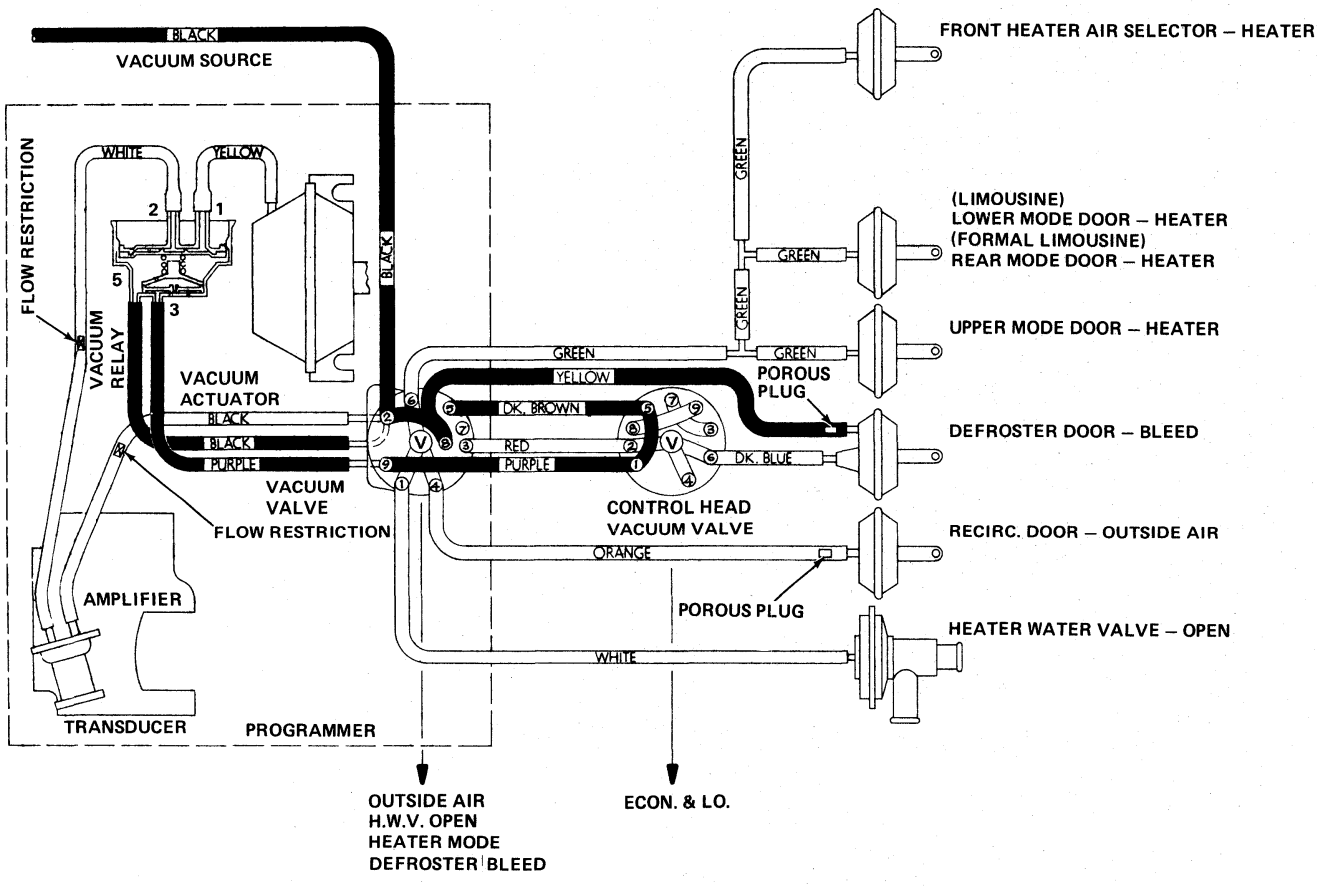


Fig. 135 Vacuum Circuit at "Economy" and "Lo" - Heater Mode

SYSTEM OPERATION AT ECONOMY AND LO-HEATER MODE (Fig. 1-135)

The control head vacuum valve position is the same for both "Economy" and "Lo," however, when the sensor string sets the programmer in the heater mode, the vacuum valve connections shown in Fig. 1-135 are provided. The resulting actuator/door positions and hence airflow is the same as at "Off" except that the defroster bleed port is supplied vacuum so that a small windshield airflow occurs.

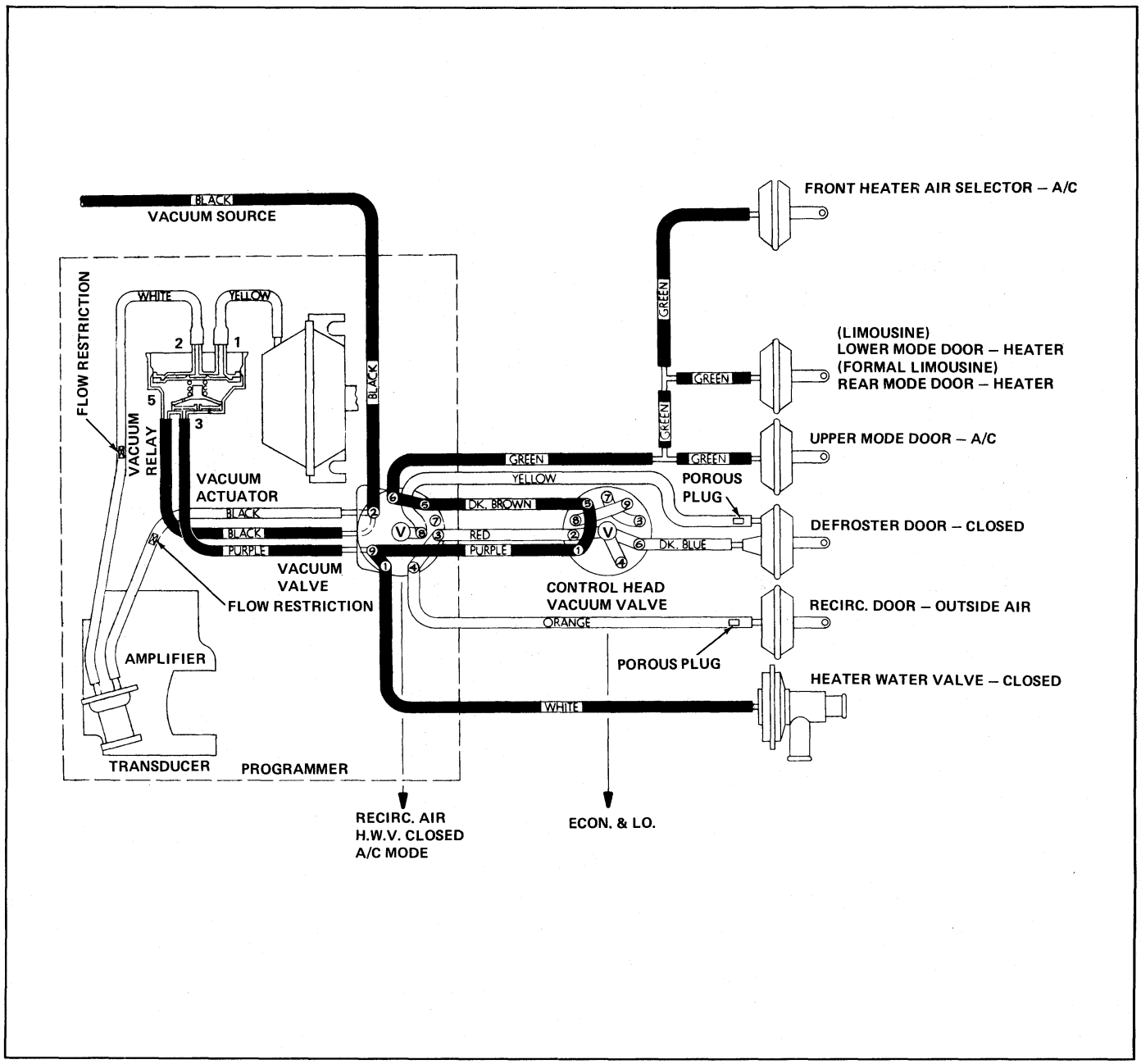


Fig. 1-136 Vacuum Circuit at "Economy" and "Lo" - A/C Mode

SYSTEM OPERATION AT ECONOMY AND LO - A/C MODE (Fig. 1-136)

The control head vacuum valve position is the same for both "Economy" and "Lo," however, when the sensor string sets the programmer in the A/C mode, the valve connections shown in Fig. 1-136 are provided. With this arrangement, vacuum is applied to the water valve to block water flow through the heater core. The recirc door remains in the outside air position and the defroster door remains closed.

Limousine - On the 6DF23 model the upper, lower and front air doors are all actuated. With the upper and lower mode doors in the A/C position, all air is exhausted through the front A/C outlets *except andthat which is allowed to pass through a small hole in the upper mode door. This air continues on to the heater outlet and out to the front compartment through the partially open front heater air door and to the rear compartment by way of the driveshaft tunnel duct.*

Formal Limousine - The vacuum circuit for the formal limousine (6DF33) is similar except that the rear mode door is actuated rather than the lower mode door. This action results in a mode door arrangement similar to bi-level where the upper door is open (a/C position) which allows airflow from the front A/C outlet and the lower door is closed (heater position) to allow a substantial airflow to the heater outlet. Of this air a small portion is intercepted by the front mode door and delivered from the front heater outlet. However, the majority is directed through the driveshaft tunnel duct. When this airstream reaches the rear mode door, it is directed upwards and out the rear A/C outlets. Since the rear mode door does not completely seal, some air will be delivered from the rear heater outlets..

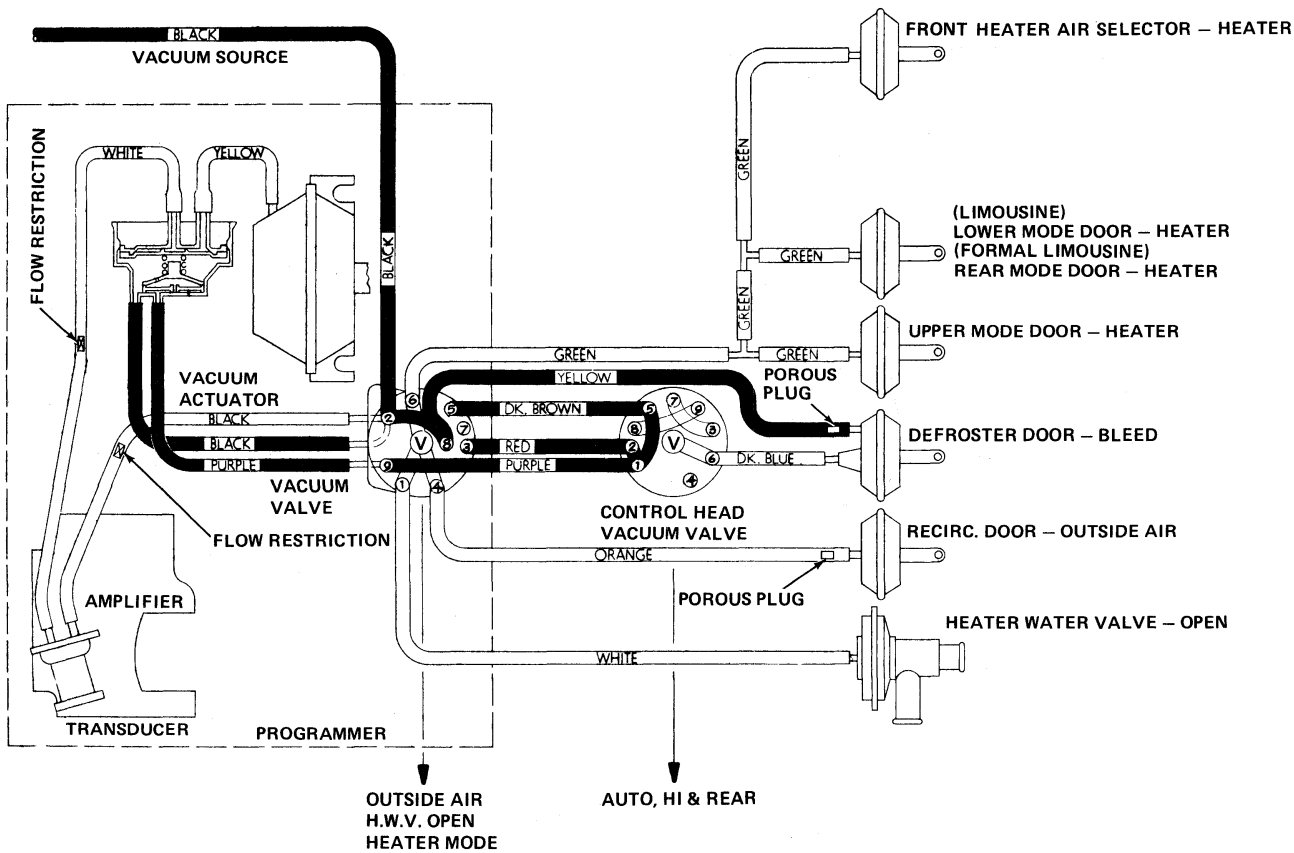


Fig. 1-137 Vacuum Circuit at "Auto" "Hi" and "Rear" - Heater Mode

SYSTEM OPERATION AT AUTO, HI AND REAR - HEATER MODE (Fig. 1-137)

Control head vacuum valve connections at "Auto," "Hi" and "Rear" while not identical will always result in the port connections shown in Fig. 1-137. Door operation and airflow are the same as described for "Economy" and "Lo."

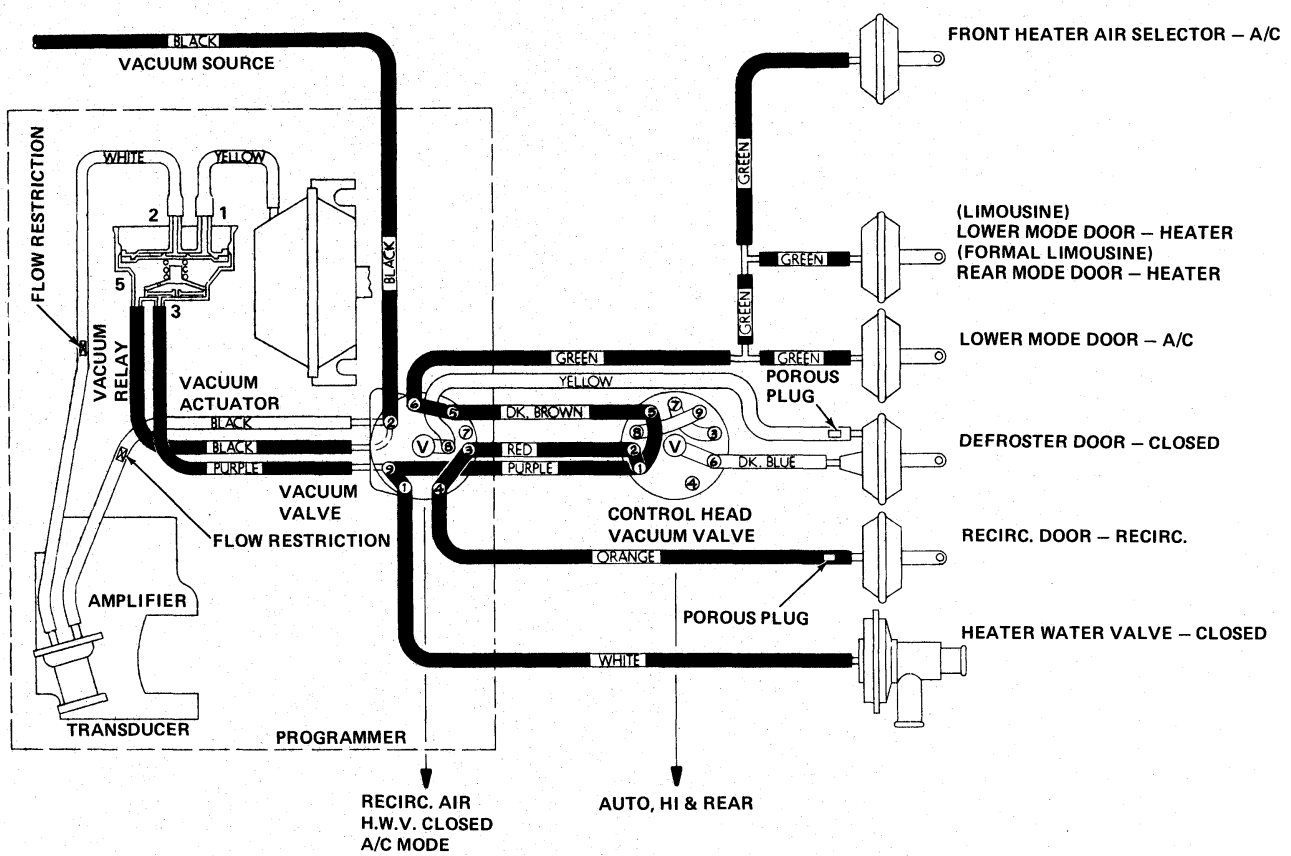


Fig. 1-138 Vacuum Circuit at "Auto", "Hi" and "Rear" A/C Mode

SYSTEM OPERATION AT AUTO, HI AND REAR - A/C MODE (Fig. 1-138)

Control head vacuum valve connection at "Auto," "Hi" and "Rear" while not identical will always result in the port connections shown in Fig. 1-138. Door operation and airflow is the same as at "Economy" and "Lo" except that when maximum cooling is required, the recirc door is actuated to provide recirc air. This position is shown in Fig. 1-138. As the sensor string senses the approach of dialed temperature, it causes the programmer to vent the recirc port and return to outside air. This can be seen in the complete vacuum circuit, Fig. 1-143.

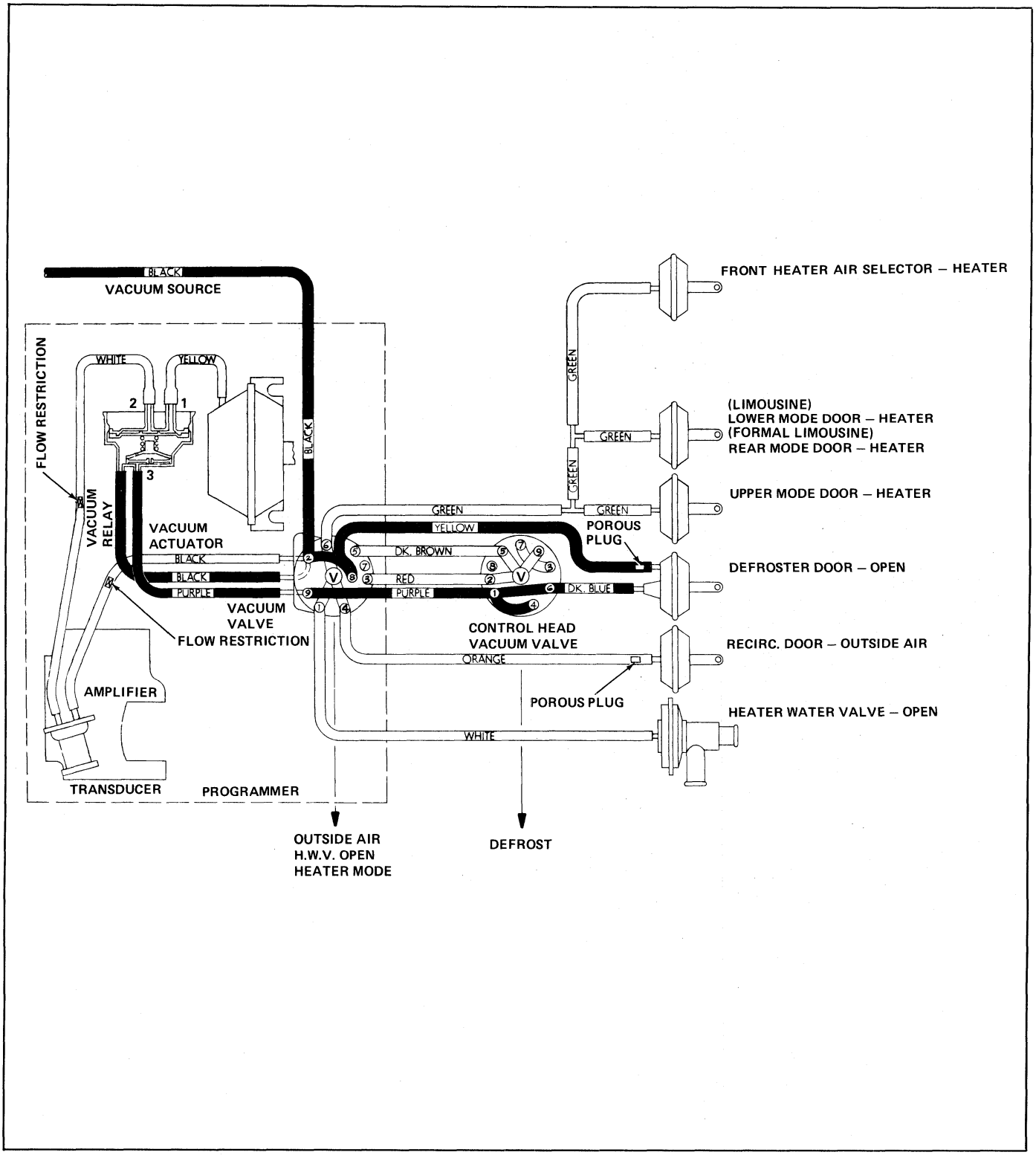


Fig. 1-139 Vacuum Circuit at "Def"

SYSTEM OPERATION AT DEFROST (Fig. 1-139)

The vacuum circuit at defrost is essentially the same as shown in Fig. 1-35.

With the control head in "Defrost" vacuum us supplied to the center port of the defroster door actuator which moves the defroster door full open. The position of the programmer valve has no effect in this circuit. With both mode doors vented, the doors remain closed providing heater airflow, however, since the defroster door intercepts most of this air, very little heater airflow results. The recirc actuator and water valve are vented so that outside air and coolant flow through the heater core are provided.

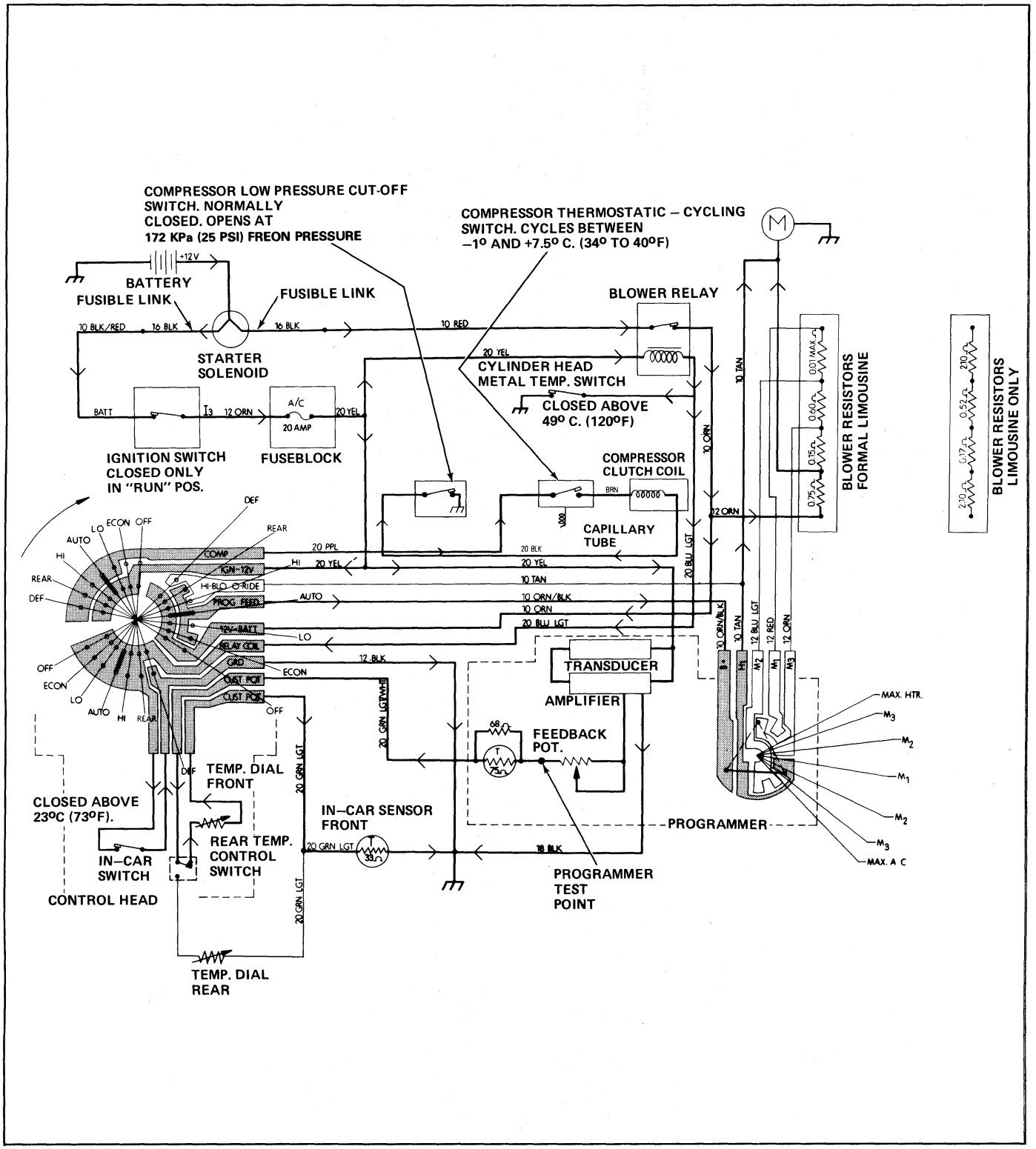


Fig. 1-140 Blower Operation - Front Controlling

BLOWER OPERATION AT ALL EXCEPT REAR (Fig. 1-140)

The control head used on both limousine models contains a rear temperature control switch which forms the connection shown in Fig. 1-140 in all control head positions except "Rear." In these positions, the front temperature dial is in control of the system and the blower control circuits operate as previously described. The specific blower resistance values for the limousine and formal limousine are shown in Fig. 1-140.

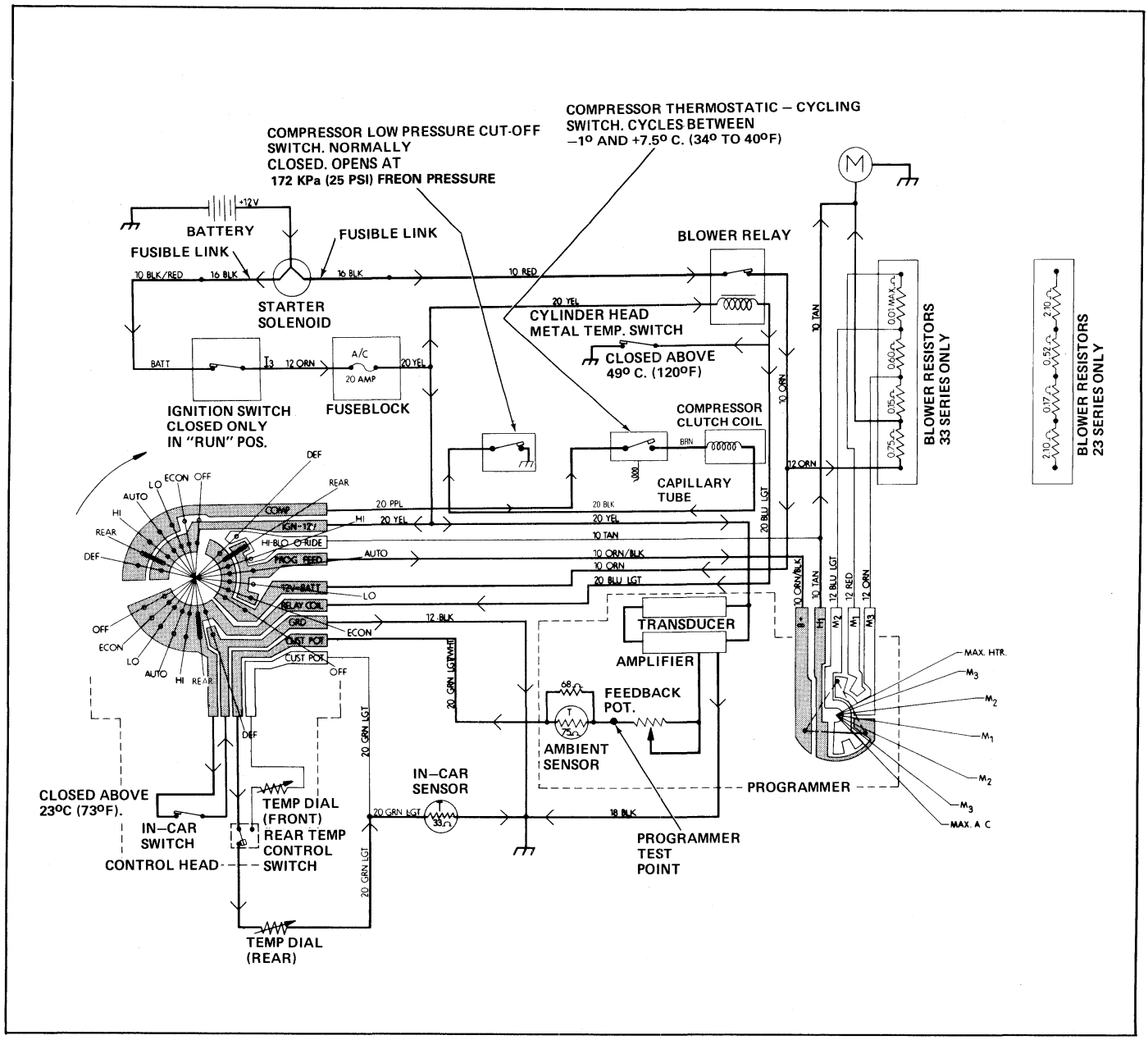


Fig. 1-141 Blower Operation - Rear Controlling

BLOWER OPERATION AT REAR (Fig. 1-141)

In the "Rear" position of the control head, the rear temperature control switch is mechanically moved to provide the connection to the rear temperature dial shown in Fig. 1-141. In this position, regulation of blower speed, discharge air temperature, air delivery mode, system turn-on and compressor operation are all accomplished automatically to maintain the temperature on the rear dial.

Four blower speed, HI, MED3, MED2, and MED1 are utilized. If the car interior is significantly hotter or colder than the temperature on the dial, the blower will start at higher speed and then sequence down to lower speeds as the dial temperature is approached.

Discharge air temperature will be varied automatically between approximately 7°C and 66°C (45°F and 150°F). If the discharge air temperature is above approximately 32°C (90°F), the air will be delivered from the heater outlets while below approximately 24°C (75°F) it will be delivered from air conditioner outlets.

If the car interior is above approximately 23°C (73°F), the system will be turned on immediately when the car is operated by the in-car switch. If the car interior is below 23°C (73°F), system turn-on will be delayed, if the engine is cold, until engine coolant reaches approximately 49°C (120°F) when it is turned on by the heater switch.

Compressor operation is provided at all ambient temperatures above approximately 0°C (32°F) even when not required for cooling, to assure maximum dehumidification of the air.

Recirculated air is used when maximum cooling is required.

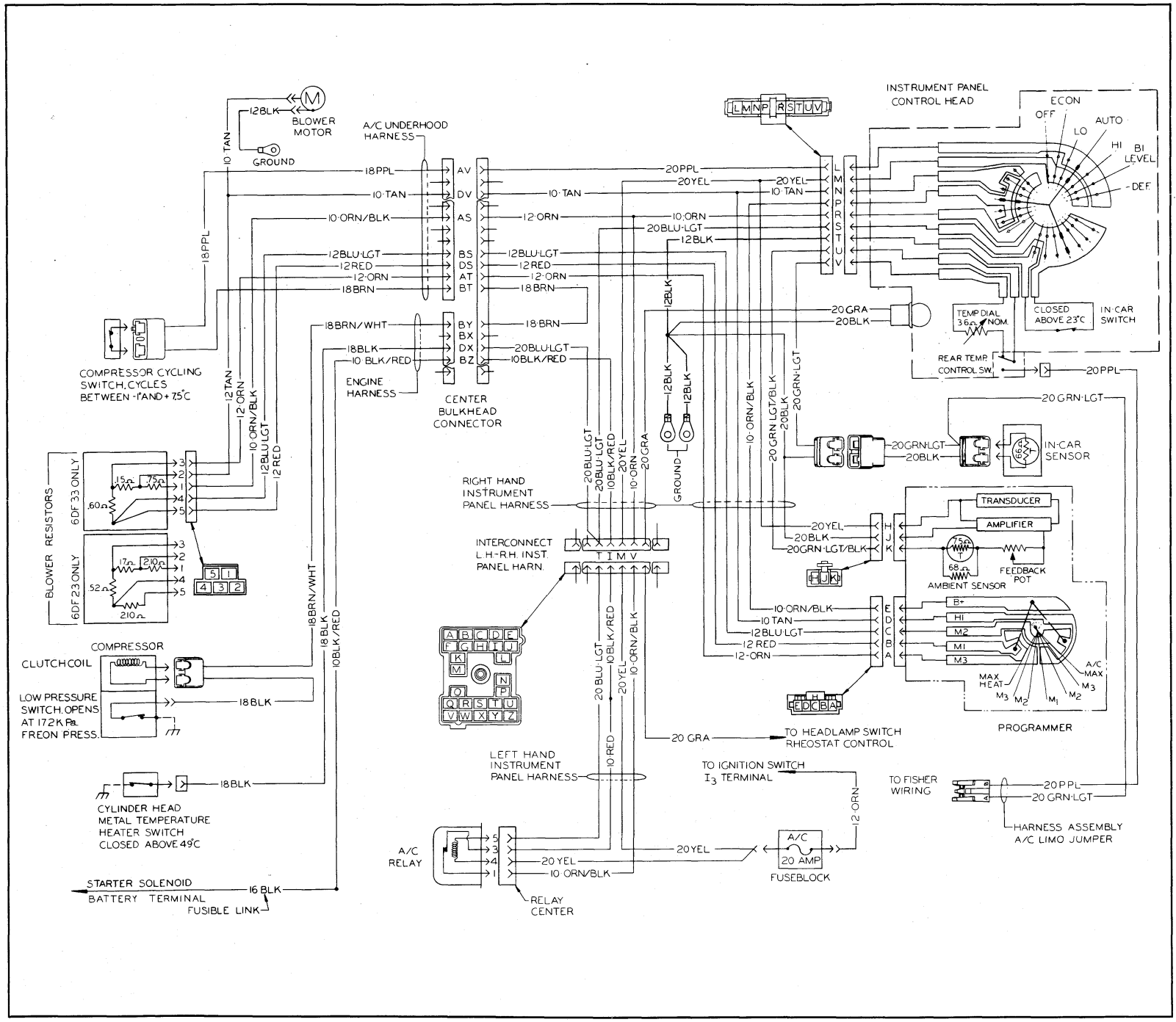


Fig. 1-142 Complete Electrical Circuit - Limousine

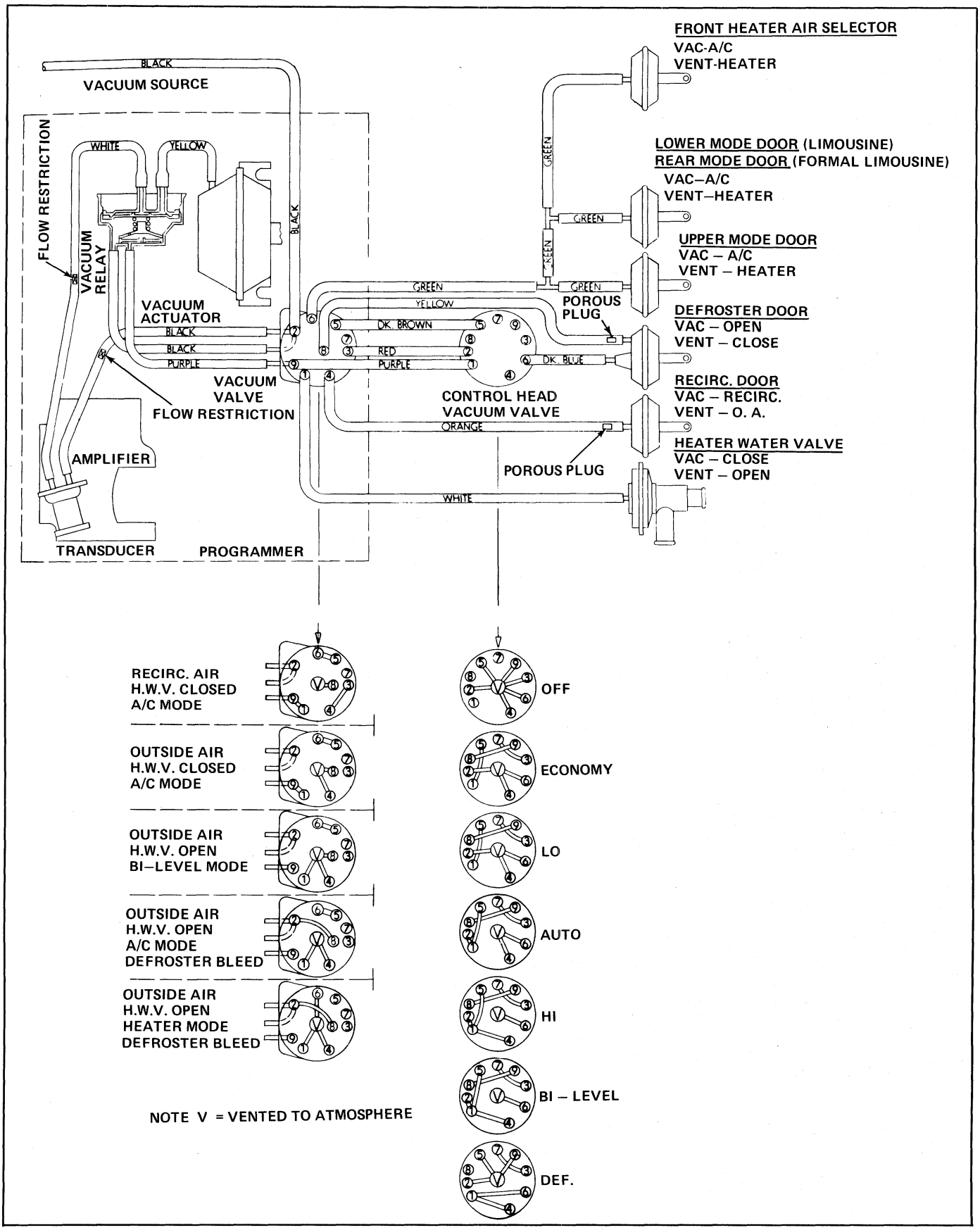


Fig. 1-143 Complete Vacuum Circuit - Limousine

DIAGNOSIS - SERVICE PROCEDURES

Refer to page 1-36 for diagnosis information and to page 1-49 for service procedures.

TORQUE SPECIFICATIONS (EXCEPT ELDORADO AND SEVILLE)

Material	Application	Size	Inch Pounds	Newton Meters
1022N	Center Outlet Duct to Inst. Panel Screw	M4.2 x 1.41	15	1.6
6010M	Center Outlet Duct to Distributor Screw	M4.2 x 1.41	15	1.6
300M	Compressor Front Support to Compressor Bolt	5/16-24	25*	
300M	Compressor Front Support to Crankcase Bolt	3/8-16	40*	
300M	Compressor Rear Support to Compressor Bolt	3/8-16	40*	
300M	Compressor Rear Support to Intake Manifold Bolt	3/8-16	40*	
1022N	Control Head to Inst. Panel Screw	M4.2 x 1.41	13	1.4
9.8N	Condenser Top Bracket Attach. Screw	M6.3 x 1.00	90	10
6010M	Defroster Nozzle Attach. Screw (Top)	M4.2 x 1.41	15	1.6
6010M	Defroster Nozzle Attach. Screw (Bottom)	8-18	13	
1022N	Distributor to Inst. Panel Low Attach. Screw	M4.2 x 1.41	13	1.4
6010M	Heater Outlet Attach. Screw	M4.2 x 1.41	13	1.4
1022N	In-Car Sensor Attach. Screw	M4.2 x 1.41	13	1.4
1022N	LH Adapter Top Attach. Screw	M4.2 x 1.41	13	1.4
6010M	LH Out Duct Attach. Screw	M4.2 x 1.41	15	1.6
6010M	LH Out Duct to LH Adapt. Screw	8-18	15	
1022N	Module Insulator Attach. Screw	M4.2 x 1.41	13	1.4
6010M	Module Attach. Screw	M6.3 x 1.81	50	5.6
6010M	Programmer Attach. Screw	M4.2 x 1.41	13	1.4
6010M	Programmer Frame Screw	M4.2 x 1.41	13	1.4
1022N	RH Adapter to Inst. Panel Screw	M4.2 x 1.41	13	1.4
6010M	Selector Assy. Attach. Screw	M4.2 x 1.41	13	1.4

*Foot Pounds TS-Self Tapping

ELDORADO

TABLE OF CONTENTS

ELDORADO
General Description 1-105
Diagnosis 1-137
On-Car Service 1-149
Unit Repair 1-154
Specification 1-157
Special Tools 1-211

GENERAL DESCRIPTION

Air Delivery System

In normal operation, air utilized by the system is drawn into the body air plenum through openings at the base of the windshield and directed to the air inlet which is located inside the plenum on the right side of the body. From the air inlet, the air enters the blower which directs it through the evaporator where it is filtered, dehumidified and cooled to approximately 2°C (35°F). It is then "reheated" as required by being passed through and around the heater core. This air is then directed by air doors in the heater assembly to the air conditioner outlets in the instrument panel, to the heater distributor at floor level or to the defroster outlets. Air exhausts from the body by passing through the air exhaust grilles located in the door lock pillars. This provides positive air flow even when windows are closed. The components comprising the air delivery system are listed and described below.

a. Air Inlet

The air inlet which is attached to the rear surface of the blower scroll and located inside the body air intake plenum is composed of a plastic housing, an air door and a vacuum actuator that controls the position of the door. See Fig. 1-145. The door has two positions - with no vacuum applied to the actuator, the door is in a rearward position, blocking off the recirculating air opening and allowing only outside air to enter the blower. When vacuum is applied to the actuator, the door is moved to a forward position where it blocks most of the outside air and allows approximately 80% of the total air supply to be recirculated from the passenger compartment.

b. Blower and Evaporator

The blower and evaporator, shown in Fig. 1-145, is located in the engine compartment on the right side of the cowl. This assembly consists of a plastic housing, a squirrel-cage type blower, the evaporator core and accumulator.

The evaporator core, which is aluminum and similar in construction to the car radiator, is the actual cooling unit of the system. The blower draws air from the air inlet and forces it through the evaporator core where it is cooled and dehumified. Condensate is allowed to drain from the housing through a small hole in the bottom. The blower is air cooled - a small portion of blower output air is circulated through the motor housing via a rubber tube.

c. Heater

This assembly, shown in Fig. 1-146, is located inside the passenger compartment under the right-hand side of the instrument panel. It consists of a sheet metal and plastic housing, a heater core, an air-mix door which is controlled by the ATC (automatic temperature control) programmer, an upper and a lower mode door, each controlled by a vacuum actuator, and a defroster door which is controlled by a two-stage vacuum actuator.

Cold, dehumidified air from the evaporator enters this assembly through an opening in the dash panel and is reheated, as required, by the heater core. The **air-mix door** controls the amount of reheat that takes place. In one of its end positions it forces all the air from the evaporator to flow through the hot heater core - the resulting air stream is very hot. In the extreme opposite position, the door forces all the air to bypass around the heater core so that no reheat takes place and the resulting air stream is very cold. In intermediate positions, some of the air passes through the heater core and some bypasses it, so that the resulting air stream is mixed to the desired temperature.

The air stream is next directed by **two mode** doors so that it either flows out an opening in the rear surface of the heater case and into the A/C distributor or it continues to flow to the left toward the heater distributor. The two mode doors operate in unison most of the time, causing air to be discharged either from A/C outlets or from the dealer distributor; however, when the control head lever is set at "Bi-Level", the upper mode door is not actuated and allows part of the air stream to continue on to the heater distributor while the lower mode door is actuated and positions itself to cause the remainder of the air stream to enter the A/C distributor and be delivered from the A/C outlets. This type of air delivery is referred to as bi-level air delivery.

The defroster door located at the left-hand end of the heater is operated by a two-stage vacuum actuator and has three positions. With vacuum applied to the side port of the actuator, the door is pulled down slightly so that it intercepts only a small amount of air to be diverted to the defroster outlet. When vacuum is applied to both the side and center ports, the door is pulled full down and intercepts most of the air that would normally go to the heater distributor.

d. Air Conditioner Distributor

The A/C distributor is a large plastic duct attached to the rear surface of the heater. It receives air from the heater and distributes it to the left-hand center and right-hand A/C outlets through flexible air hoses and plastic ducts to the outlets, Fig. 1-146.

e. Air Conditioner Outlets

Four outlets, Fig. 8-15, are located in the instrument panel; one at the left side of the cluster. Two in the center of the pad and one at the right-hand side. Each outlet provides an air stream whose direction can be controlled independently. The outlet may be rotated to provide a vertical

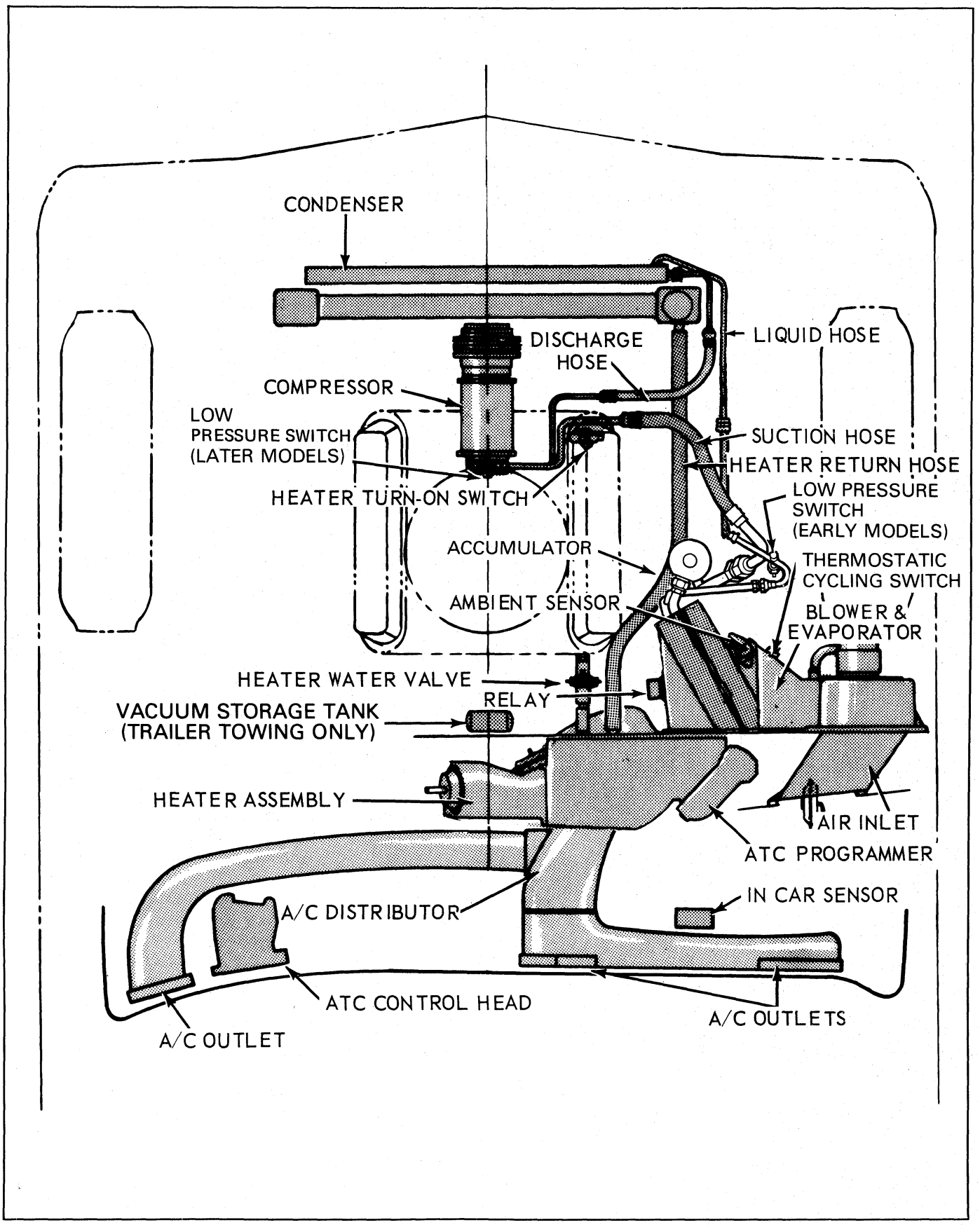


Fig. 1-144 Location of Air Conditioner Components

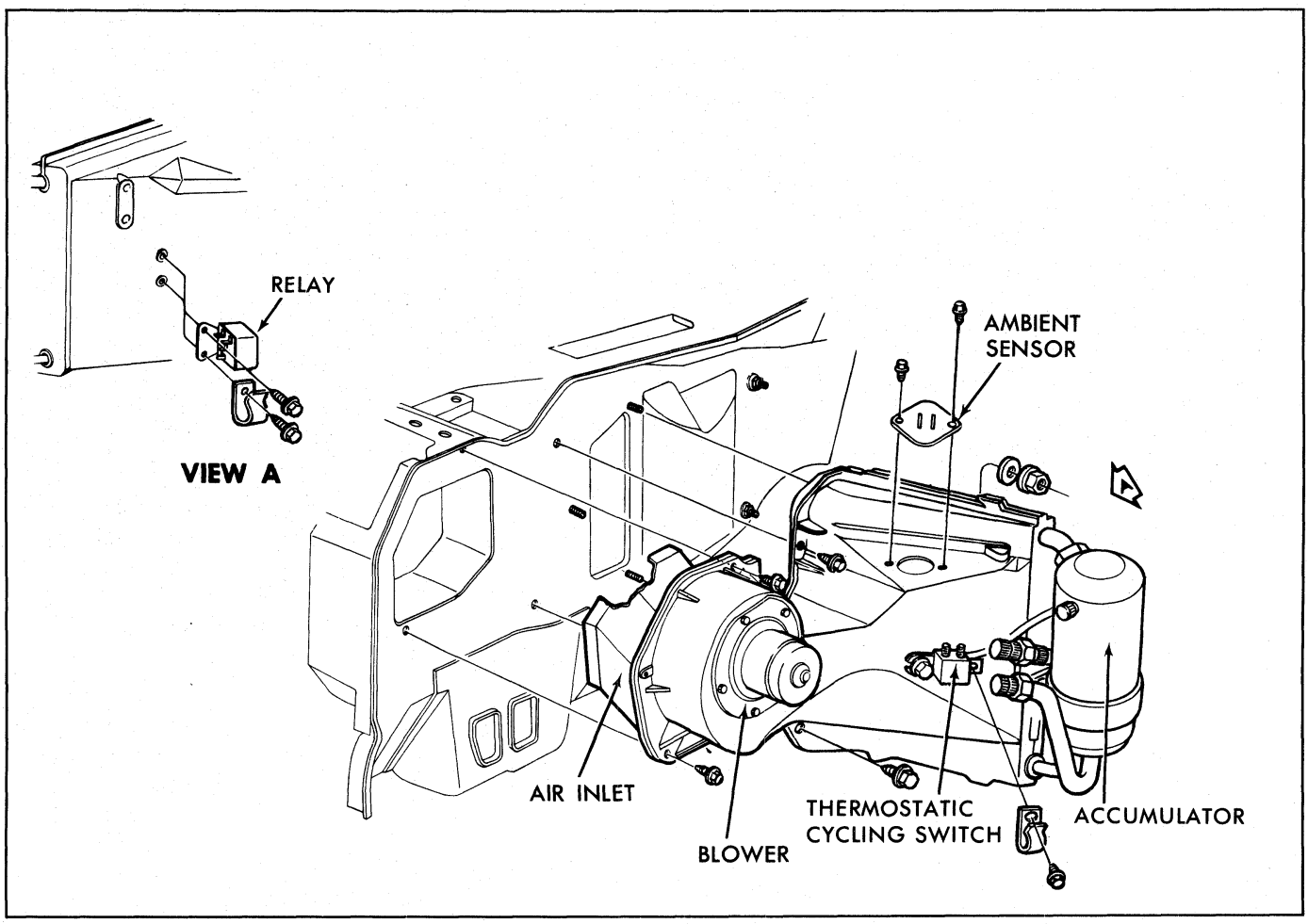


Fig. 1-145 Air Inlet, Blower and Evaporator

air adjustment while the knob is used to provide horizontal adjustment. Air flow may be stopped altogether from each outlet by moving the shut-off knob beneath each outlet.

A moderate flow of cool air to the floor is provided by two small plastic outlets located on the sides of the A/C distributor (Fig. 1-146). The right hand outlet can be rotated to obtain a more indirect flow of air to the floor area, if desired.

f. Heater Outlet

The heater outlet, (See Fig. 1-146) is attached to the bottom surface of the heater case at centerline of car. It distributes air to the left-hand and right-hand sides of the front floor and also directs two heavy streams of air under the front seat to heat the rear compartment.

g. Defroster Nozzle

A unitized defroster nozzle delivers defrosting air to both sides of the windshield. It is attached to the top of the heater case near centerline with one screw and to the lower windshield frame.

Temperature Control System

The temperature control system provides automatic regulation of the car interior temperature regardless of outside temperature changes. The control panel, Fig. 1-147, consists of a temperature dial with a range of 18°C to 29°C (65°F to 85°F) and a single sliding lever to permit the driver to choose various modes of operation. The "Auto" setting is recommended for most situations. There are 5 additional settings which provide driver control for unusual conditions. An explanation of the system operation at various lever settings begin on page 1-114.

Control System Components

Following is a complete list of the components which comprise the temperature control system. The location of the part is given together with a brief description of how the part works. System operation and how the various components interact within the system is explained in a subsequent section.

a. Control Panel

The control panel, Fig. 1-147, is located in the instrument panel cluster to the left of the steering column and consists of a plastic bezel and baseplate, an acrylic lens and the functional components described below.

The *temperature dial* is graduated in 5°F increments between 18°C to 29°C (65° to 85°F) and is color-coded - red for hot blue for cold and white for moderate temperatures - to facilitate adjustments. The dial actuates and varies the resistance of a wire-wound rheostat mounted directly above it.

The *circuit board electrical switch* is mounted on the underside of the baseplate. Attached to and positioned by the control lever are wiper contacts which ride on the circuit board pads to provide the required electrical circuit connections. How these connections are made is shown in Figs. 1-168 through 1-174. Electrical wires from the switch

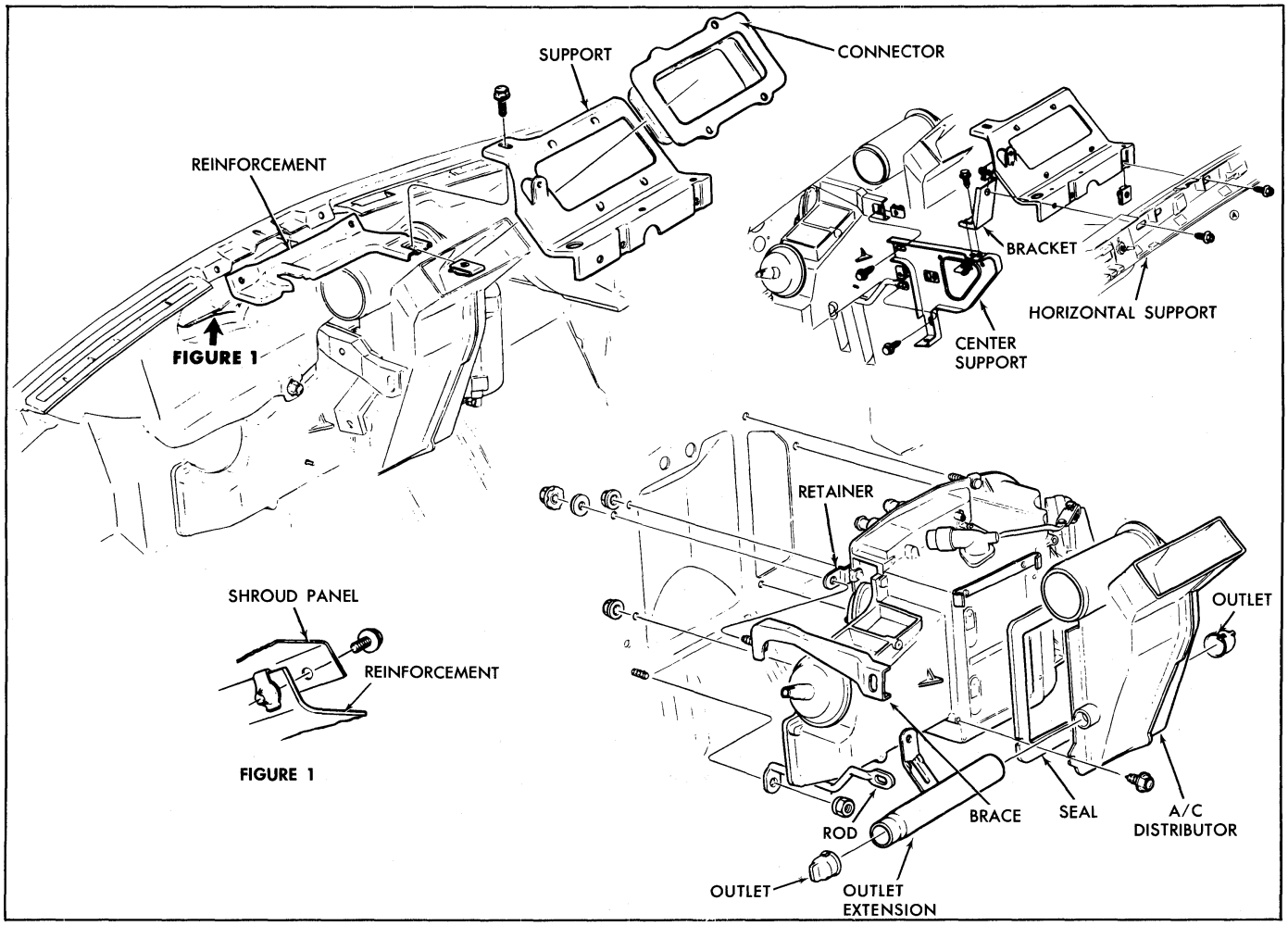


Fig. 1-146 Heater Assembly

and from the temperature dial rheostat terminate at a ten-way connector.

The *in-car turn-on switch* is a thermostatic switch enclosed in a small plastic cylinder located just forward of the wire-retaining clip on the baseplate. It senses car interior temperature and will close and turn the system on if that temperature is above approximately 23°C (73°F), even if engine water is cold and the other turn-on switch, located in the right cylinder head, is cold. This provides immediate cooling in a hot car that has not been run for some time.

The *control vacuum valve,* located at the forward edge of the baseplate, is a nine-port rotary valve which interconnects or vents the vacuum hoses attached to it to perform various vacuum functions required in the system. How the valve performs these functions is shown in Figs. 1-153 through 1-159.

The control lens and the temperature dial are illuminated by a single bulb on the right side of the control.

b. Sensors

Two sensors are used, one sensing outside air temperature and the other the car interior temperature. Both are disc-type thermistors approximately .30″ in diameter and .060″ thick. (A thermistor is a special resistor with a value that changes markedly with temperature change - it also differs from an ordinary resistor in that its resistance decreases as it gets hotter). The changes in resistance of these units forms the basic input to the control system.

The *in-car sensor* is located behind the slots on the instrument panel top cover.

The *ambient sensor* is mounted on a flat phenolic board that is attached to the plenum surface of the evaporator. The sensor protrudes into and senses the temperature of the airstream entering the evaporator core. Fig. 1-177 shows sensor characteristics. Also mounted on the evaporator case is the thermostatic cycling switch (fig. 1-144) which cycles the compressor on and off as a function of evaporator inlet temperature as described on page 1-12.

c. Aspirator

To provide accurate sensing of the car interior temperature, a small amount of air is drawn into the in-car sensor housing and passed over the thermistor. See Fig. 1-148. This air movement is accomplished by the use of an aspirator mounted on top of the heater assembly and a rubber hose that connects the in-car sensor housing to the aspirator. The aspirator is a tube-within-a-tube arrangement; air from the heater case is discharged out the main, outer tube - this air stream causes a suction at the end of the inner tube so that air flows out it also. The aspirator is equipped with a shield to prevent its outlet end from being blocked.

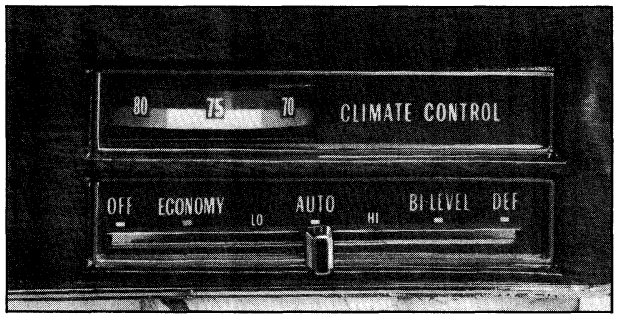


Fig. 1-147 Climate Control Panel Face

d. Programmer

The programmer designated MKII, contains the bulk of the temperature control components, and is located in the passenger compartment on the right-hand end of the heater case. It may be identified by the white electrical connector. It consists of a zinc die-cast chassis, a removable plastic cover and the functional components described below. See Fig. 1-149.

The *amplifier,* mounted to the programmer chassis, is athree-stage D-C amplifier that accepts a weak electrical signal from the sensors and the temperature dial and provides a strong output signal proportional to input. The amplifier should be serviced only as an assembly. No attempt should be made to repair an amplifier except by an experienced electronics technician with the proper service aids for calibration.

The *transducer,* is mounted directly to the amplifier board and is essentially a throttling device with the vacuum level set by balancing an air force against a ball with a magnetic attraction between the armature and pole piece. Output current from the amplifier flows through the solenoid coil to control the vacuum level of the transducer. This component, in effect, transforms the electrical signal from the amplifier to a vacuum signal which is fed to the vacuum motor.

The *vacuum checking relay* provides two separate vacuum checking functions. See Fig. 1-150. In the upper part of the relay is a conventional rubber check valve which is opened by engine vacuum applied at port 5, allowing port 3, which supplies vacuum to the rotary vacuum valve on the programmer and the control head, to be evacuated. If engine vacuum drops because of acceleration or steep grades, the check valve closes, maintaining the vacuum level at port 3.

In the lower part of the relay is a spring-loaded diaphragm which blocks or passes regulated vacuum from the transducer which is connected at port 2 to the vacuum motor which is connected to port 1. When engine vacuum at port 5 is high, the diaphragm is pulled upward allowing regulated vacuum to pass to the vacuum motor. When engine vacuum drops, the diaphragm moves downward blocking passage and maintaining vacuum in the vacuum motor.

The *vacuum motor,* produces all mechanical motion within the programmer. It positions the vacuum motor mechanism which actuates the rotary shaft which drives the air-mix door link. This same mechanism moves the blower circuit board wiper, the vacuum valve operating arm and the feedback potentiometer. The vacuum motor mechanism is spring-loaded by a spring at its left-hand end so that with no

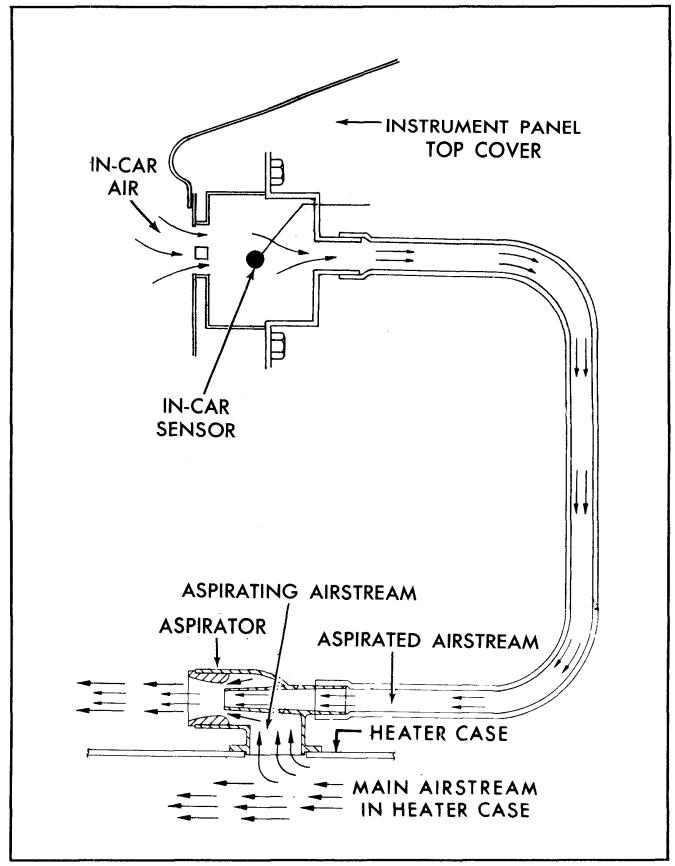


Fig. 1-148 In-Car Sensor and Aspirator

vacuum it is fully extended out of the vacuum motor. This is the "Max A/C" position. When vacuum is applied to the vacuum motor, the mechanism is pulled into the vacuum motor - approximately 8" of mercury vacuum is required to pull the mechanism all the way to the "Max Heat" position. In order to prevent the loss of position during stop-restart operations, it is necessary to add a restriction between the

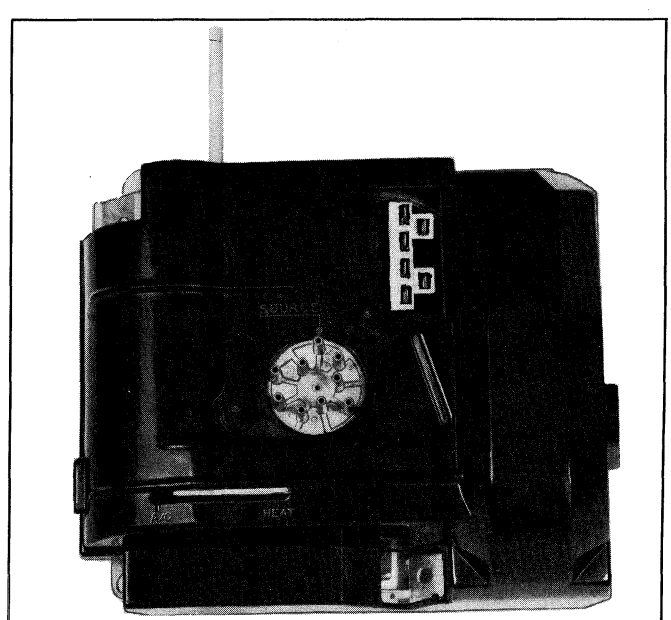


Fig. 1-149 MK II Automatic Temperature Control Programmer

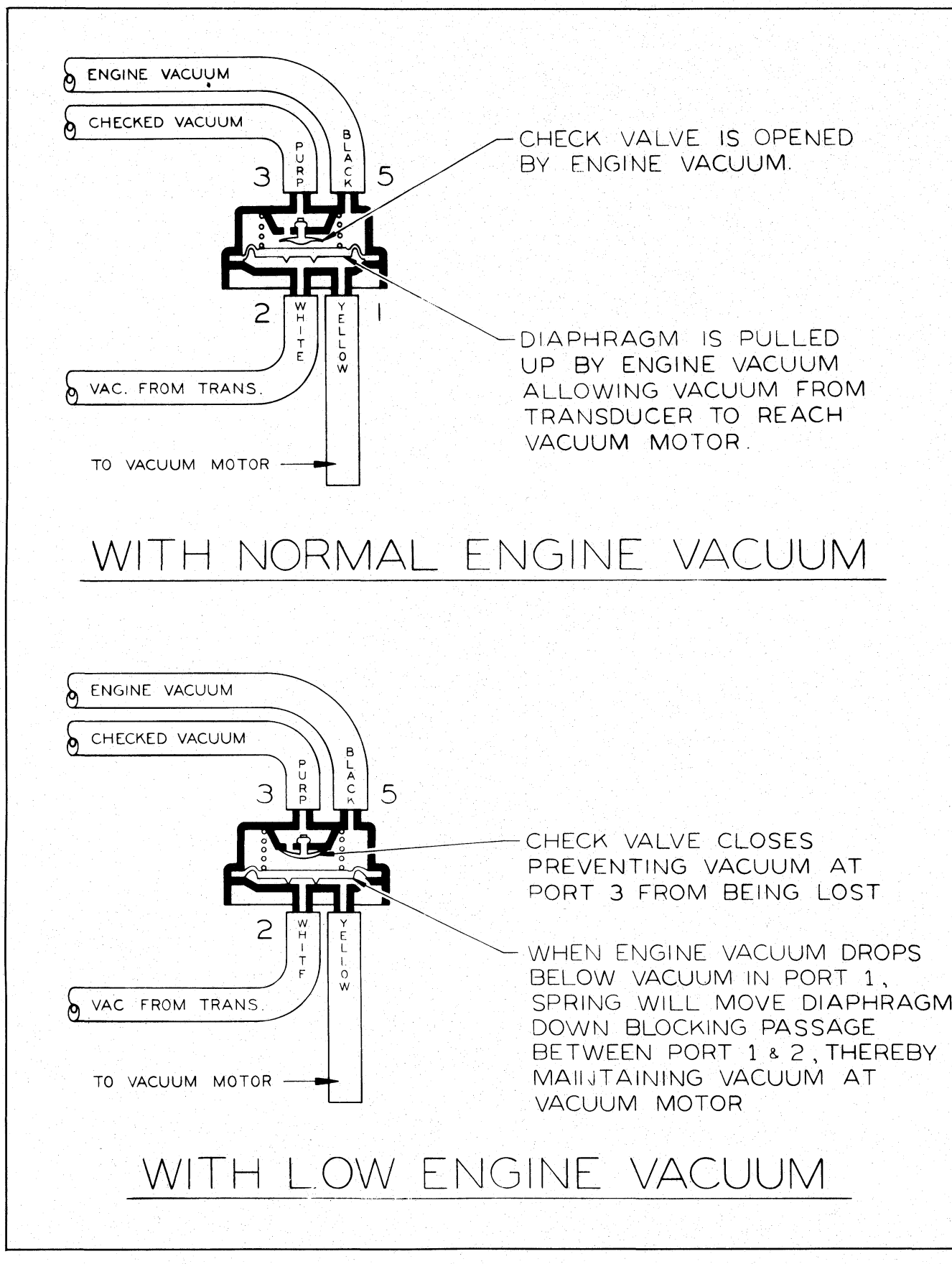


Fig. 1-150 Vacuum Checking Relay Operation

vacuum checking relay and the transducer. This a sintered plug-in hose type.

The *blower circuit board switch* is located in the center part of the programmer. Spring-loaded contacts move across the board making the required blower circuit connections. The configuration of this switch is similar to that of the circuit board switch on the control head. Four resistors are attached to the underside of the circuit board and protrude through into the programmer adapter. Air from the evaporator is ducted to the adapter to provide cooling for them. The function of the switch is to place these resistors into the blower circuit at the required points in the program to control blower speed. A low blower resistor is also attached to the circuit board. Refer to the electrical circuit diagram contained in Fig. 1-178.

The *vacuum valve,* located in the center of the assembly, is a nine-port rotary valve which makes connections between the various ports or vents them, as required, to move air doors, operate the heater water valve, etc. Refer to vacuum circuit in Fig. 1-159 for additional information.

The *feedback potentiometer* is located just above the vacuum valve. Its function is to snub movement of the vacuum motor so that a small signal from the sensors does not drive the motor all the way, one way or the other. The feedback pot is located, electrically, in the sensor string circuit and operates in opposition to the sensors - if a sensor drives the vacuum motor toward "Max Heat", for example, when the motor starts to move, it will rotate the potentiometer so that its resistance to change tends to offset the resistance change of the sensor. This unit is adjustable - follow procedure on page 1-150 carefully when adjusting it.

The sequence of events in the control program as the programmer moves from "Max A/C" to "Max Heat" is given below:

1. Possibility of recirculated air is terminated.
2. Heater water valve opens.
3. Blower speed drops from HI. to M_3.
4. Air-mix door starts to move, blending in hot air.
5. Blower speed drops to M_2.
6. Blower speed drops to M_1.
7. Mode of air delivery changes from A/C to Bi/Level.
8. Mode of air delivery changes from Bi/Level to heater.
9. Blower speed increases to M_2.
10. Air-mix door reaches "Max Heat" position.
11. Blower speed increases to M_3.

The sequence of events is reversed as the programmer moves from "Max Heat" to "Max A/C".

e. Air-Mix Door Link

The air-mix door link consists of a spring steel crank arm which slips down over the top of the output shaft of the programmer and a rod riveted to the crank arm. The other end of the rod attaches to the air-mix door crank arm and is retained to it with a clip. The spring steel cranksarm is attached to the output shaft with a set screw which is tightened when the link is adjusted. The programmer positions the air-mix door by this link. See page 1-150 for adjustment procedure.

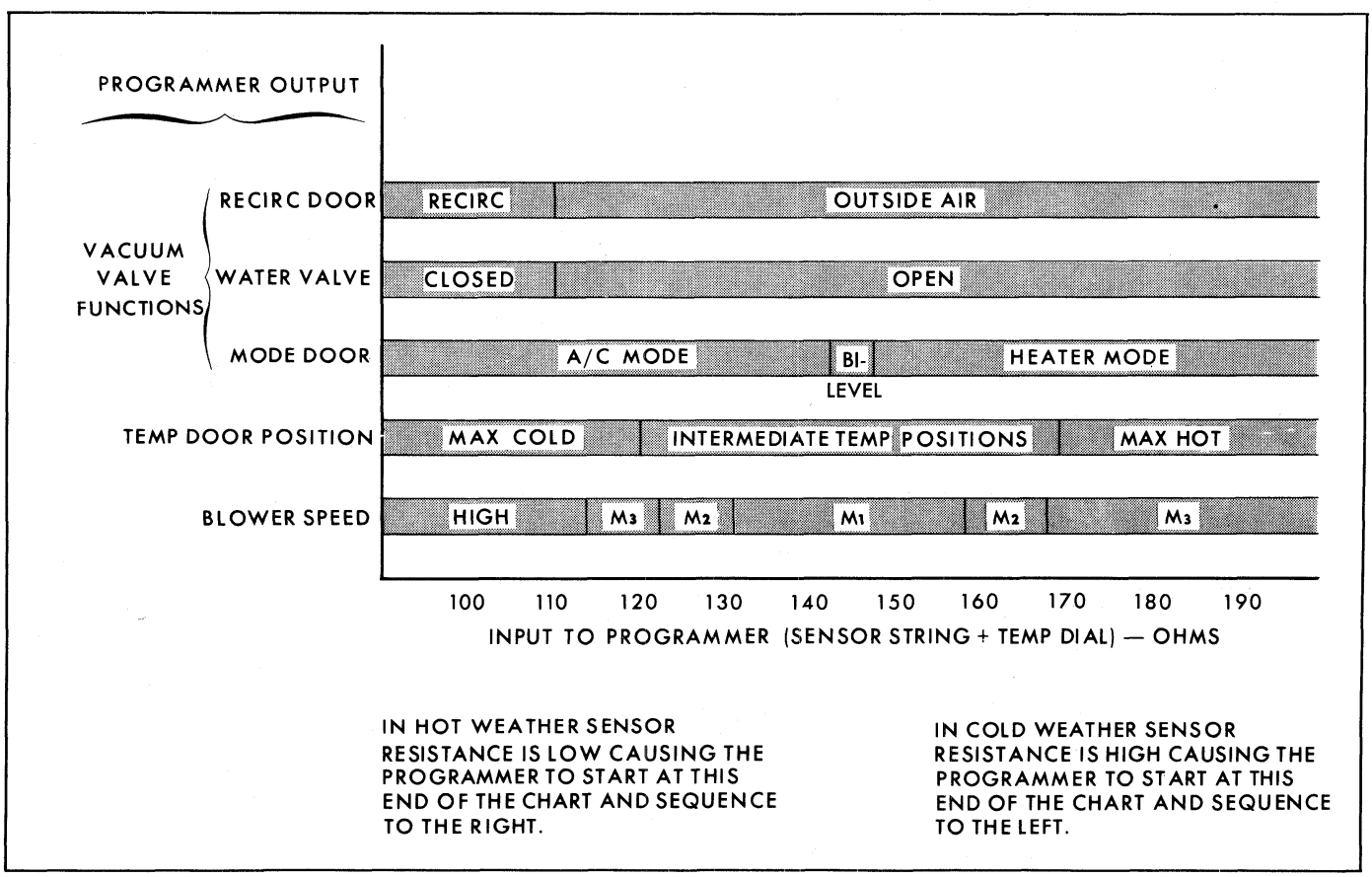


Fig. 1-151 Programmer Input-Output Chart

f. Blower Relay

A single-pole, single throw relay is used to supply power to the blower. It is located on the evaporator case in the engine compartment. The Relay supplies power in all except the "Off", and "Lo" positions of the control lever.

g. Heater Turn-On Switch

This switch is a bi-metal, snap-action switch located on the front of the right cylinder head. It senses engine coolant temperature; it is closed above approximately 49°C (120°F) and is open below that temperature.

h. Heater Water Valve

This valve is located on tne evaporator assembly. Its function is to pass or block flow of water to the heater. It is normally open but is closed by vacuum from the programmer vacuum valve when the programmer is positioned at "Max A/C".

Control System Operation

The automatic temperature control system is made up of three major sections which perform the following operations:

A. Temperature Control
B. Blower Control
C. Auxiliary Electrical and Vacuum Functions

The above sections will be described separately and in detail to aid system understanding and service diagnosis. System response at various lever settings is shown in Figs. 1-152 through 1-174.

a. Temperature Control Circuit

This circuit is comprised of the following parts, described in the preceding section and shown in Fig. 1-152.

- Ambient Sensor
- In-Car Sensor
- Temp Dial

} Input to Programmer

- Feedback Pot
- Amplifier
- Transducer
- Vacuum Relay
- Vacuum Motor

} Programmer

The resistance of the two sensors varies with their temperature. Their resistance, plus that of the temperature dial, form the input to the programmer. This weak electrical signal, which varies with the temperature of the sensor or with temperature dial movements, is amplified by the amplifier to produce a relatively strong current flow through the transducer that varies in accord with input signal changes. The transducer converts this electrical signal to a proportional vacuum signal which is routed through the vacuum relay to the vacuum motor. The vacuum motor performs the following five output functions:

1. Positions the air-mix door
2. Positions the wiper on the blower circuit board switch
3. Controls mode door operation
4. Controls heater water valve
5. Controls recirc and outside air doors

} Through Vacuum Valve

Input-output characteristics of the programmer are shown in Fig. 1-151. Input is resistance in ohms; output consists of the five functions listed above. Several examples are listed below to provide further understanding.

1. Assume the car is stabilized on a sunny 27°C (80°F) day with the in-car sensor being maintained at 24°C (75°F) with a 75°F temp tial setting. The resistance of the ambient sensor at 27°C (80°F) is 32 ohms, the in-car sensor resistance at 24°C (75°F) is 68 ohms, and the temp dial resistance at the 24°C (75°F) setting is 36 ohms. These three resistances total 136 ohms. Referring to Fig. 1-151, this resistance will position the programmer to produce M1 blower speed, an intermediate discharge air temperature of approximately 16°C (60°F), A/C mode, an open heater water valve and outside air.

2. If the ambient temperature were to increase to 32°C (90°F), the ambient sensor resistance would *decrease* to 26 ohms. This change in resistance would cause amplifier output current to increase which would cause the transducer output vacuum to the vacuum motor to decrease so that the new point of operation would be at the 130 ohm point in Fig. 1-151, producing M2 blower speed and colder discharge air. The system would still be in A/C mode, with the water valve open, utilizing outside air. In this way, the in-car temperature is maintained at 24°C (75°F) despite the change in ambient temperature.

3. If heat load on the car were to be decreased, by driving under cloud cover, for example, the in-car sensor temperature would tend to decrease. This would cause its resistance to *increase* so that the total resistance to the programmer would increase. This would cause the programmer to move back to the right on the chart to a warmer position.

Note in the foregoing examples that an increase in amplifier output current cause a *decrease* in transducer output vacuum. Understanding this and similar relationships is important in problem diagnosis - for that reason they are listed below.

- *Hot* sensors result in *low* sensor string resistance which results in *low* transducer output vacuum which positions the vacuum motor in the *cool* or cold area of operation.
- Conversely, *cold* sensors operate at *high* resistance which results in *low* amplifier output which causes a *high* transducer vacuum which positions the vacuum motor in the *warm* or hot area of operation.

It is worth noting that an open sensor (disconnected, etc.) would represent a high resistance (as though the sensor were very cold) which would drive the programmer to maximum heat, while a shorted sensor would produce low resistance and drive the system to "Max A/C".

b. Blower Control Circuit

Three modes of blower speed control are available to the driver. During A/C operation and two during heater operation in addition to the constant low blower speed.

1. Fixed low blower speed.
2. Four blower speeds automatically controlled by the programmer, ranging from M_1, which is slightly higher than the fixed low speed, through M_2 and M_3 (plus high in A/C mode).
3. Fixed high blower speed (approximately the same as the high in the automatic range). Or M_3 in heater operation.

Blower turn-on occurs in the following ways:

1. Delayed turn-on in cold weather until warm water is available from the engine in all positions except "Off" and "Lo".
2. Immediate turn-on in warm weather when the car interior is warm, regardless of engine water temperature.

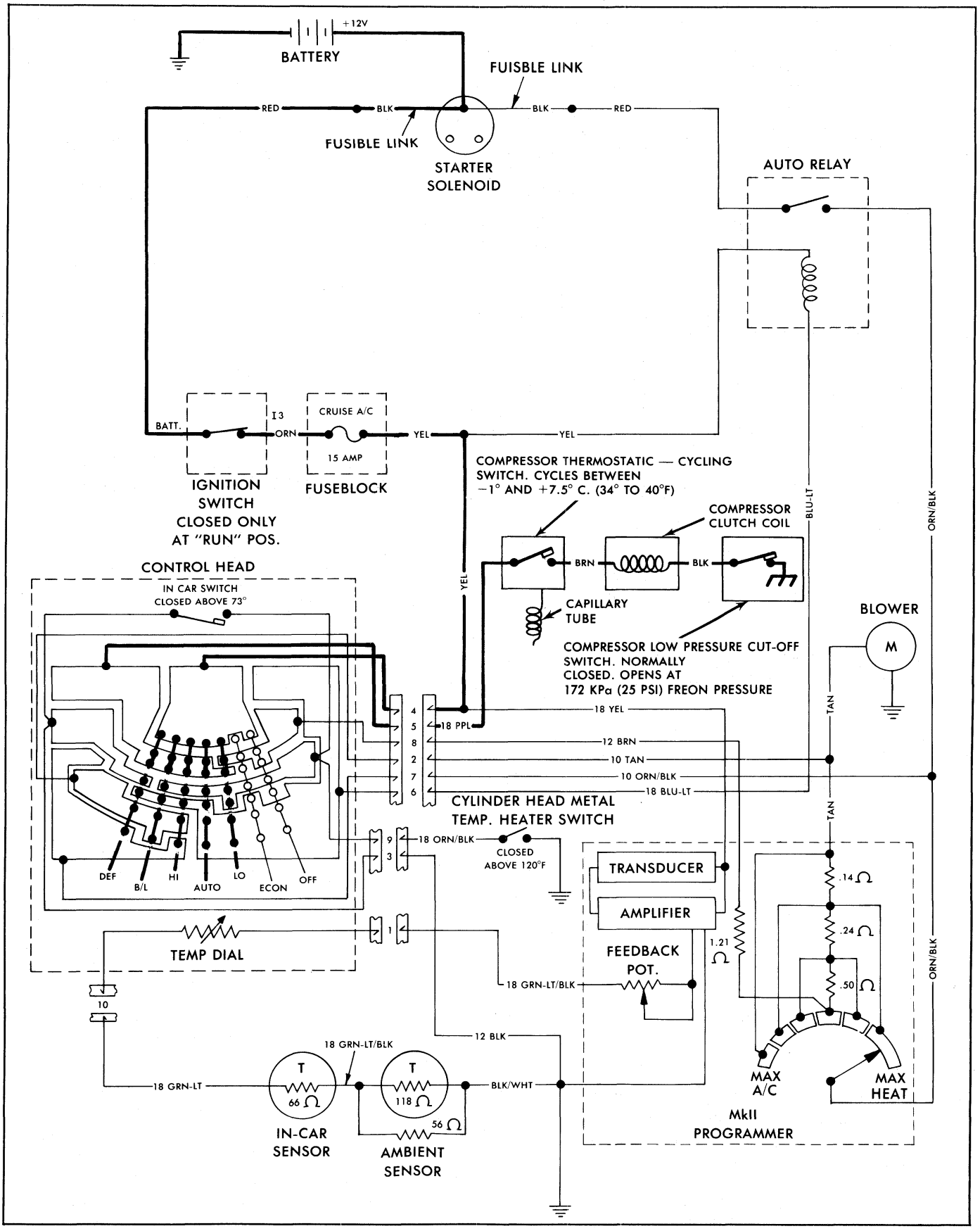


Fig. 1-152 Compressor Electrical Circuit

3. Immediate turn-on regardless of temperatures, by owner override to the "Vent" or "Def" lever settings.

c. Auxiliary Electrical and Vacuum Functions

The *Compressor Clutch Circuit* is shown in Fig. 1-152. When the ignition switch is closed, current flows through two pads on the control head which are inter-connected at all lever settings except "Off" and "Economy" and through the thermostatic cycling switch, clutch coil and compressor mounted low pressure switch to ground. On early models with the low pressure switch located in the evaporator inlet line, current flows from the control head as described above through the low pressure switch, thermostatic cycling switch and clutch coil to ground.

Auxiliary vacuum circuits are those which provide vacuum to operate the various air doors and the heater water valve. They do not include vacuum circuitry connected with the transducer and vacuum motor which functions independently and was explained in a previous section.

REFRIGERATION SYSTEM

Refer to page 1-8.

SYSTEM OPERATION AT VARIOUS LEVER SETTINGS

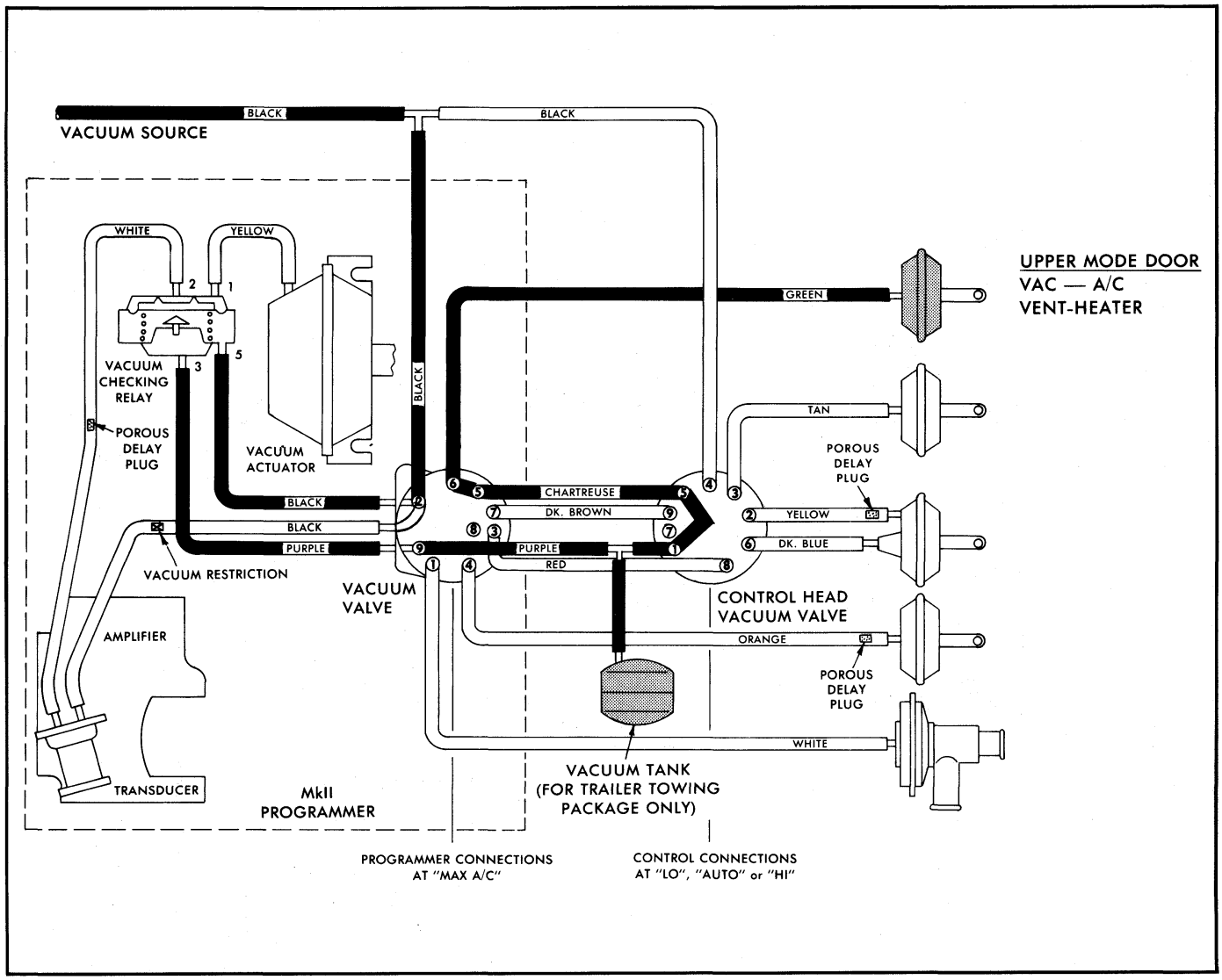


Fig. 1-153 Upper Mode Door Vacuum Circuit

Upper Mode Door Vacuum Circuit (Fig. 1-153)

The upper mode door actuator is connected by a green hose to port 6 on the programmer valve. This port is vented in the heater portion of programmer travel so that the actuator is vented which places the mode door in the heater position. When the programmer is positioned toward the "Max A/C" position, port 6 is connected to port 5, which is connected by the chartreuse hose to port 5 on the control head vacuum valve. This port is vented at "Off", "Bi-Level" and "Def" so that the door must remain in the heater position at those settings even though the programmer is positioned to produce A/C mode. At "Lo", "Auto" and "Hi", however, port 5 is connected to port 1, as is shown above. This port is connected by the purple hose to port 9, back on the programmer valve. Port 9 has checked vacuum at all times, which it receives from the check valve portion of the vacuum checking relay. The vacuum checking relay receives its vacuum from port 2 which has full vacuum at all times.

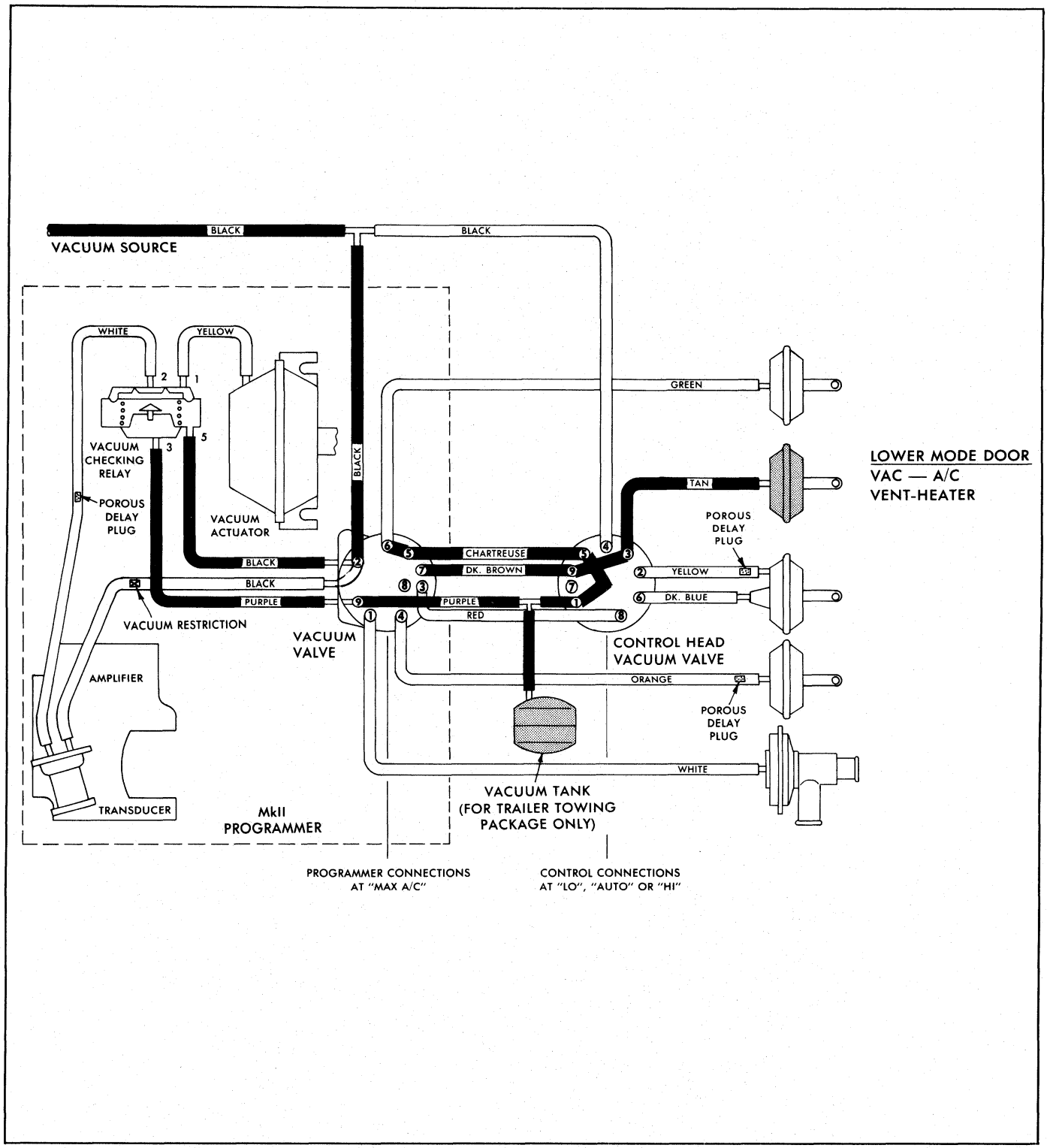


Fig. 1-154 Lower Mode Door Vacuum Circuit

Lower Mode Door Vacuum Circuit (Fig. 1-154)

The lower mode door actuator is connected by a tan hose to port 3 on the control head. Port connections in the control valve at "Lo", "Auto" and "Hi" are as shown above. At the programmer, port 5 is connected to port 7 in the A/C portion of the programmer travel, as shown. Under these conditions, checked vacuum is fed to the actuator which positions the lower mode door in the A/C position. At "Off" and "Def", port 3 on the control head is vented forcing the door to heater mode. At "Bi-Level", port 3 is connected to port 1 on the control head, forcing the mode door to the A/C position regardless of the position of the programmer.

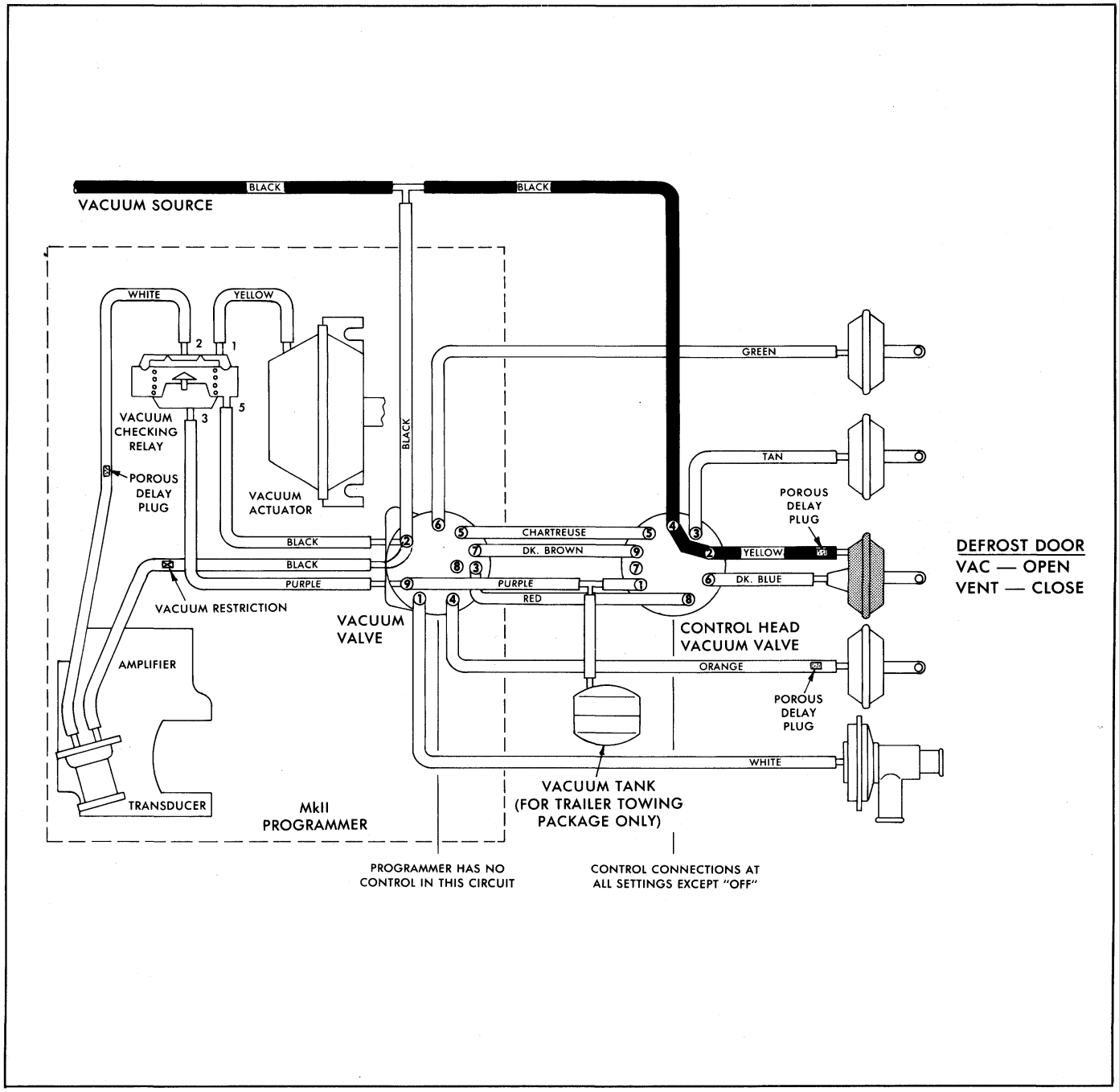


Fig. 1-155 Defroster Bleed Vacuum Circuit

Defroster Bleed Vacuum Circuit (Fig. 1-155)

To provide a small "bleed" of air to the defroster outlet in heater mode, the defroster door is open approximately .75 inch. This is accomplished by applying vacuum to the outer nipple of the two-stage defroster actuator. The outer port is connected by the yellow hose to port 2 on the control head. This port is connected to port 4 at all lever settings except "Off" in which case port 2 is vented. This provides the possibility of defroster bleed at all settings except "Off". The programmer exerts an indirect influence in this function; if it, in conjunction with the control head valve, provides vacuum to put the mode doors in the A/C positions, these doors intercept all air headed toward the defroster door and there is no defroster bleed air even though the defroster door is cracked open. Note that port 4, which feeds vacuum to the defroster bleed nipple, is connected to full engine vacuum, not checked vacuum. This is done deliberately to permit the vacuum to escape when the car is stopped so that the defroster door will seal. A restrictor is located in the yellow hose to provide a delay of approximately 45 seconds in the operation of the door. This prevents fogging of the windshield that can sometimes occur when the car is restarted.

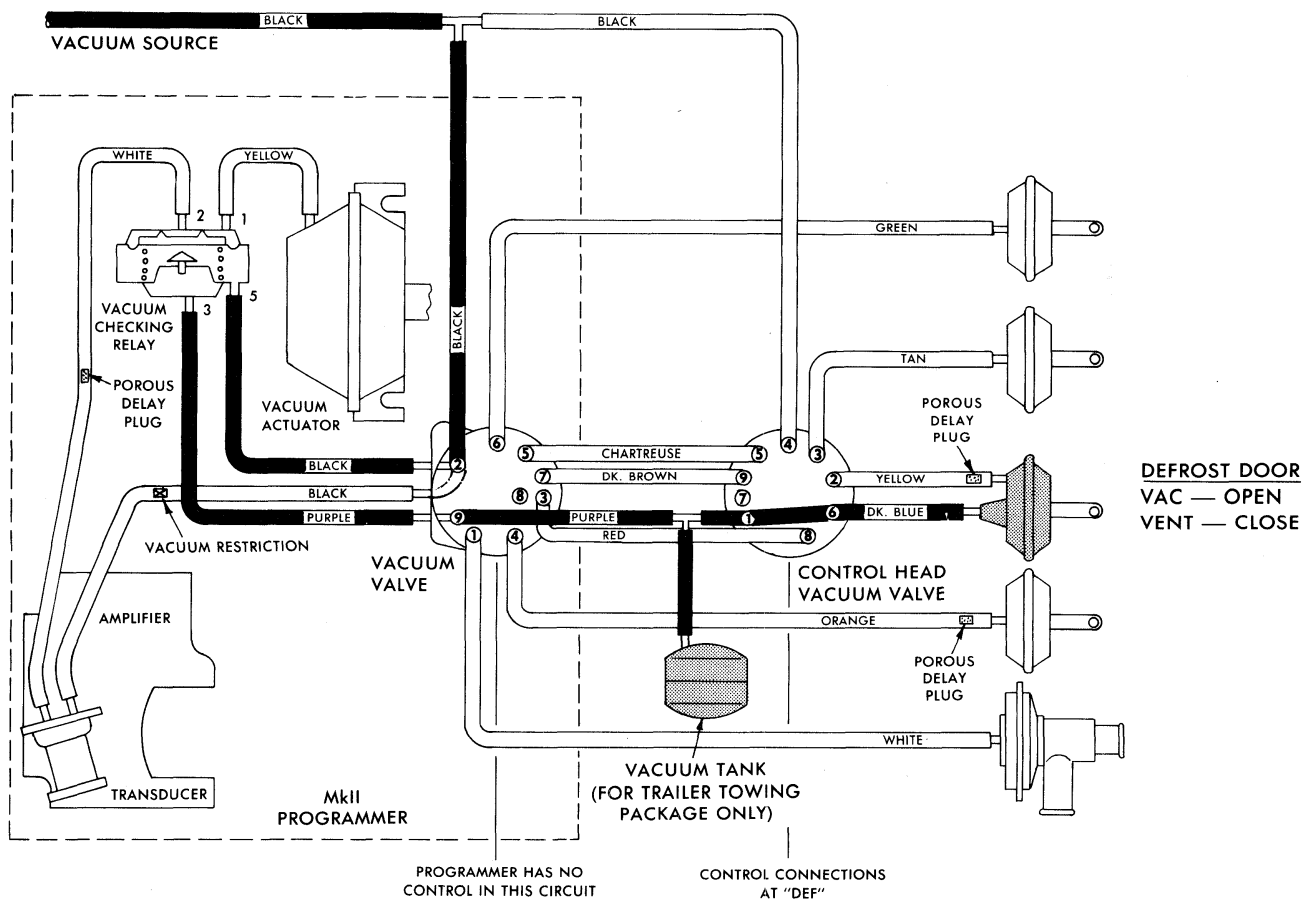


Fig. 1-156 Defroster Vacuum Circuit

Defroster Vacuum Circuit (Fig. 1-156)

The defroster door is moved full open when vacuum is applied to the center nipple of the actuator. This nipple is connected by the dark blue hose to port 6 on the control head. This port is vented at all settings except "Def" where it is connected to port 1, as shown. The programmer has no control in this circuit.

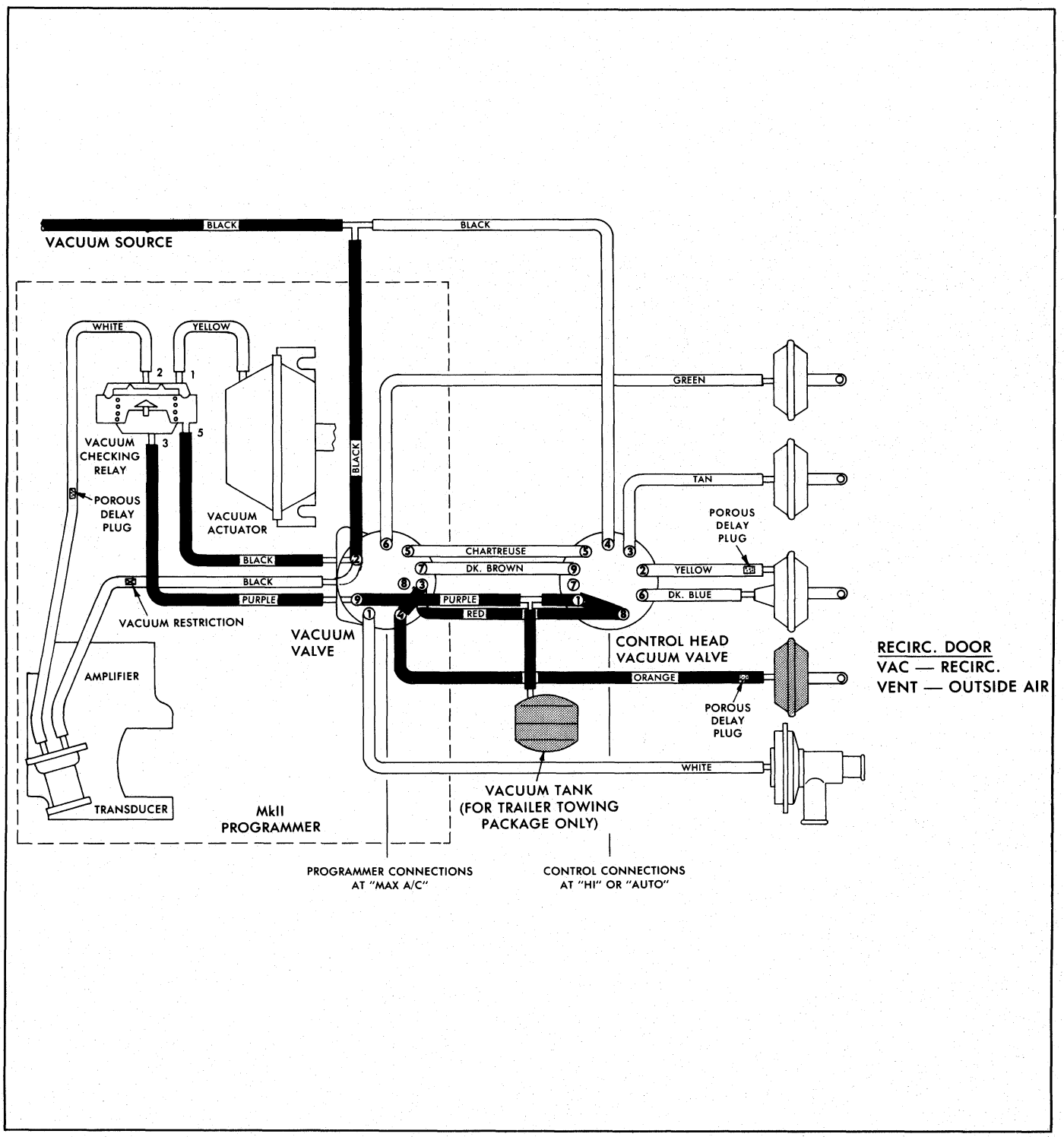


Fig. 1-157 Recirc Air Vacuum Circuit

Recirc Air Vacuum Circuit (Fig. 1-157)

The recirc air actuator is connected by the orange hose to port 4 on the programmer. This port is vented at all programmer positions except "Max A/C", resulting in outside air. At "Max A/C", port 4 is connected to port 3 which is connected by the red hose to port 8 on the control head. Port 8 is connected to checked vacuum at port 1 at the "Auto", "Hi", "Bi-Level" and "Def" settings. Thus, if the programmer is at "Max A/C" and the control is at "Auto", "Hi", "Bi-Level" or "Def" recirc air operation will be obtained.

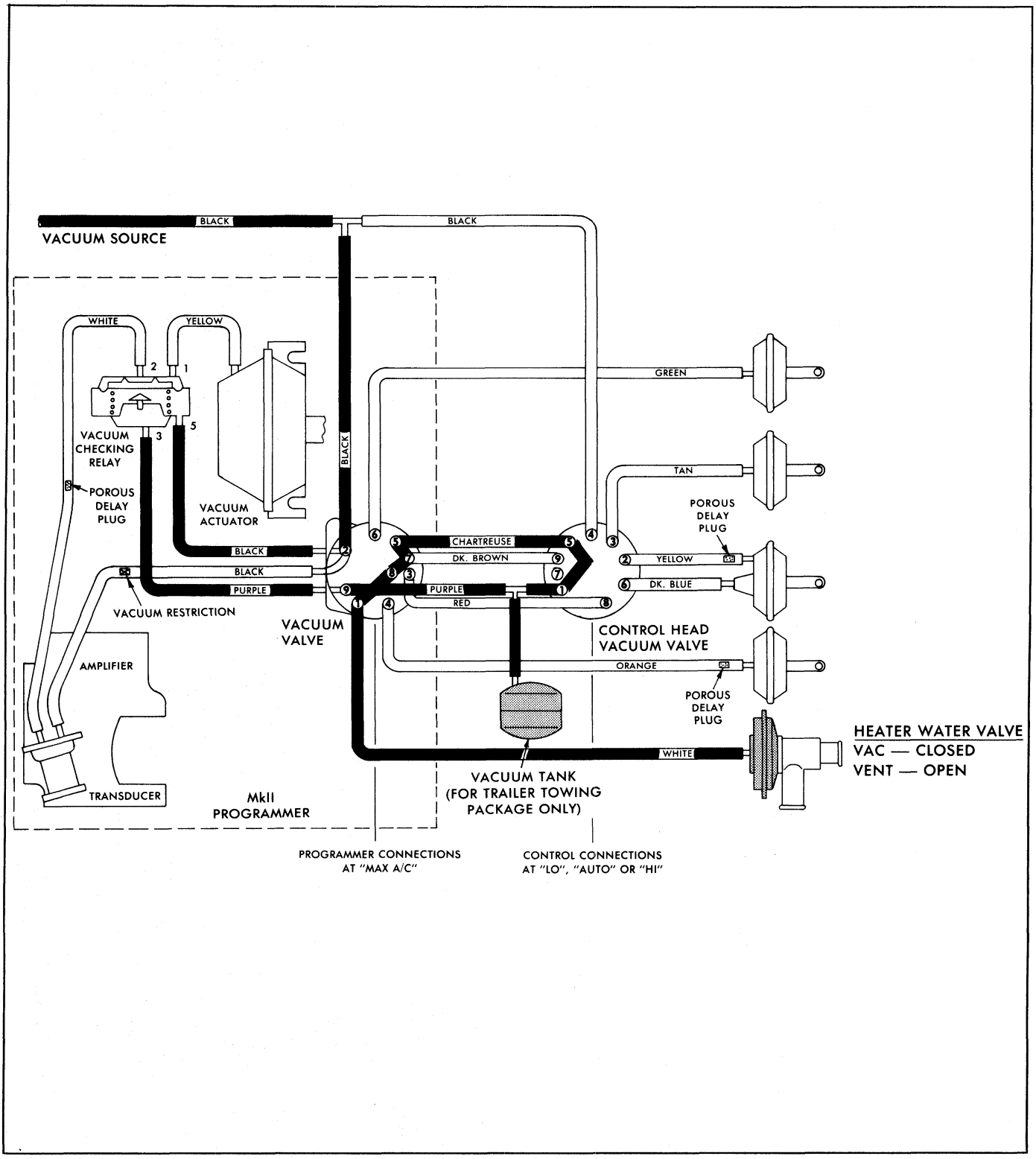


Fig. 1-158 Heater Water Valve Circuit

Heater Water Valve Vacuum Circuit (Fig. 1-158)

The water valve is connected to port 1 of the programmer which is vented, opening the valve, at all programmer positions except at the "Max A/C" end of travel. There it is connected, as shown, to port 5 which is connected by the chartreuse hose to port 5 on the control head. At "Economy", "Lo", "Auto" and "Hi", port 5 is connected to checked vacuum at port 1, closing the valve.

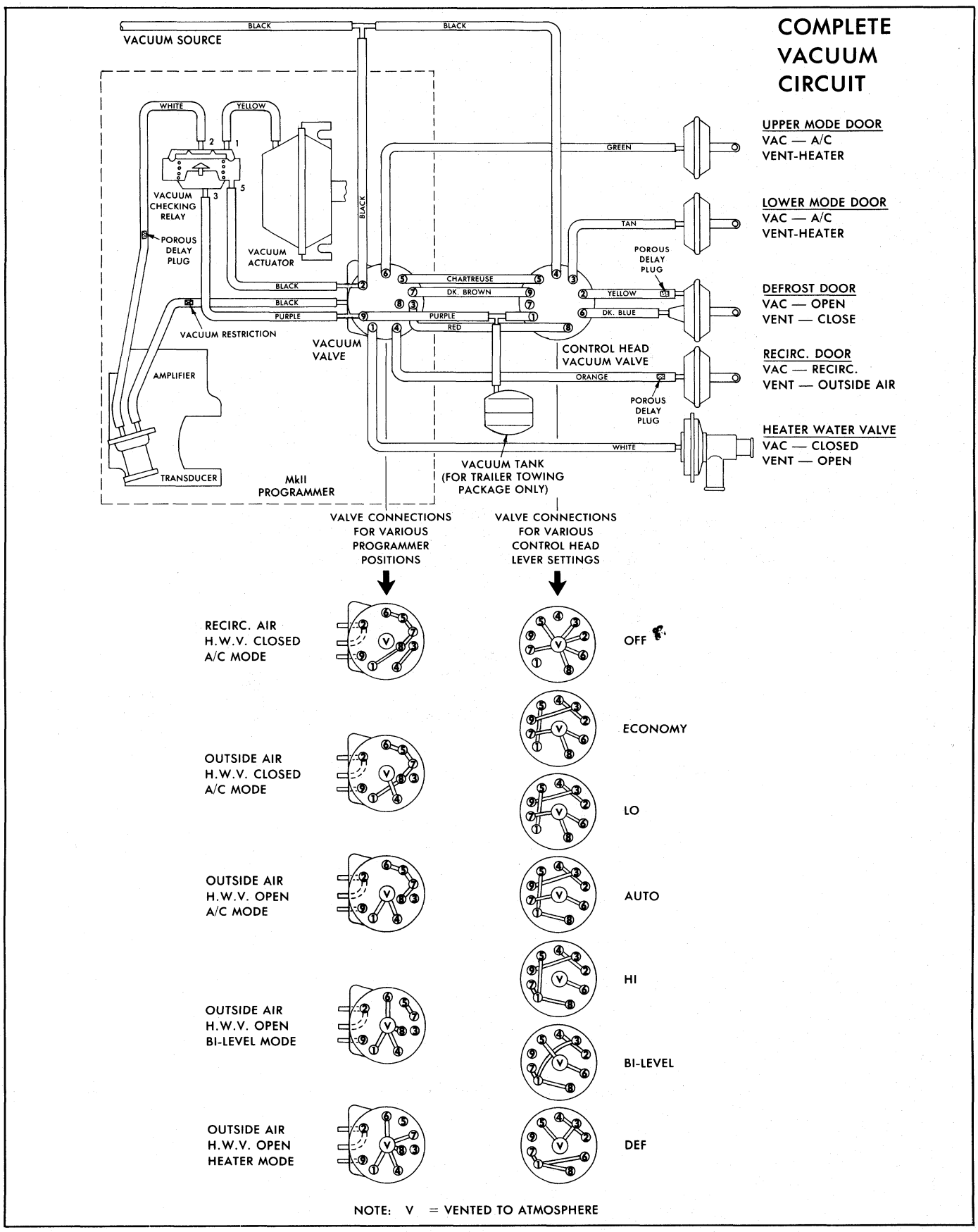


Fig. 1-159 Complete Vacuum Circuit

Complete Vacuum Circuit Diagram

A complete vacuum circuit diagram is shown in Fig. 1-159. Included are "clocks" which shown the internal connections of the programmer and control head vacuum valves at various positions and settings.

Complete Electrical Circuit Diagrams

Fig. 1-178 shows a complete circuit diagram in a form to permit easy tracing of circuits. Fig. 1-175 is a wiring circuit diagram that shows actual wiring arrangements, such as connectors, bulkhead connectors, location of splices, etc. The two circuits are in agreement in everything except the form in which they are presented.

AIR FLOW AT VARIOUS LEVER SETTINGS

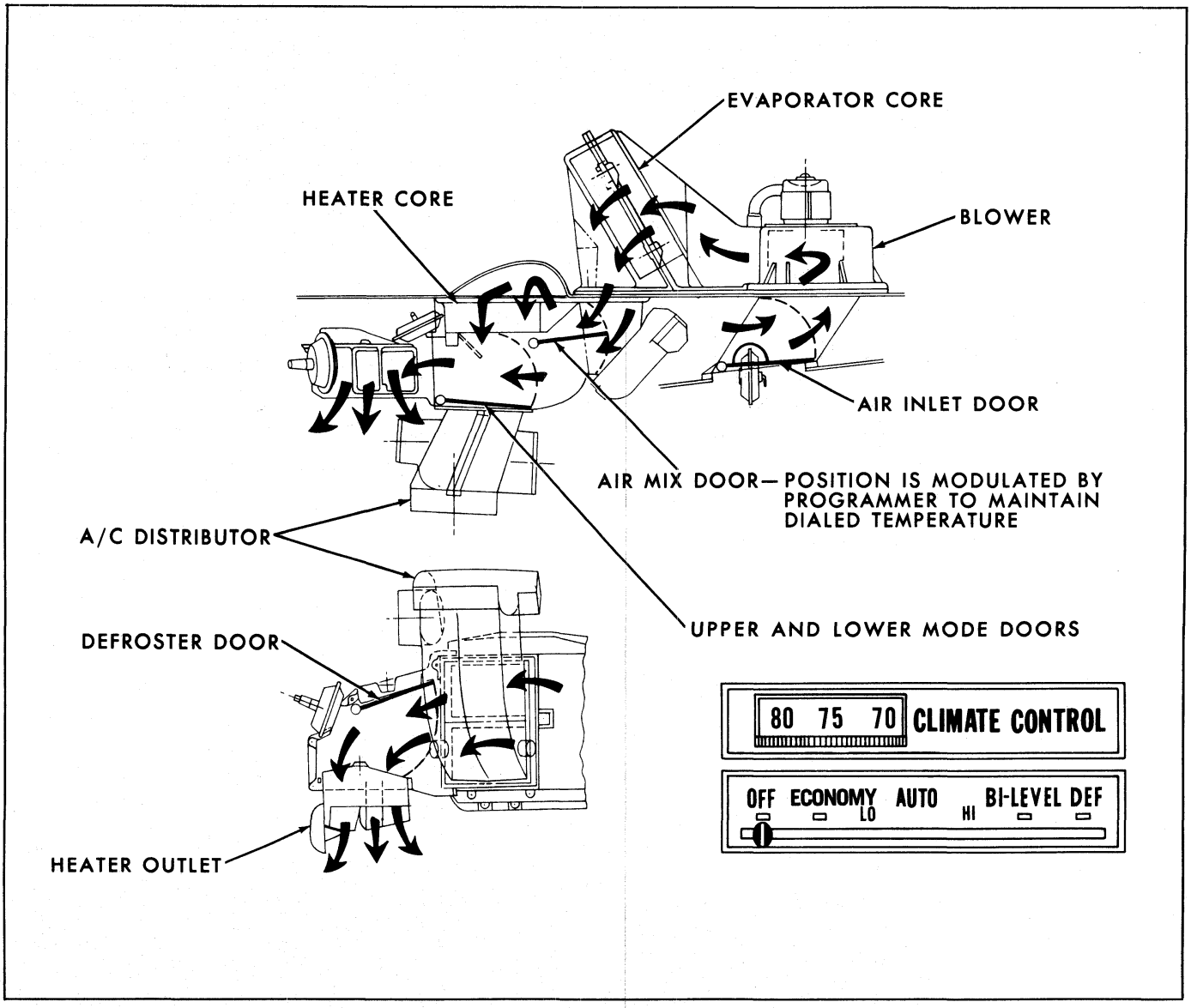


Fig. 1-160 Air Flow at "OFF"

Off

Outside air is circulated at a fixed low blower speed through the evaporator and heater assembly and discharged into the passenger compartment from the heater outlet when the ignition switch is in the "Run" position if turn on requirements are met. The temperature of the air is modulated to maintain the temperature on the dial; the ability of the system to maintain this temperature in warm weather is restricted, however, since the compressor is disengaged at this setting.

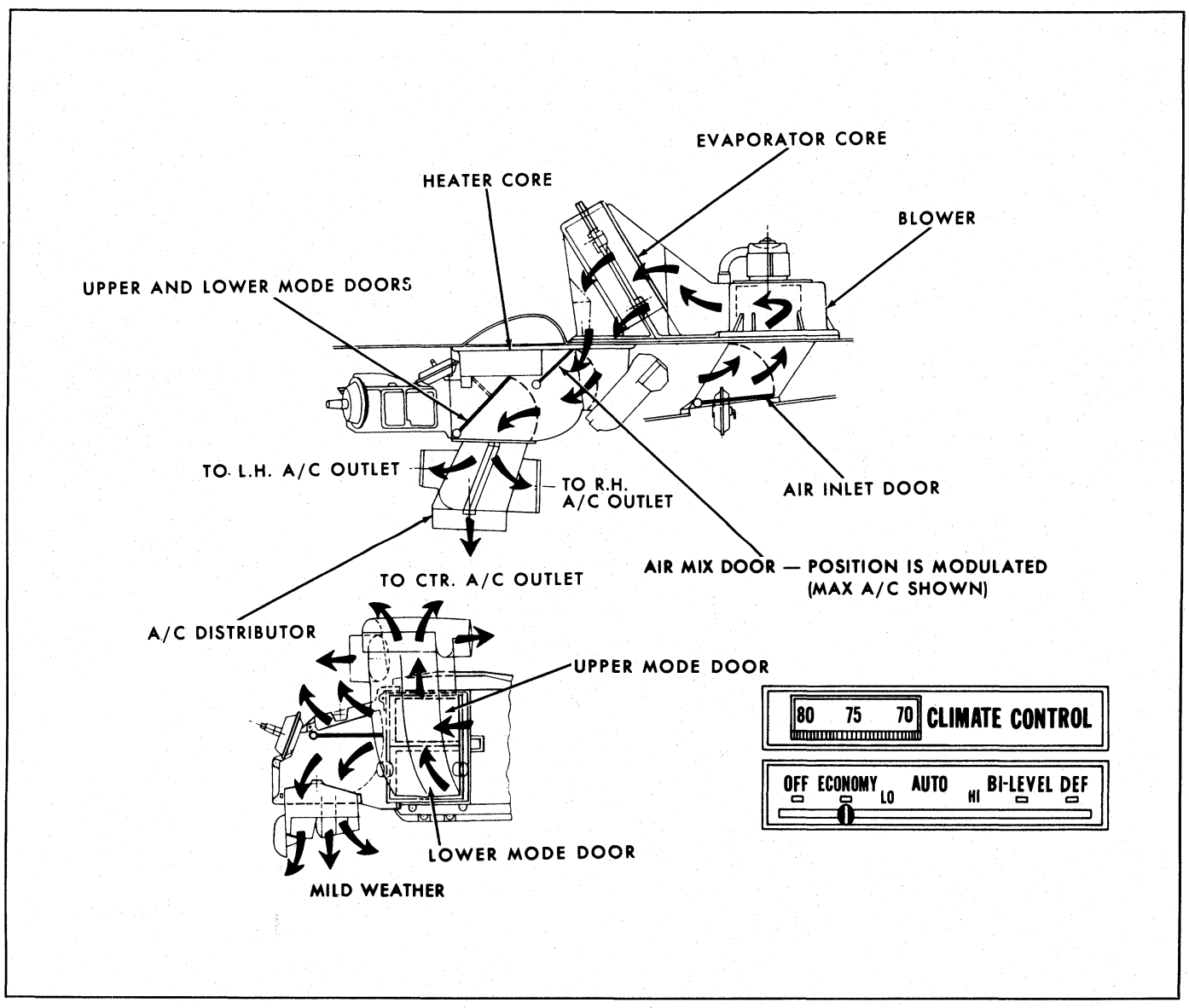


Fig. 1-161 Air Flow at "ECONOMY"

Economy

Outside air is circulated at an automatically selected blower speed through the evaporator and the heater assembly and discharged into the passenger compartment from the air conditioning or heater outlets. Since the compressor is disengaged at this setting, the ability of the system to maintain the dial temperature is restricted. It may be necessary to set the dial approximately 3°C (5°F) cooler than normal to maintain comfort at 10°C (50°F) to 21°C (70°F) ambient temperatures.

Four blower speeds, HI, MED_3 MED_2, and MED_1 are utilized. If the car interior is significantly hotter than the temperature on the dial, the blower will start at high and then sequence down to lower speeds as the dial temperature is approached. With a colder interior temperature, the blower will start at MED_3 and sequence down to lower speeds.

In the upper part of the usable range of this setting approximately 10°C to 21°C (50°F to 70°F) air is delivered from the air conditioner outlets. Below 10°C (50°F), air is delivered in BI-LEVEL fashion - from both the air conditioner and heater outlets or from the heater outlet only in cold weather. System turn on will be delayed, if the engine is cold, until engine coolant reaches approximately 54°C (130°F).

The Economy setting is designed so that it is possible to maintain comfort at ambient temperatures below approximately 21°C (70°F) without having the compressor operate.

In some situations (high sunload or excessive humidity) this setting may not provide comfort or windows may tend to become fogged. Under these conditions, the control lever should be returned to the "AUTO" setting.

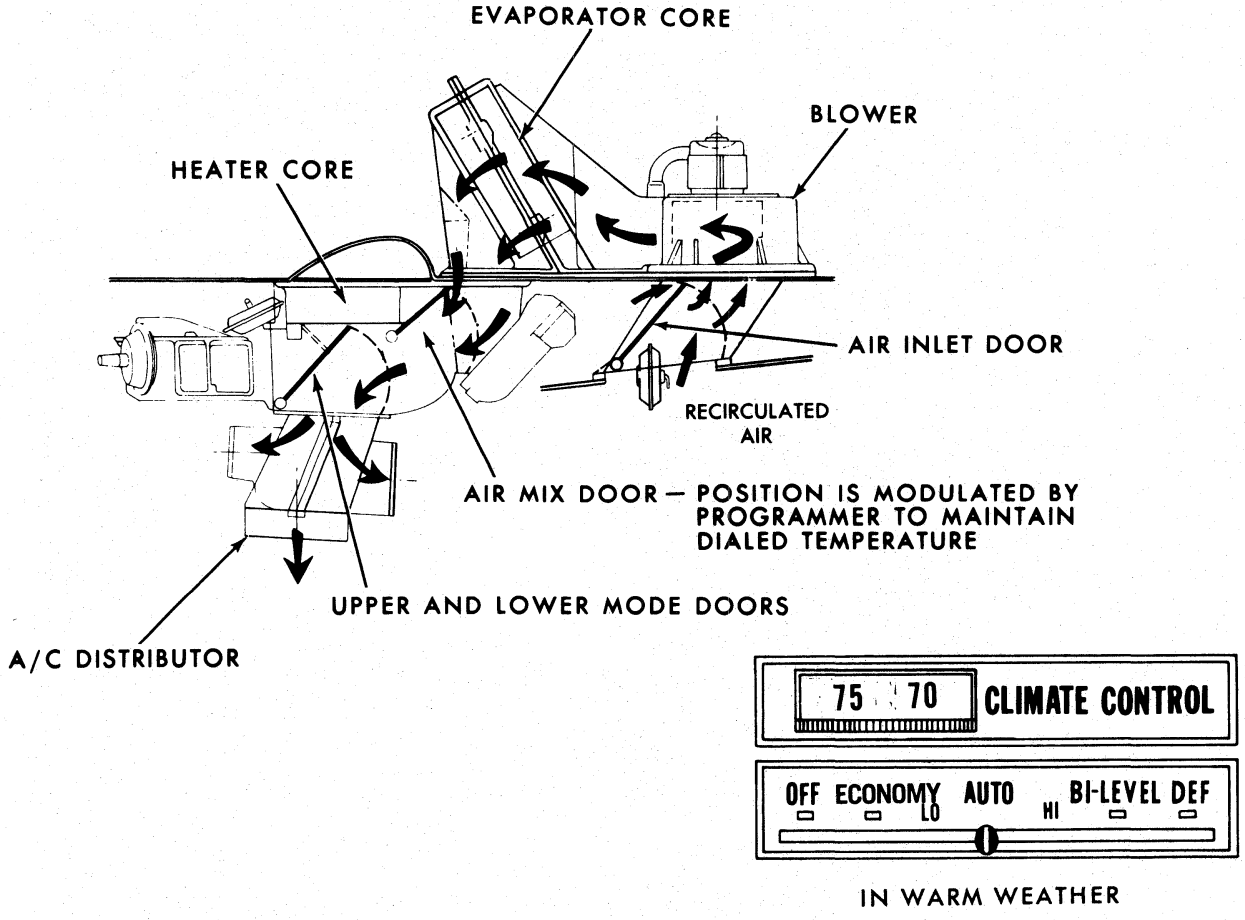


Fig. 1-162 Air Flow at "Auto" - Warm Weather

Lo

Operation at this setting is identical to that provided at "Auto" except that the blower operates at a fixed low speed with no turn on delay provision.

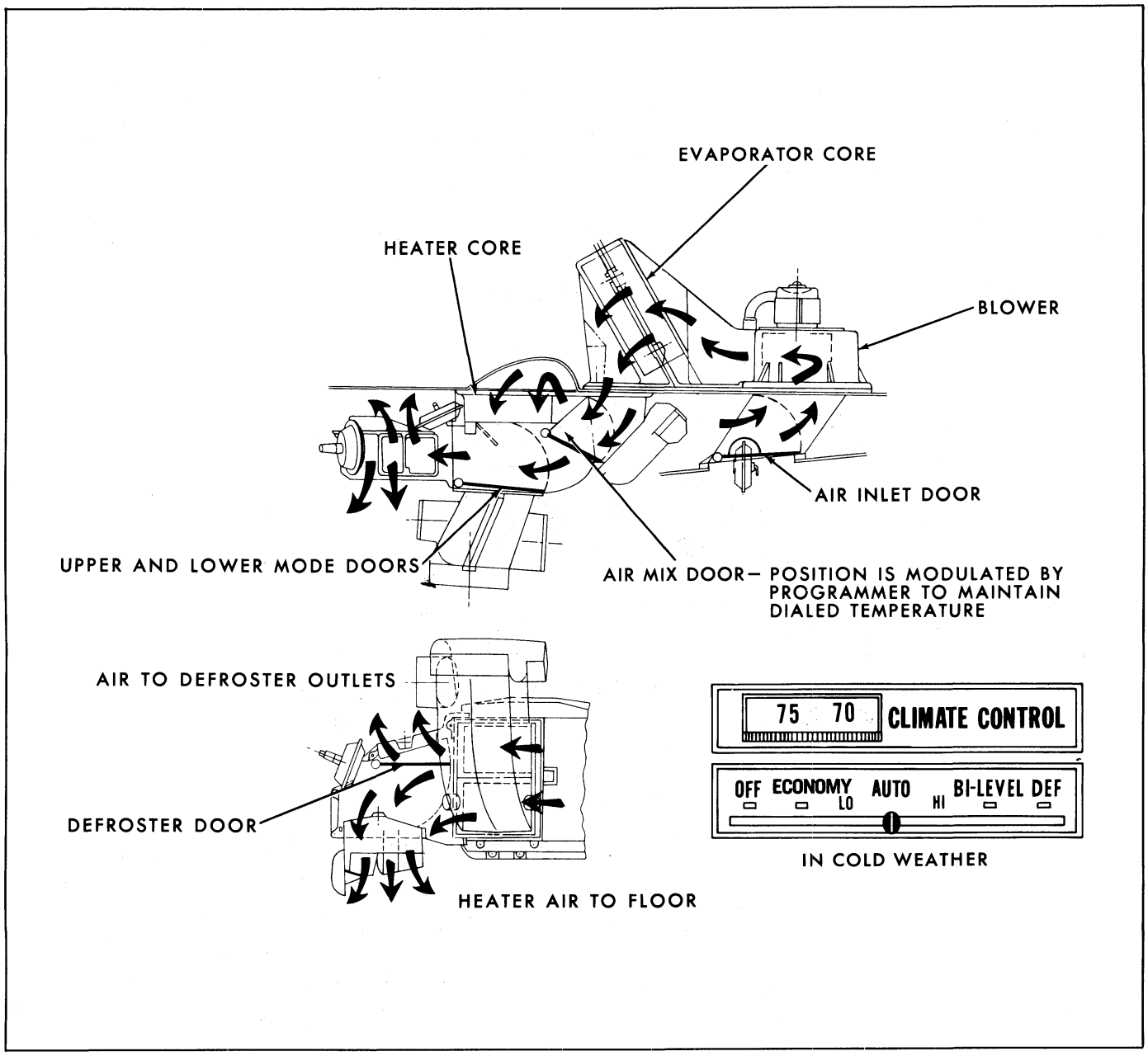


Fig. 1-163 Air Flow at "Auto" - Cold Weather

Auto

Regulation of blower speed, discharge air temperature, air delivery mode, system turn-on and compressor operation. is accomplished automatically to maintain the temperature on the dial and to provide comfort.

Four blower speeds, HI, MED_3, MED_2, and MED_1 are utilized (three in heater mode). If the car interior is significantly hotter or colder than the temperature on the dial, the blower will start at high and then sequence down to lower speeds as the dial temperature is approached.

Discharge air temperature will be varied automatically between approximately 7°C to 66°C (45°F to 150°F). If the discharge air temperature is above approximately 32°C (90°F) the air will be delivered from the heater outlet (fig. 1-163); below approximately 24°C (75°F) it will be delivered from air conditioner outlets. Between these temperatures, air is provided from both the heater and air conditioner outlets (Bi-Level operation).

If the car interior is above approximately 24°C (75°F) the system will turn on immediately when the car is operated. If the car is below 24°C (75°F) system turn-on will be delayed, if the engine is cold, until engine coolant reaches approximately 54°C (130°F).

Compressor operation is available provided at all ambient temperatures above approximately 0°C (32°F) even when not required for cooling, to assure maximum dehumidification of the air.

Recirculated air is used when maximum cooling is required.

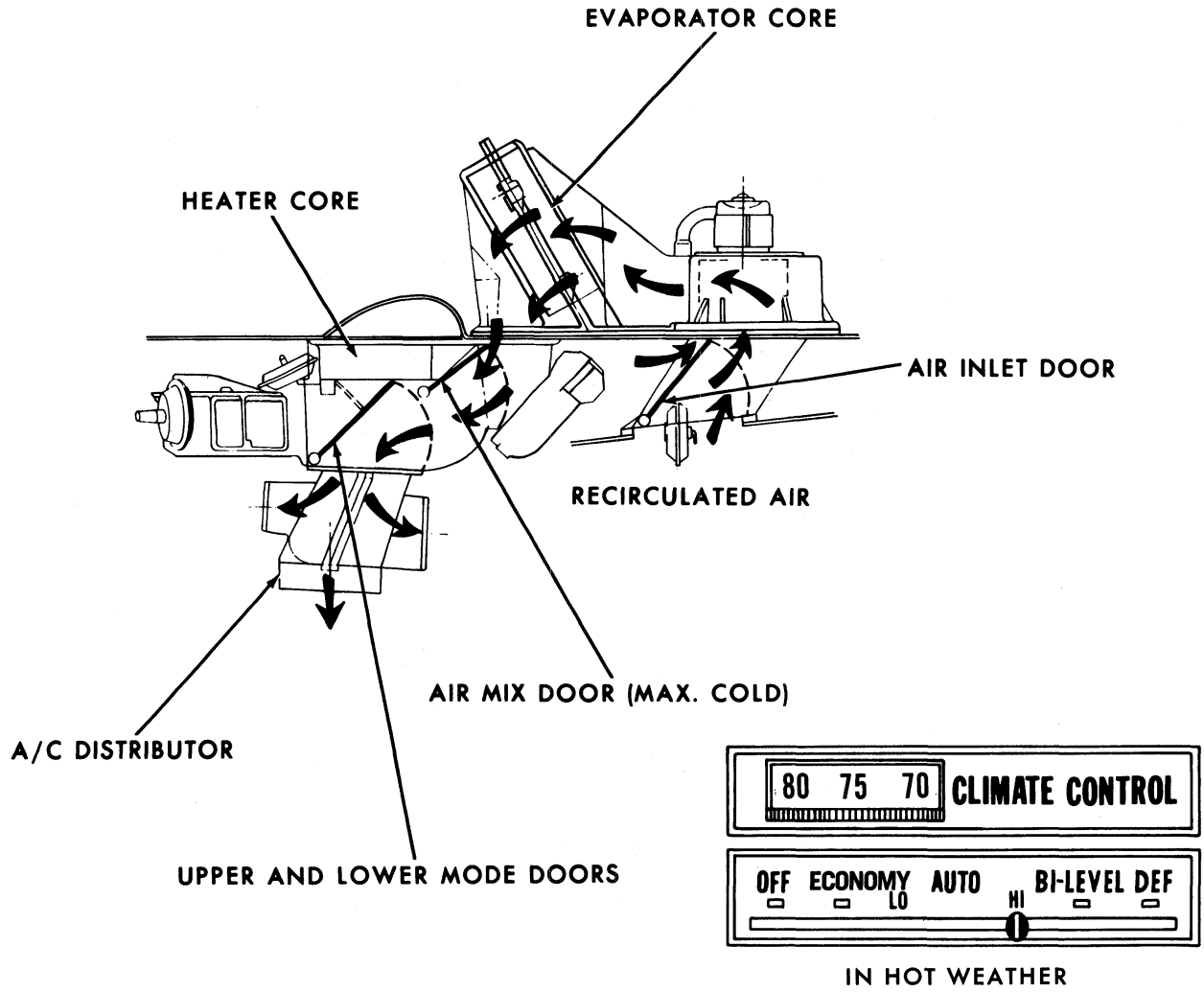


Fig. 1-164 Air Flow at "HI"

Hi

Operation at this setting is identical to that provided at "Auto" except that the blower operates at a fixed maximum speed. Recirculated air is used when maximum cooling is required. This setting is provided for quickest possible cool down under extremely hot ambient conditions.

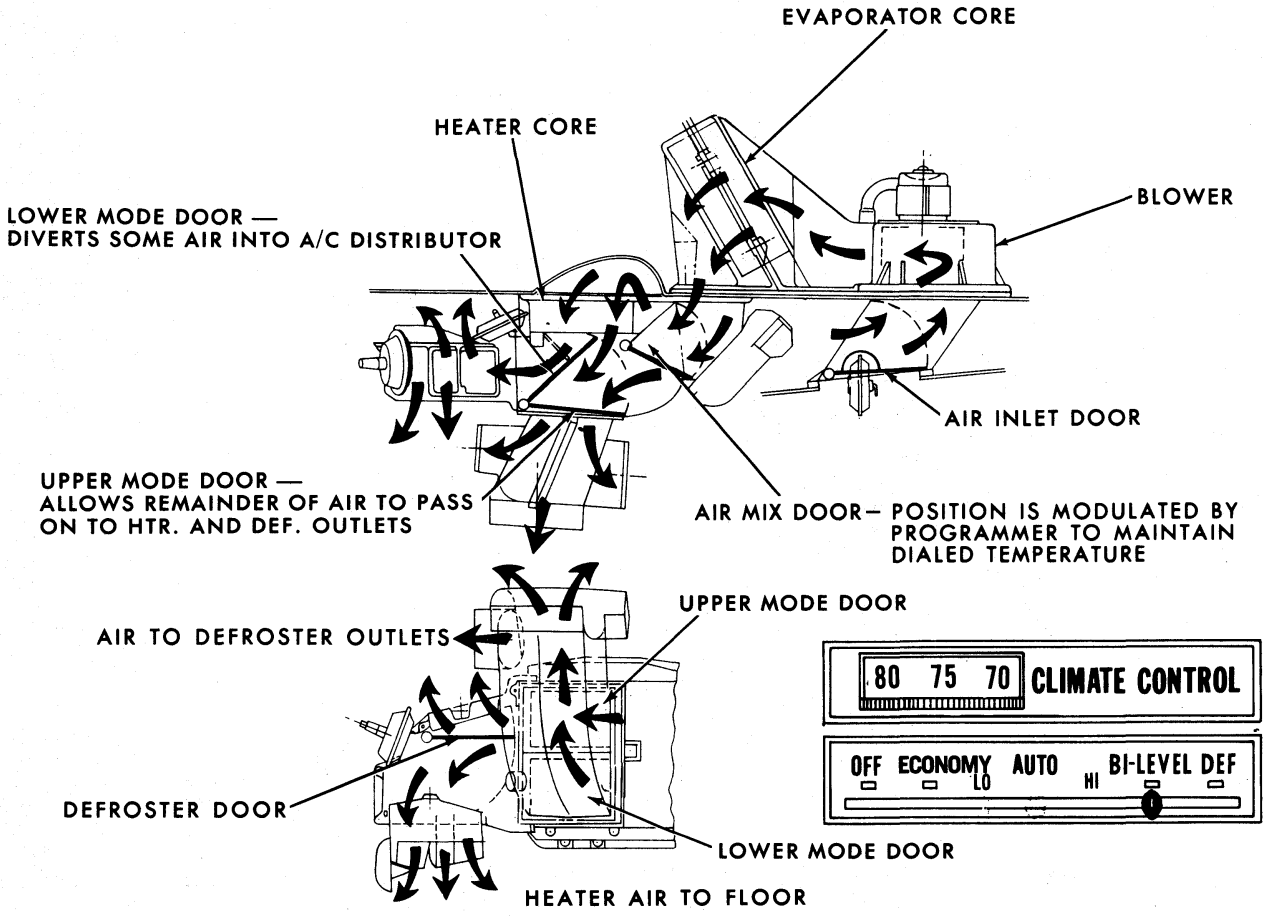


Fig. 1-165 Air Flow at "Bi-Level"

Bi-Level

Operation at this setting is the same as at "Auto" except **bi-level** air delivery is provided - approximately half the air is delivered from the heater outlet and the other half is discharged from the air conditioner outlets. This provides a pleasant, draft-free mode of operation in mild weather; it also permits defrosting of the side windows by the air streams from the end air conditioner outlets in cold weather.

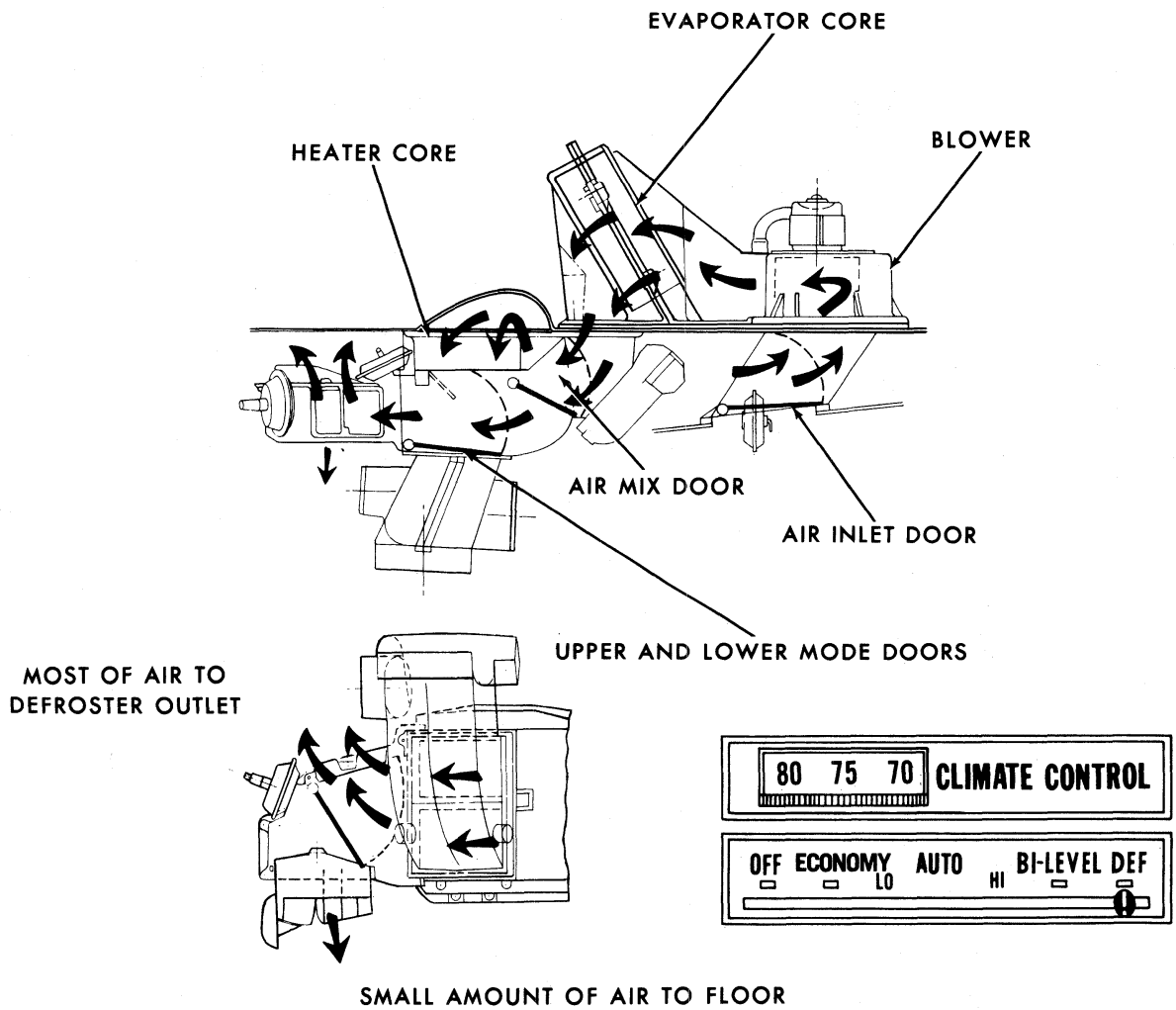


Fig. 1-166 Air Flow at "Def"

Def

At this setting all the air is delivered to the windshield and the blower operates at a fixed high speed. Temperature regulation is maintained. Blower turn-on is immediate, even with a cold engine.

How the system operates at the various lever settings is depicted in organized fashion in the chart in Fig. 1-167.

		SYSTEM RESPONSE							
		BLOWER SPEED	AIR INLET DOOR POSITION	TEMPERATURE DOOR POSITION	MODE DOORS POSITION	DEFROSTER DOOR POSITION	COMPRESSOR	HTR-WATER SHUT-OFF VALVE	IS BLOWER DELAYED FOR ENGINE WATER WARMUP?
CONTROL LEVER SETTINGS	OFF	FIXED LOW 5.0V – HTR 4.5V – A/C	OUTSIDE AIR	VARIES – RESPONSIVE TO SENSORS	FORCED TO HEATER	SEALED	DOESN'T OPERATE	USUALLY OPEN – EXC. CLOSED AT MAX. A/C POSITION OF PROGRAMMER	YES – EXCEPT WHEN CAR INTERIOR IS WARM, IN WHICH CASE IN-CAR SWITCH ON CONTROL HEAD TURNS BLOWER ON IMMEDIATELY, EVEN IF ENGINE IS COLD.
	ECON.	VARIABLE BLOWER PROGRAM			EITHER HEATER, BI-LEVEL OR A/C DEPENDS ON PROGRAMMER POSITION	DOOR WILL ASSUME "BLEED" POSITION AFTER 45 SECOND DELAY AND WILL DELIVER BLEED AIR TO W/S IF IN HEATER OR BI-LEVEL MODE			
	LO	FIXED LOW 5.0V – HTR 4.5V – A/C					CYCLES ON AND OFF TO MAINTAIN EVAPORATOR BETWEEN MINUS 1°C AND 7 1/2°C (31°F TO 34°F)		
	AUTO.	VARIABLE BLOWER PROGRAM	RECIRCULATE AIR WHEN PROGRAMMER IS AT MAX. A/C - OTHERWISE OUTSIDE AIR						
	HI	FIXED HI - 13.5 V							
	BI-LEVEL	VARIABLE BLOWER PROGRAM			BI-LEVEL			OPEN	
	DEF	FIXED HI - 13.5 V			FORCED TO HEATER	FULL OPEN TO W/S			NO – BLOWER IS TURNED ON BY O'RIDE SW.

Fig. 1-167 System Operation at Various Settings

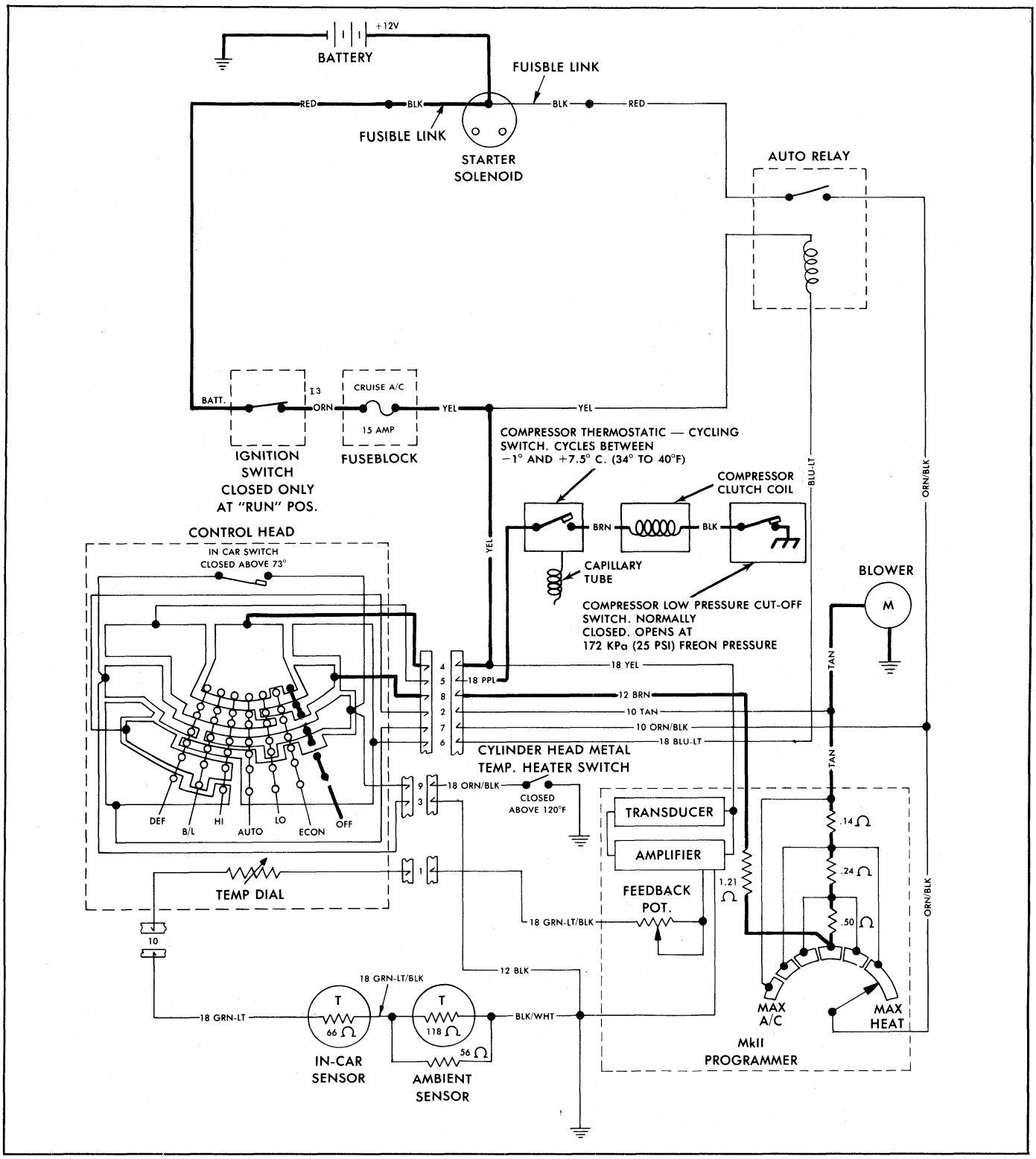


Fig. 1-168 Blower Operation at "OFF"

Blower Operation at "Off" (Fig. 1-168)

When the ignition switch is closed, current flows through the fuse block, control head, lo blower resistors to ground at the blower motor. Blower current flows through all four resistors in the programmer to the blower motor which operates at low speed. Movement of the programmer has no affect on blower speed.

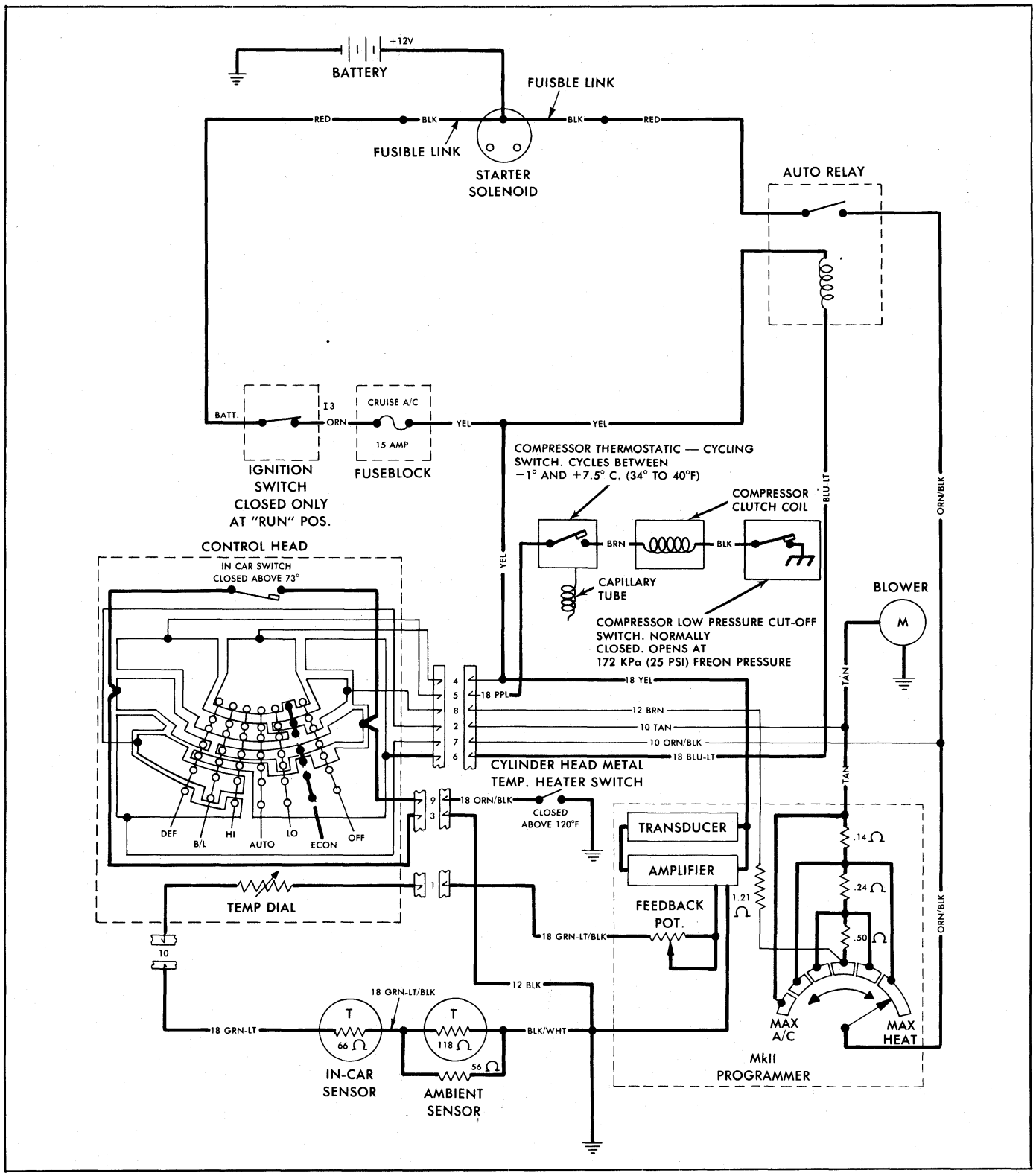


Fig. 1-169 Blower Operation at "Economy"

Blower Operation at "Economy" (Fig. 1-169)

Current flows through the ignition switch and fuse block to the auto relay coil and to ground through either the engine temperature switch or the in-car switch. There is no grounding connection on the control head circuit board switch for the auto relay so that multiple blower speeds will delay in cold weather. Blower current flows through the fusible link to the center point of the wiper on the programmer and through none, one, two or three resistors, depending on the position of the programmer, to the blower motor and after 54°C (130°F) coolant temperature.

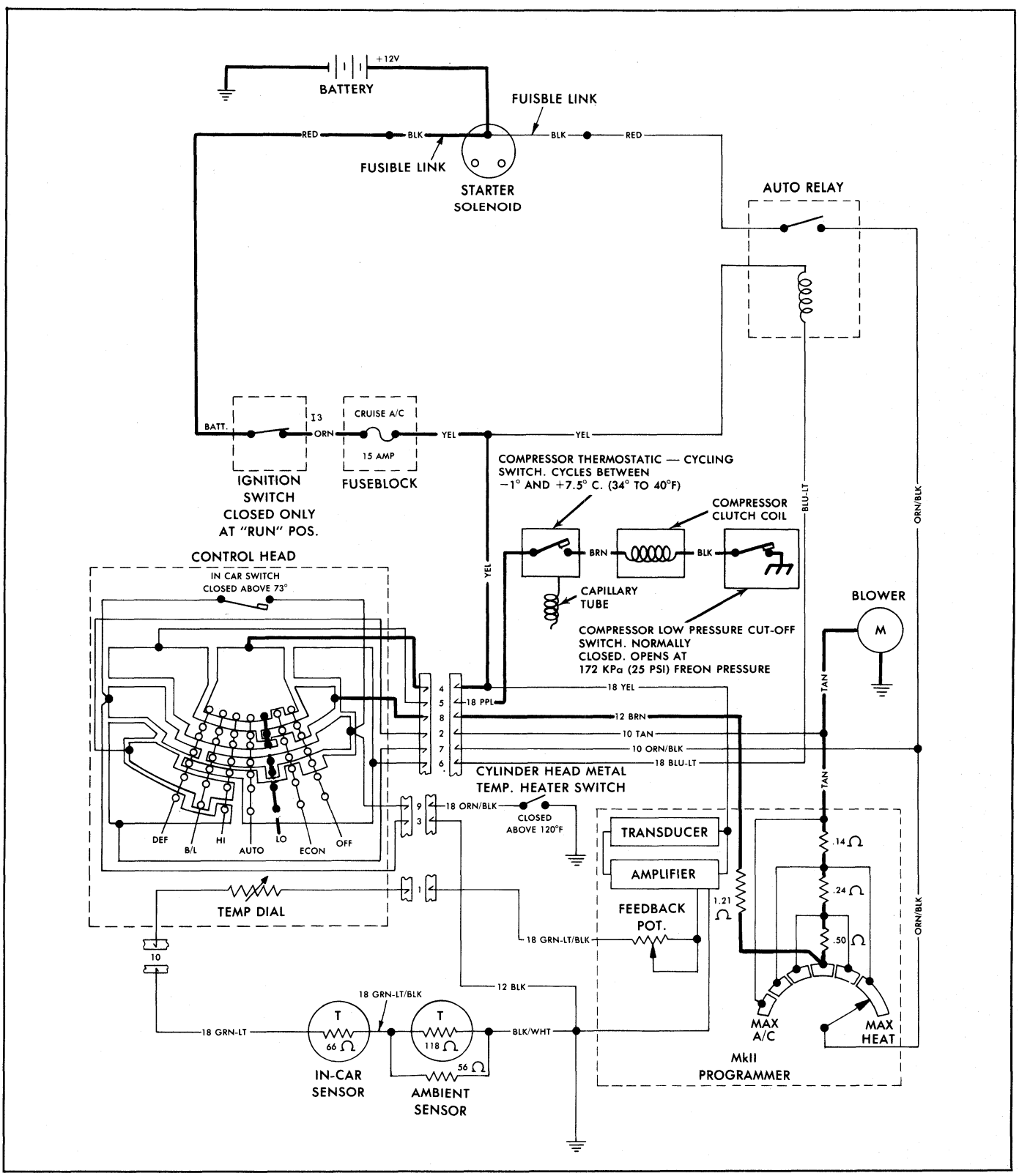


Fig. 1-170 Blower Operation at "LO"

Blower Operation at "Lo" (Fig. 1-170)

When the ignition switch is closed, current flows through the fuse block, control head, lo blower resistors to ground at the blower motor. In cold weather the blower will operate at low speed regardless of engine coolant temperature. Blower current flow through all four resistors in the programmer to the blower motor which operates at low speed. Movement of the programmer has no affect on blower speed.

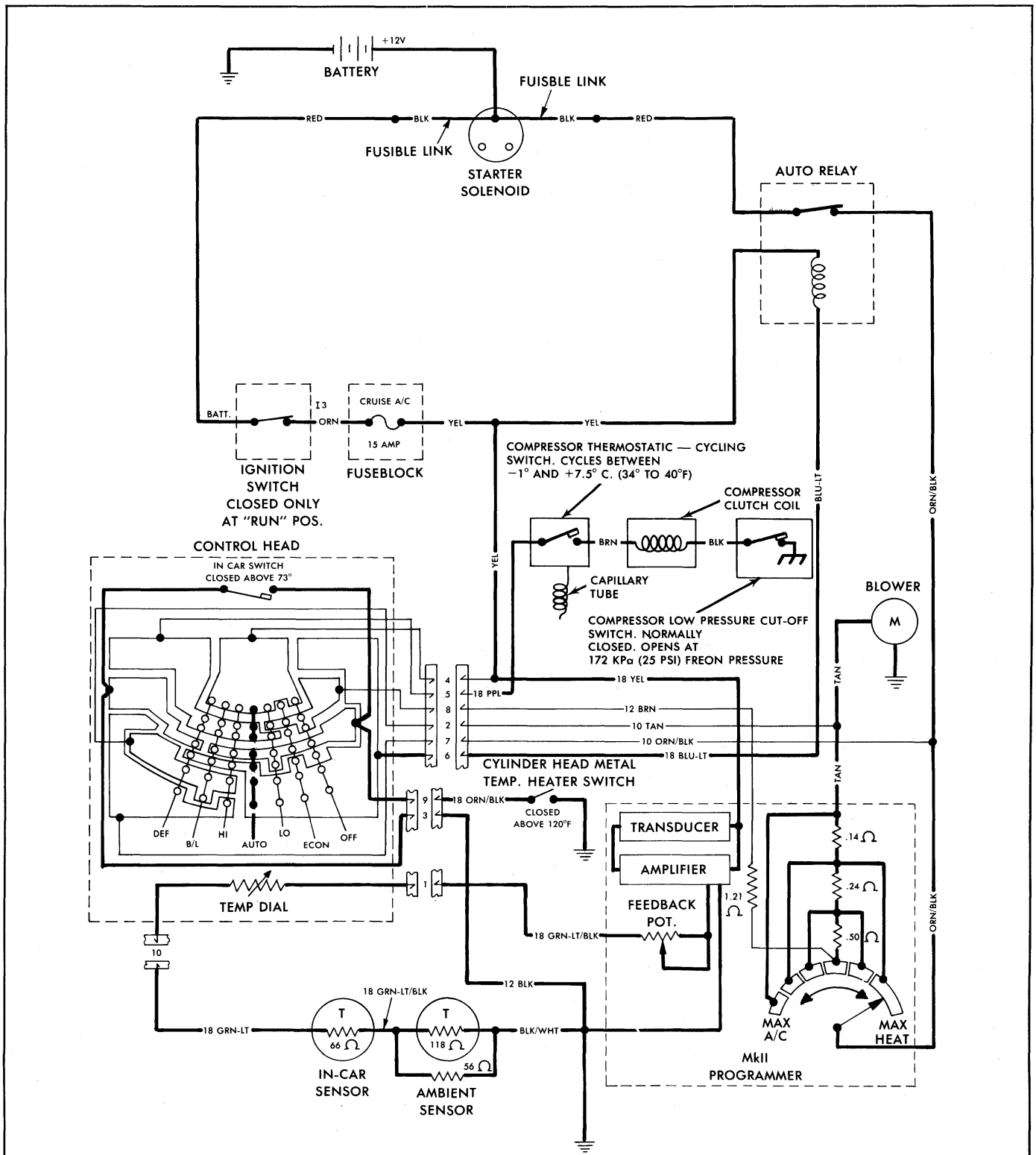


Fig. 1-171 Blower Operation at "Auto"

Blower Operation at "Auto" (Fig. 1-171)

Current flows through the ignition switch and fuse block to the auto relay and to ground through either the engine temperature switch or the in-car switch. There is no grounding connection on the control head circuit board switch for the auto relay so that multiple blower speeds will delay in cold weather. Blower current flows through the fusible link to the center point of the wiper on the programmer and through none, one, two or three resistors, depending on the position of the programmer, to the blower motor and after 54°C (130°F) coolant temperature.

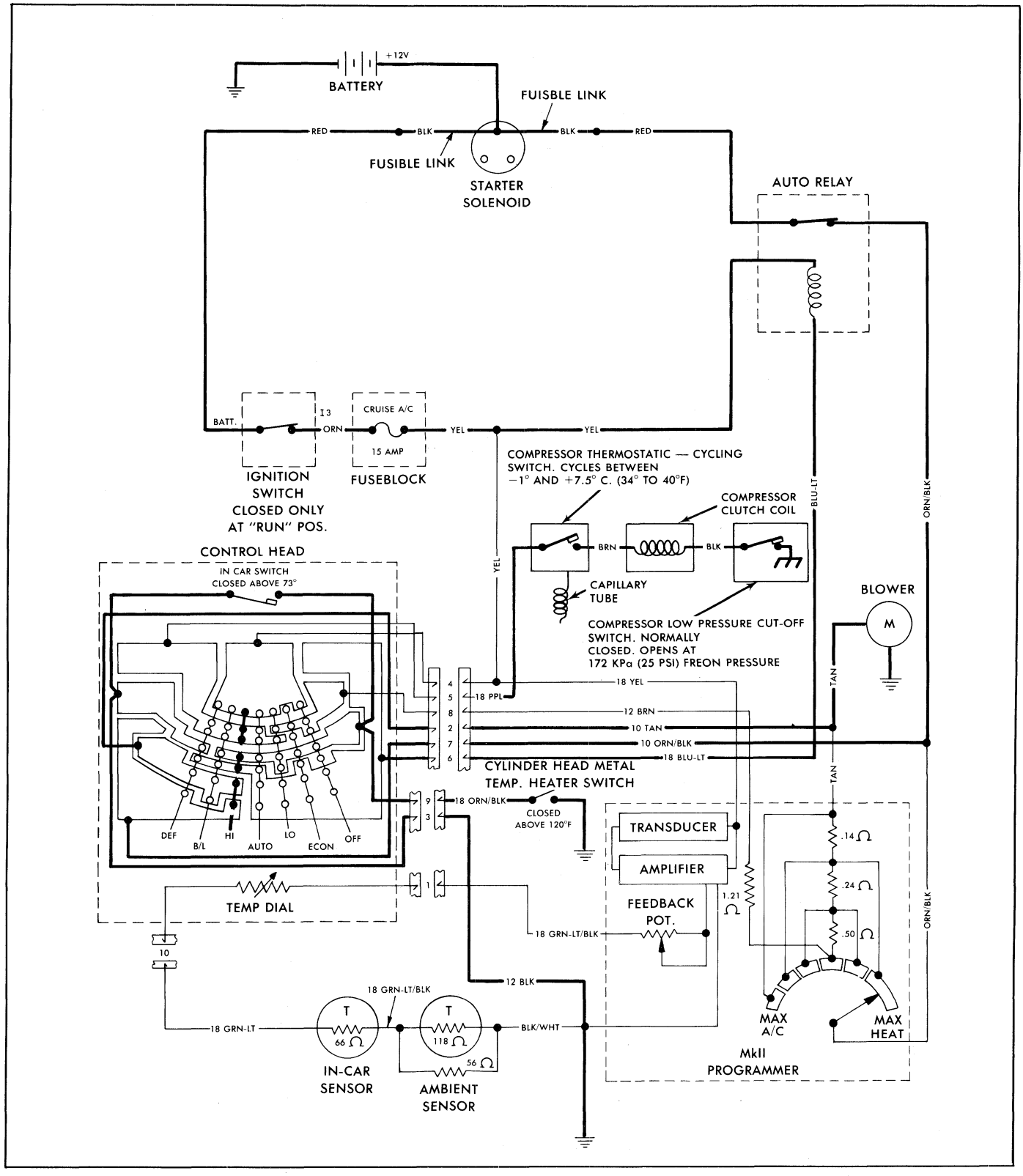


Fig. 1-172 Blower Operation at "HI"

Blower Operation at "Hi" (Fig. 1-172)

Current flow through the auto relay coil circuit is the same as at "Auto". Blower current, however, does not go through the programmer but is routed through two interconnected pads on the control head directly to the blower motor. There is no resistors in the circuit so that the blower operates at a fixed high speed, with no programmer control over its operation.

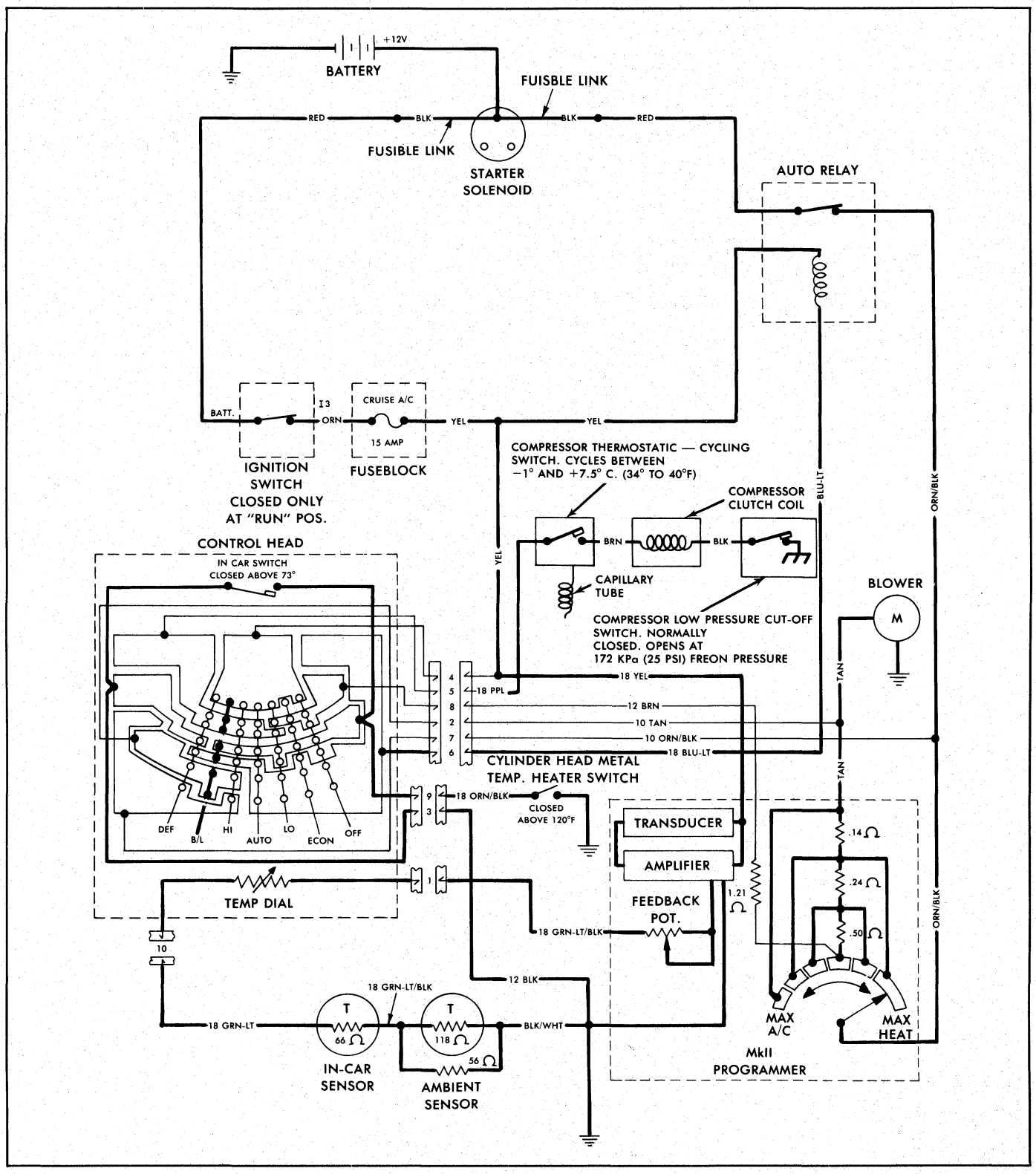


Fig. 1-173 Blower Operation at "Bi-Level"

BlowerOperation at "Bi-Level" (Fig. 1-173)

Current flows through the ignition switch and fuse block to the auto relay and to ground through either the engine temperature switch or the in-car switch. There is no grounding connection on the control head circuit board switch for the auto relay so that multiple blower speeds will delay in cold weather. Blower current flows through the fusible link to the center point of the wiper on the programmer and through none, one, two or three resistors, depending on the position of the programmer, to the blower motor and after 54°C (130°F) coolant temperature.

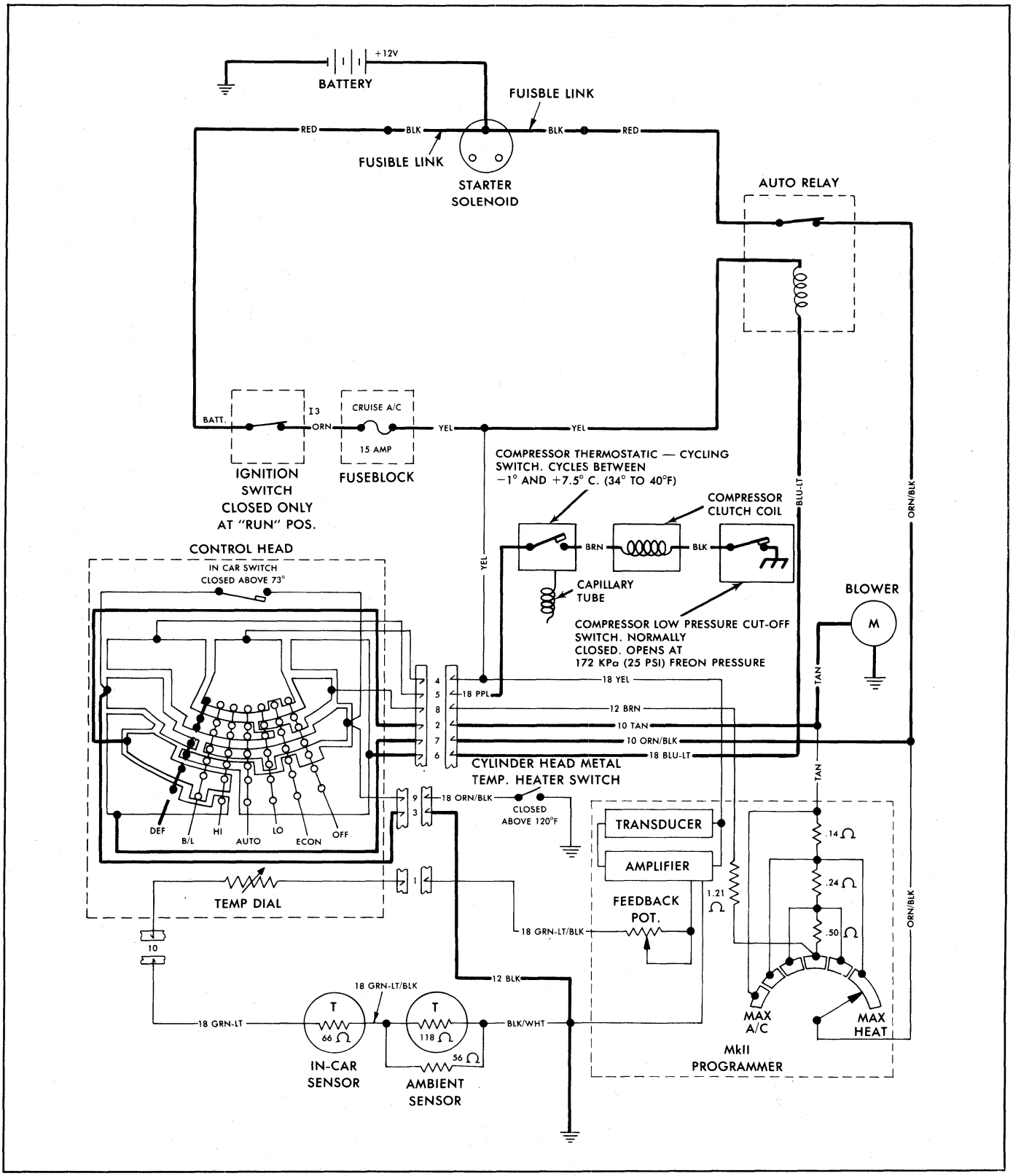


Fig. 1-174 Blower Operation at "DEF"

Blower Operation at "Def" (Fig. 1-174)

The Auto Relay Coil is grounded through two pads on the control head so that there is immediate turn-on even with a cold engine. Blower current flows to two inter-connected pads on the control head and on the blower. The blower operates at a fixed high speed.

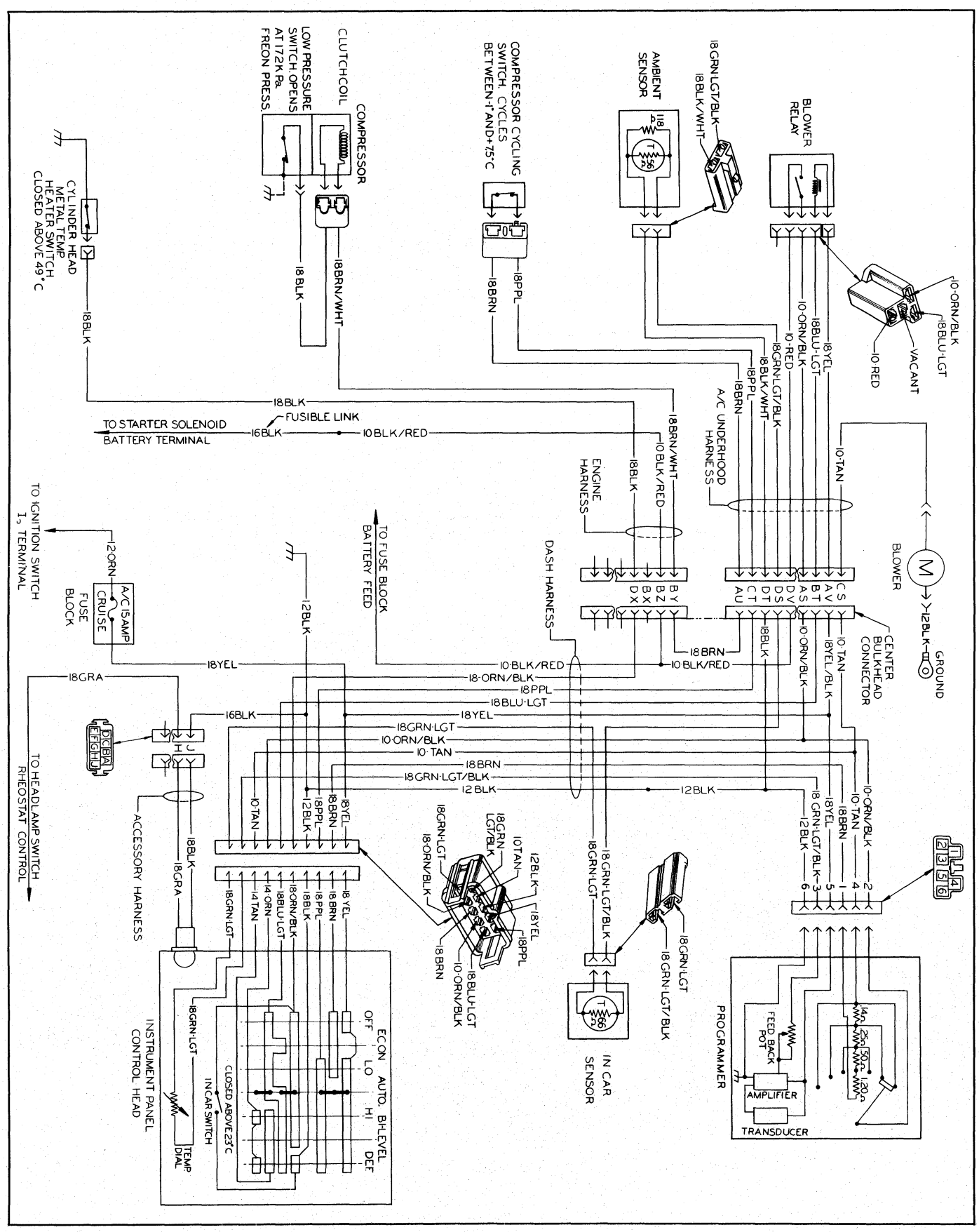


Fig. 1-175 Complete Electrical Circuit (Eldorado)

DIAGNOSIS

How to Isolate the Problem

To diagnose an air conditioner problem in the shortest time and with the least effort, it is essential to follow a logical service procedure. Time spent in conducting a system functional performance test and analyzing the malfunction in order to isolate it to a specific control function area will be repaid in reduced repair time. A recommended diagnosis procedure follows:

STEP 1 - Attempt to get an accurate, detailed description of the owner's complaint in writing on the repair order. "A/C inop." or "erratic operation" do not provide much information to the repairman.

STEP 2 - To confirm the system malfunction make a brief check of system operation by sitting in the car and operating the controls, with the engine warmed up and running at 1000 RPM or higher, in the following sequence:

AUTOMATIC TEMPERATURE CONTROL FUNCTIONAL TEST	
CONTROL SETTING	**SYSTEM SHOULD OPERATE AS FOLLOWS**
"DEF" DIAL @ 85°F	Air should be delivered out of defroster outlets at a fixed high blower speed. Some floor bleed out heater.
"BI-LEVEL" DIAL @ 85°F	Air should be delivered from both the A/C and heater outlets at a reduced blower speed. Only a small portion of air will come out the defroster outlet.
"HI" DIAL @ 65°F	Air should be delivered out the A/C outlets at a fixed high blower speed and cool to cold temperature. The recirculating air door should open (blower noise increases). Door movement will be slow because of vacuum delay porous plug.
"AUTO" DIAL @ 85°F	Blower speeds should drop (Hi-M_3-M_2-M_1- etc.). Recirc air door should close (noise level will drop). Discharge air temperature should increase. Depending on the temperature in the work area, the air delivery mode should change from the A/C outlets to the heater outlets.
"LO" DIAL @ 85°F	Air should be delivered at a fixed low blower speed with immediate turn on regardless of engine coolant temperature.
"ECONOMY" DIAL @ 65°F	Blower speeds should increase (M_1-M_2-M_3- etc.) Depending on the temperature in the work area, the air delivery mode should change from the heater outlets to both heater and A/C outlets or the A/C outlets only. The A/C compressor should not operate.
"OFF" DIAL @ 65°F	Air should be discharged out the heater outlet at a fixed low blower speed. No A/C compressor operation. Blower will turn on immediately regardless of engine coolant temperature.

During the above tests, be sure to note the following:

a. Check to assure that air delivery is **not** coming from both the A/C and heater outlets when only one mode is indicated. A split air delivery is indicative of a vacuum leak.

b. Note whether program events (air delivery mode change, blower speed change, recirc air, etc.) occur without change in discharge air temperature. This would indicate the programmer is operating without moving the temperature air door. Check the air mix door link to programmer connection.

c. If neither the program events nor the discharge air temperature change, an incorrect vacuum or electrical signal to the programmer or a programmer malfunction is indicated.

d. Malfunction of a specific vacuum operated door function could indicate a vacuum disconnect of the vacuum diaphragm at that door. See illustrations for locations of the different function doors.

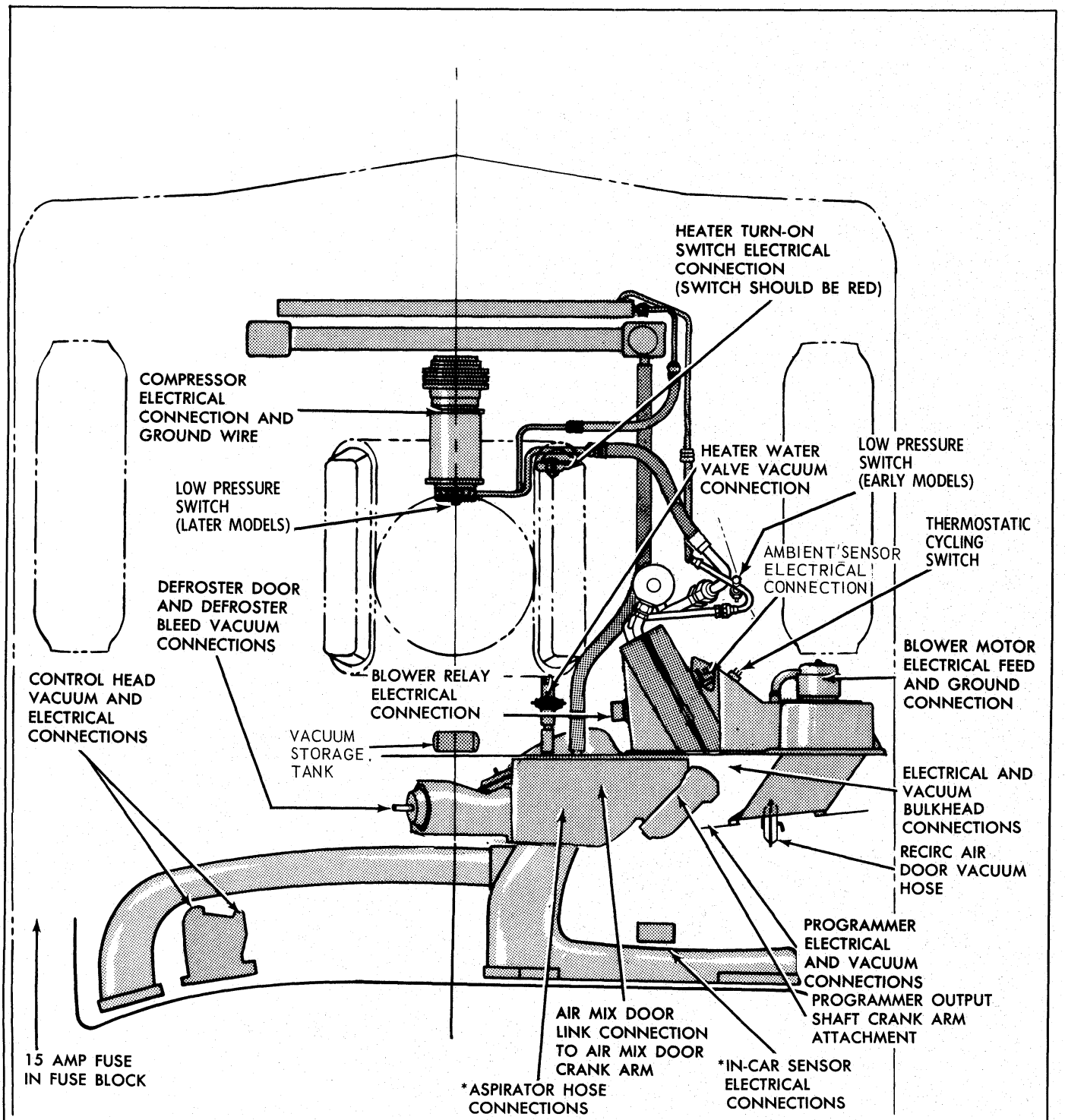
STEP 3 - Perform the easiest checks first! A simple, visual inspection of the easily accessible underhood and instrument panel electrical and vacuum connections will, in many instances, reveal the problem on the spot. The areas indicated in Fig. 1-176 can be inspected without removing any car parts: It may be necessary to remove the lower steering column cover to inspect control head.

STEP 4 - Based on information gained during the functional test performed in step 2, try to relate the problem to one of the following areas:

1. Temperature Control Problems
2. Blower Control Problems
3. Auxiliary Vacuum Problems
4. Refrigeration System Problems

Once a problem has been isolated to one of the areas listed above, refer to that diagnosis section on the following pages. Diagnosis charts and control circuit illustrations are provided. **It is of special importance to be familiar with the general description of the major sections of the system as presented beginning on page 1-105.**

STEP 5 - After the problem has been properly diagnosed and the repair made, it is important to run through the brief check listed in Step 2 in order to assure that the system is now performing correctly.



*REMOVE GLOVE BOX LINER FOR ACCESS

Fig. 1-176 Diagnosis Areas

Temperature Control Problem Diagnosis

The primary function of the temperature control circuit is to determine the correct temperature of the air to be discharged into the passenger compartment and to set the air mix door position to accomplish that function. The signal used for this purpose (vacuum to position the programmer vacuum motor) is also used in the blower speed control circuit, and the auxiliary vacuum function circuit. Those uses may be disregarded when dealing with problems which relate only to the temperature control circuit.

Examples of temperature control problems are: "System operates at maximum air conditioning (no heat) or only at maximum heating (no air conditioning)", "Temperature dial does not provide comfort", "Poor heating or poor cooling". Blower cycling and mode cycling are also caused by a malfunction in the temperature control circuit.

It is important to separate temperature control circuit problems from refrigeration or heater circuit problems. If the complaint is "poor" or "no" heating or cooling and the programmer moves to both extremes of travel with the air mix door and program functions known to follow, the problem probably lies in the refrigerant or heater water circuits. Refer to pages 1-48 and 1-49 later in this section.

Many temperature control problems result from poor electrical or vacuum line connections. The following relationships may aid diagnosis:

- A **disconnected sensor or temperature dial** interrupts the electrical signal and drives the programmer to maximum heating.
- A **poor sensor connection** adds resistance to the sensor string driving the system hotter.
- An **open amplifier power feed** eliminates the output signal and drives the programmer to maximum A/C.
- A **disconnected vacuum hose** supplying the vacuum checking relay actuating nipple will lock the relay in an intermediate position.
- A **disconnected vacuum hose** in the transducer-programmer vacuum motor line will drive the system to maximum cooling.
- A **leak** in the auxiliary vacuum circuit may reduce the transducer vacuum supply level below control requirements, causing an "off-calibration" or "poor heating" type complaint.
- A **loss** of supply vacuum usually results in cold air flow on the floor.

Diagnosis of most of the problems encountered in the temperature control circuit will be greatly aided by use of tester, J-23678 (use Harness Adapter J-24774 to connect to programmer and harness). Information on how to use the A.T.C. Tester is provided on the tester cover. MK II programmer equipped systems must use instructions J-23678-50A which are provided with the tester and also printed on pages 1-43 and 1-44.

Specific problems and probable causes are as follows:

SYSTEM OPERATES ONLY AT MAXIMUM AIR CONDITIONING

This can be a vacuum or electrical problem. The problem can be separated into problems of erroneous signal external to the programmer or internal programmer malfunctions. With the system operating, disconnect the ambient sensor electrical connector, and observe the programmer movement through the slot at the bottom of the programmer cover. If the programmer remains in the maximum air conditioner position, remove the multiple vacuum connector and check for supply vacuum at the black hose. If no (or low) vacuum supply, check for leaks or disconnects in vacuum hose assembly. If vacuum supply is okay, programmer is malfunctioning. Remove programmer cover and inspect for obvious disconnects. If no programmer problem is obvious, use Tester J-23678, Adapter Harness J-24774 and instructions J-23678-50A to analyze and correct problem.

If the programmer moved to the maximum heater position when the electrical connector was removed, the problem is external to the programmer. Check the following items:

1. Shorted in-car sensor or ambient sensor.
2. Shorted or miscalibrated temperature dial.
3. A short in the sensor circuit of the wiring harness.
4. Disconnect or open in ground circuit (black wire) between control head and programmer.
5. No electrical power to programmer (yellow wire).
6. No ground at amplifier.
7. Malfunction within programmer assembly.

Use Tester, J-23678, Adapter Harness J-24774 and instructions J-23678-50A to analyze and correct the above problems.

SYSTEM OPERATES ONLY AT MAXIMUM HEATING

This is usually an electrical problem either internal or external to the programmer. Investigate the following areas:

1. Disconnected or malfunctioning in-car sensor.
2. Disconnected or malfunctioning ambient sensor.
3. Open circuit or backed-out terminal in the wiring harness sensor string circuit.
4. Disconnected or malfunctioning temperature dial.

SYSTEM FLUCTUATES BLOWER SPEEDS and/or MODE SHIFTS DURING ACCELERATION

1. Malfunctioning vacuum checking relay (inside programmer).
2. Leaking programmer vacuum motor.

It is possible to distinguish between the two above items. With the system operating and the programmer cover removed, reinstall the vacuum and electrical connectors, and perform the following steps:

a. Remove the ambient sensor connector to force the programmer to maximum heating (full vacuum).

b. Remove the vacuum hose assembly connector. The programmer should remain in the maximum heat position. If it does not, repeat Step a, and then pinch the programmer vacuum motor supply hose with a pair of needle-nose pliers. If the programmer still moves, the vacuum motor is leaking. If the programmer does not move, the checking relay is malfunctioning.

c. If the original complaint was mode shifts without blower change, the check valve portion of the checking relay is probably malfunctioning.

DIAL SETTING DOES NOT PROVIDE COMFORT

The best approach to solving problems of the "off calibration" variety, is to use Tester, J-23678, Adapter Harness J-24774 and instructions J-23678-50A to check and reset calibration on all of the following parts (see page 1-149).

1. The temperature dial.
2. The feedback potentiometer in the programmer.
3. The temperature door link adjustment.
4. The sensor string.

(NOTE: Check to assure that in-car sensor aspirator hose is attached at both the in-car sensor and the aspirator and not kinked in routing.)

Refer to the instruction sheet included with the Tester or the section on System Adjustments for procedures on checking and calibrating the above items.

BLOWER CYCLING AND MODE CYCLING

Erratic system performance may be caused by poor electrical connections, "cold" solder joints, or a malfunctioning sensor or amplifier. The problem may be intermittent and occur from the shock of going over road bumps. Such a problem may be accompanied by a clicking or buzzing of the transducer. To isolate the problem area, "rap" the areas around the sensors, control head, and programmer, and shake the wires attached to those areas. Listen for buzzing or clicking of the transducer. If the problem cannot be pinpointed by transducer buzzing, remove the programmer cover, (reinstall the vacuum and electrical connectors) and attach a good voltmeter to the transducer output terminal (grey wire). Repeat the rapping and wire shaking, and observe the voltmeter for violent, erratic voltage fluctuations. Replacement of parts or resoldering of terminals may be necessary. The sensors may be individually checked to the sensor resistance curve, Fig. 1-177.

(NOTE: Some system cycling may also occur and is normal if the temperature dial is moved in large increments. Instruct owner of this, and explain system operation.)

INSUFFICIENT HEATING OR COOLING

This problem may be caused by a control system malfunction or by the refrigerant or heater systems. Determine first which area to pursue:

1. Check for compressor clutch actuation (no cooling). If not operating, refer to diagnosis of refrigerant system, Page 1-149.
2. Check for cold suction line (no cooling).
3. Check engine coolant level (no heating).
4. Check temperature of heater hoses by feel with engine hot to see if hot water is entering the heater core (no heating).

5. Check for proper air flow at the "Auto" and "Hi" lever settings. (Improper air flow may be a blower relay problem, a blocked air passage, or a disconnected air hose.)

If a refrigeration problem exists, refer to the refrigeration diagnosis section on page 1-149. If the problem appears to be caused by the temperature control system, locate problem area using Tester, J-23678, Adapter Harness J-24774 and directions J-23678-50A or is specified elsewhere in this section. Also check air mix door link adjustments.

BLOWER SPEEDS AND MODE SHIFT OCCURS WITHOUT TEMPERATURE CHANGE

Check connection of air mix door link to programmer shaft and to air door crankarm.

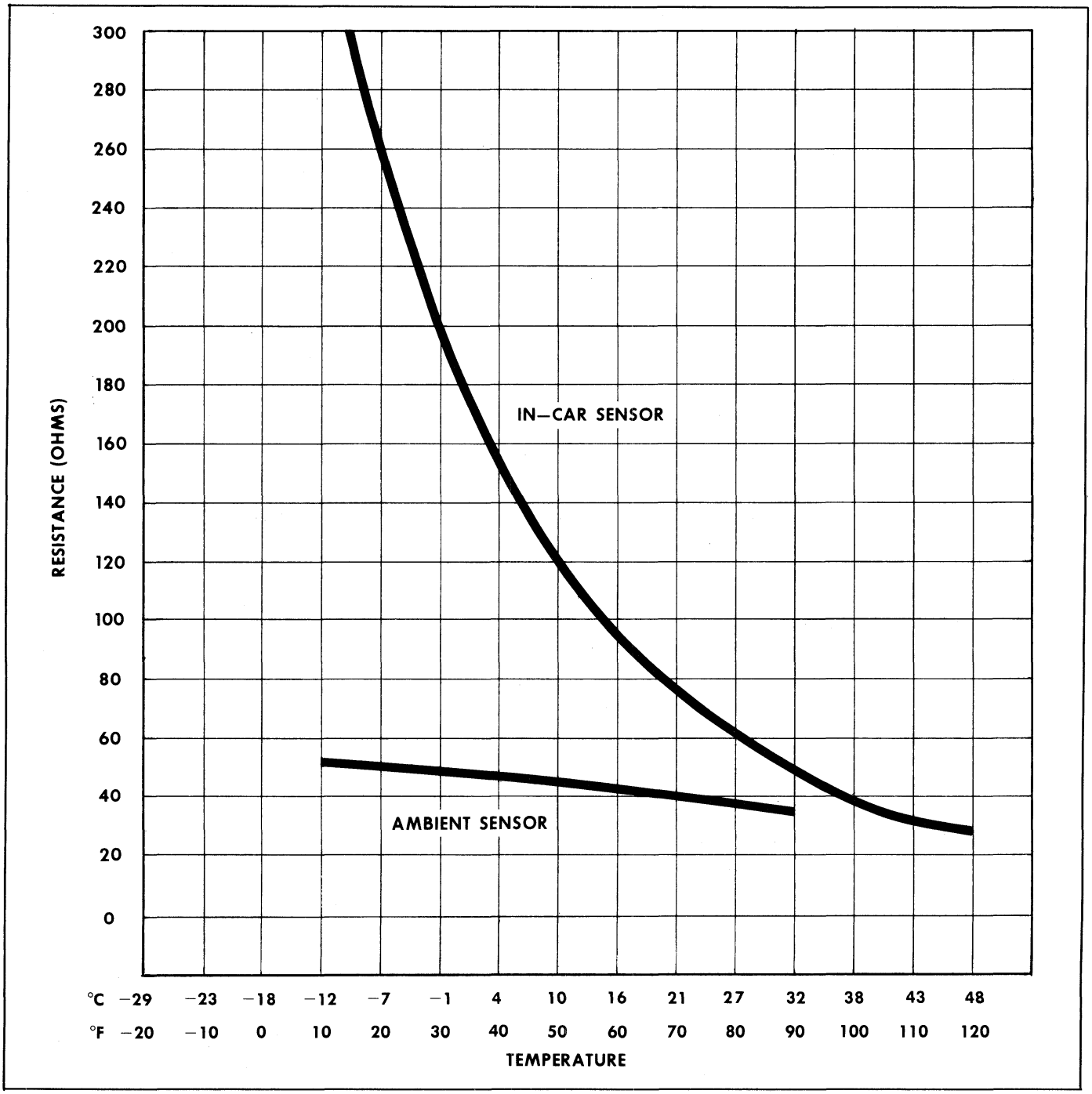


Fig. 1-177 Resistance Values of Sensors

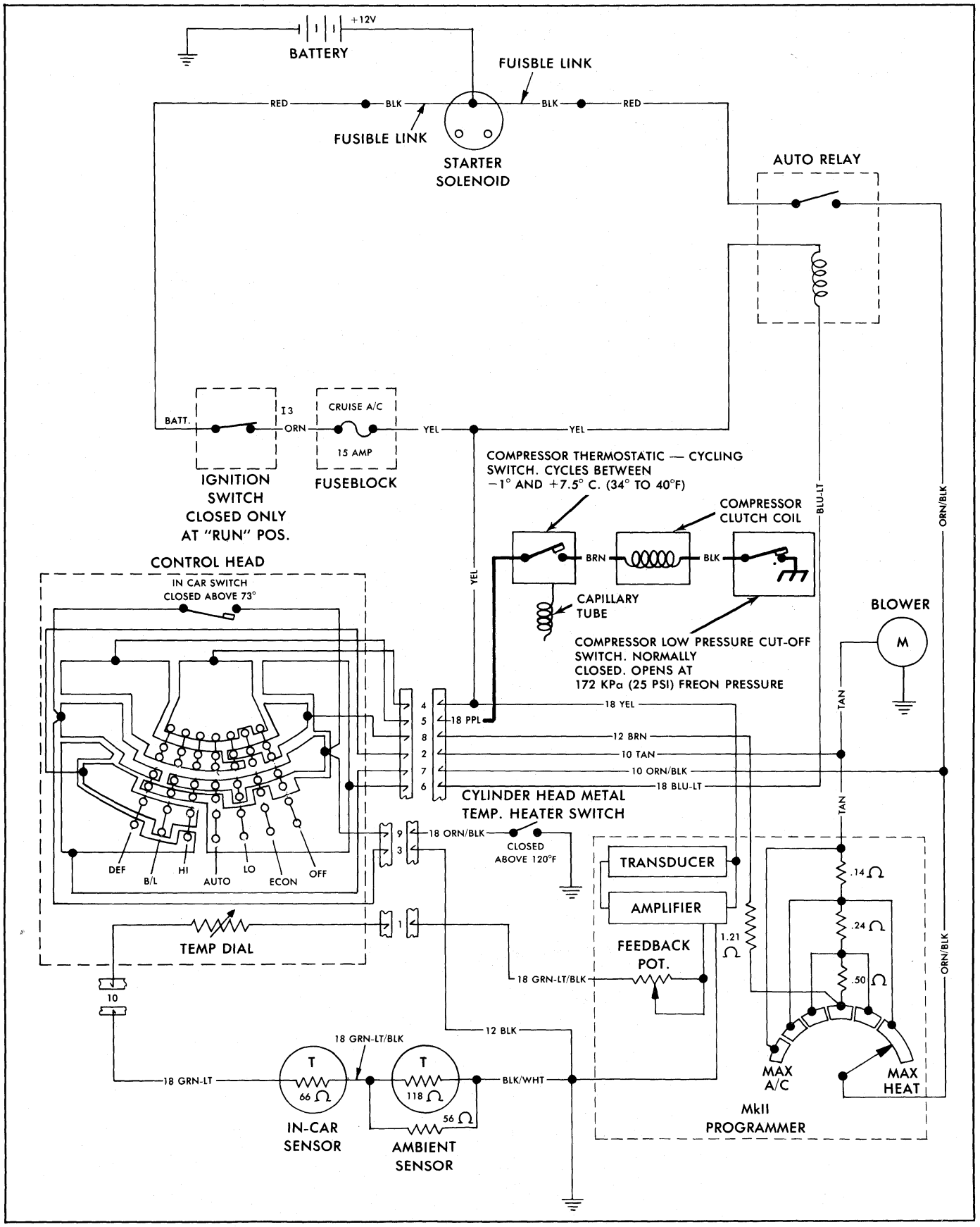


Fig. 1-178 Blower Control Circuit

SYSTEM FUNCTIONAL TEST – ALWAYS START DIAGNOSIS WITH THIS TEST
MK II PROGRAMMER WITH COMBINED AMPLIFIER-TRANSDUCER

SET CONTROL AT:	SYSTEM SHOULD OPERATE AS FOLLOWS (ENGINE RUNNING – 70° - 80° GARAGE
DEF ..... 85°	Fixed high blower – most of air delivered from defroster outlets - some air from heater outlet – instant blower turn on.
BI-LEVEL ..... 75°	Lower blower speed – cooler air from both A/C and HTR outlets – only very small amount of air out defroster.
HI ..... 65°	Fixed high blower – cold air from A/C outlets – recirc should occur (will take approx. 3 min. on some cars because of restrictor in hose.
AUTO ..... 65°	No recirc – door will approx. take 5 min. on some cars
AUTO ..... 85°	before outside air enters.
LO ..... 85°	Blower should drop to fixed low speed.
ECON ..... 85°	No compressor operation, otherwise same as AUTO.
OFF ..... 85°	Fixed low blower – warm air out heater outlets – no air out A/C or defroster ducts – no compressor operation.

PROGRAMMER FUNCTIONAL TEST

1. Connect tester electrical harness to programmer and car harness to tester. Use harness adapter No. J-24774.
2. Operate car at idle – approx. 1000 RPM.
3. Set control head lever at auto.
4. Turn temp dial calibration switch off.
5. Place manual-automatic switch in manual position.

   (NOTE: This substitutes variable resistor for sensor string at all control head settings.)

6. Place the manual control at max. heat and then rotate slowly counter-clockwise. The vacuum motor mechanism which can be seen through the slot in the programmer cover should start moving at 175 OHMS. Rotating the knob to max. cold should move the programmer to its full A/C position. Check air mix door for full travel and no obstructions. If the programmer operates in this manner, the components governing programmer movement – amplifier, transducer and vacuum motor – are OK. Proceed to sensor string test.
7. If the programmer moves but the movement does not start at 175 OHMS, adjust feedback pot per procedure on the next page.
8. If the programmer does not move check as follows for supply voltage and supply vacuum:
   a. Place voltmeter switch in 2 position. Battery voltage should appear on meter. No voltage indicates lack of ground on Term. 1 or battery supply to Term. 2 of programmer.
   b. Plug testers dummy vac plug on programmer valve. Connect dummy hose to vac supply (port 2 hose in car vacuum harness). Make sure vac is present (11 in. hg. or more). Programmer now has vac supply with no car vac system components connected. If programmer functions using manual control, troubleshoot car vac system. If programmer does not function problem is in programmer. See next page.

SENSOR STRING TEST (MUST PASS PROGRAMMER FUNCTIONAL TEST FIRST)

(NOTE: Do not perform sensor string test on car which has been run at idle for a long period of time in a heated building. This condition produces sufficient engine heat to heat the ambient sensor and cause lower resistance readings than specified in the procedure even though no problem exists in the sensor string.)

1. Set control lever at auto and temperature dial at 75.
2. Place temp dial calibration switch at off.
3. Place manual-automatic switch at automatic position.
4. Observe position of vacuum motor mechanism through slot in programmer cover.
5. Switch to manual and adjust manual control for same mechanism position.
6. When manual control is properly adjusted moving manual-automatic switch back and forth will not move vacuum motor.
7. Read manual control. This indicates the resistance of the sensors and the temperature dial combined and should be 120 to 150 OHMS at 70° to 75° room temp.
8. If reading is not 120 to 150 OHMS perform the temperature dial calibration test to check out the temp dial. If temp dial checks OK, the in-car or ambient sensor or connecting wiring is the problem.

TEMPERATURE DIAL CALIBRATION (CONTROL LEVER IN ECON.)

1. Place control lever at economy.
2. Place manual-automatic switch in manual position.
3. Place calibration switch in cal. position.
4. Disconnect in-car sensor connector and plug connector into mating connector on tester harness adaptor (ground both sensor wires).
5. Read voltmeter.
6. Press pushbutton and adjust temp dial on control head to get same voltmeter reading as above.
7. Temp dial should read as indicated on tester panel near pushbutton. If it does not, slip temp dial clutch to correct.

   (NOTE: If same voltmeter reading cannot be obtained the temp dial is malfunctioning.)

8. Reconnect in-car sensor.

BLOWER CIRCUIT TESTS

1. Place calibration switch in off position.
2. Place manual-automatic switch in manual position.
3. Set control lever at LO using voltmeter knob. There should be battery voltage at 7 (approx. 11 volts) and approx. half-battery voltage at 6 (4.0 to 4.5 volts). If there is no voltage at 7, there is a problem in the LO blower circuit. If there is voltage at 7 but no voltage at 6 the programmer is malfunctioning.
4. Set control lever at auto. There should be battery voltage at 8 (approx. 11 volts) and the voltage at 6 should stairstep down and then back up as the manual control is rotated from max. heat to max. cold. If there is no battery voltage at 8, there is a problem in the auto relay circuit. If the voltage at 6 does not change as described, the programmer is malfunctioning.

   (NOTE: A good connection between 6 and the blower motor is assumed. If the blower wire is disconnected, only battery voltage will appear at 6.)

DIAGNOSING MALFUNCTIONS IN PROGRAMMER. THE FOLLOWING TESTS SHOULD BE PERFORMED TO DETERMINE MALFUNCTIONING INTERNAL PART. TESTS SHOULD BE MADE IN THE NUMBERED SEQUENCE.

TEST 1 PROGRAMMER VACUUM CIRCUIT

Turn temp dial calibration switch off. Place manual-automatic switch in manual. Position manual control–max. heat. If programmer moves to max. heat position skip to Test 2, otherwise perform following test.

1. Remove programmer cover. Install dummy vacuum plug with vacuum gauge feed-in to port 2 of car harness plug.
2. If vacuum drops below supply vacuum found in programmer functional test, use long-nose pliers to pinch the two black hoses leading from side of rotary valve. If vacuum reading improves, check programmer hoses for leaks, then go to Test 2.
3. If reading does not improve, leak is in rotary valve.

TEST 2 VACUUM MOTOR AND CHECKING RELAY

1. Leave tester set as in Test 1 above. Programmer should go to full heat.
2. Disconnect vacuum dummy plug or car vacuum harness from programmer. Vacuum checking relay should hold vacuum motor in full heat. If mechanism moves, vacuum motor or checking relay is leaking. Apply raw vacuum to vacuum motor then pinch hose at motor to see if leak is in motor. A good motor holds position.

TEST 3 AMPLIFIER AND TRANSDUCER

1. Connect tester harness to system. Place manual-automatic switch in manual and temp dial calibration switch in off position.
2. Remove small transducer vacuum hose and connect tester vacuum gauge to hose. 11 in. hg. or more vac. should be present on small transducer supply hose. Delay in obtaining 11 in. hg. or more may be due to a plugged restrictor located in the small transducer hose. Re-install hose on transducer.
3. Remove large vacuum hose from transducer. Connect tester vacuum gage to large port on transducer.
4. By rotating the manual control, vacuum readings of 1 to 5 in. hg. in max. A/C and 5 to 22 in. hg. in max. heat should be obtainable. Any value from 2 to 17 in. hg. can be obtained by careful adjustment of the manual control if the amplifier-transducer is functional.

TEST 4 FEEDBACK POTENTIOMETER ADJUSTMENT

1. Using screwdriver, slip feedback pot shaft counter-clockwise with respect to gear. Programmer should move to full heat.
2. Place manual-automatic switch in manual position. rotate manual control to max. heat.
3. Move manual control to 175.
4. Slip feedback pot shaft slowly clockwise looking for signs of vacuum motor mechanism movement.
5. Check adjustment with manual control. Travel should start when 175 is reached as knob is turned counter-clockwise from max. heat.
6. If feedback pot cannot be adjusted, replace amplifier-transducer assembly.

BLOWER SWITCH BENCH TEST – (USING J-23713 BENCH TEST HARNESS)

1. Place voltmeter knob at 6.
2. With manual-automatic switch in manual, rotate manual control back and forth. Voltage should drop then increase in steps. Steps will be smaller than those seen in car.

PROGRAMMER MOVES BUT VACUUM OPERATED DOOR(S) MALFUNCTION

If one of the doors does not operate, malfunction could be caused by plugged or pinched harness or plugged valve on programmer. To check programmer valve, cut off sealed hose on dummy plug for circuit malfunctioning and connect the vacuum gauge to the plug. Plug the dummy plug on the programmer vacuum valve. Connect dummy hose to vacuum supply hose (port 2) in car vacuum harness. Monitor vacuum while operating programmer with manual control. When completed seal dummy plug hose with rivet. **Do not use a screw.** Refer to Shop Manual for proper vac valve operation.

TEMPERATURE DOOR CHECK AND ADJUSTMENT

A mis-adjusted temperature door link may not allow the programmer to travel fully to max. heat or to max. cold and could result in poor heating or poor cooling complaints. To check adjustment, attach tester electrical harness between programmer and car harness. Put manual-automatic switch in manual and control lever in aut. Put voltmeter knob in 6. Rotate manual control from max. heat to max. cold. High blower should be obtained in A/C and M_3 in max. heat with control lever in high. Recirc operation should be obtained at max. cold. A 3 minute delay on some cars with these conditions met. Temperature door adjustment is correct to readjust.

1. Start engine and put control lever in defrost.
2. Loosen screw on programmer shaft.
3. Place manual-automatic switch in manual. Manual control at max. heat programmer should go to full heat.
4. Move temperature door to full heat position by pushing door link away from programmer. The blower air hold door.
5. Tighten screw and re-check as above.

Blower Control Circuit Problem Diagnosis

The components and electrical circuits that make up the blower control circuit are shown in Fig. 1-178. Blower control can be divided into two separate categories, blower turn-on and blower speed control. Blower turn-on is accomplished when a ground path is completed. Relay coil grounds are completed by (a) the heater turn-on switch which provides delay for heater water warm-up in winter operation, (b) the in-car switch which provides immediate turn-on in summer operation, or (c) manual override in the "Def" setting. Blower speed control is accomplished by circuit board lever connections in the "Off" and "Lo" positions, by selective use of the resistors on the blower circuit board in the "Economy", "Auto" and "Bi-Level" lever settings, or by a high blower override circuit in the "Hi" and "Def" lever positions. It should be noted that the system air doors are always positioned to allow delivery of air into the passenger compartment. Problem descriptions and probable causes are listed in the following diagnosis chart:

SYSTEM OPERATES ONLY AT LOW BLOWER

1. Electrical disconnect at "Auto" blower relay.
2. Malfunctioning "Auto" blower relay.
3. Back-out terminal or power connection at six-way connector (located near programmer), at programmer, or at control head. Trace "Auto" blower circuit using electrical wiring diagram, Fig. 1-178.
4. Open in "Auto" blower circuit wiring.

Refer to wiring diagram, Fig. 1-178.

NO BLOWER OPERATION IN ANY LEVER SETTING

1. Electrical disconnect at blower motor.
2. Blown or open 15 amp. A/C-heater fuse.
3. Stalled blower motor.
4. Open circuit in wiring harness to blower motor.
5. Disconnect at six-way connector (near programmer).

NO BLOWER IN OFF OR LO SETTINGS

1. Malfunction of wiper contacts on control head circuit board.
2. Open low speed resistor on programmer.
3. Open in blower circuit wiring. Refer to wiring diagram, Fig. 1-170.

OPERATES AT LOW BLOWER ONLY EXCEPT IN "HI" AND "DEF"

(NO BLOWER OPERATION IN "ECONOMY", "AUTO" OR "BI-LEVEL" SETTINGS)

1. Problem in programmer wiper contacts or board.
2. Back-out terminal or disconnect at programmer electrical connector.
3. Open in programmer internal wiring.

BLOWER OPERATION ONLY IN "HI" OR "DEF"

1. Electrical disconnect at programmer (system will also operate only at maximum A/C).

BLOWER SPEED VARIES IN "HI" AND "DEF"

1. Malfunction or board in control head circuit board switch.
2. Open in control head wiring harness.
3. Open in by-pass circuit in wiring harness (refer to electrical circuit diagram, Fig. 1-175).

BLOWER OPERATES WITH IGNITION OFF

1. Malfunctioning auto blower relay (closed contacts).

BLOWER SPEEDS SKIPPED IN "ECONOMY" OR "AUTO" SETTING

1. Open resistor on programmer blower circuit board.

NO HEATER TURN-ON IN COLD WEATHER EXCEPT IN "OFF", "LO" AND "DEF"

1. Electrical disconnect at heater turn-on switch (located at front of R.H. cylinder head).
2. Heater turn-on switch inoperative (will not close). Check by grounding switch feed wire.
3. If problem persists, refer to electrical circuit diagrams for wiring discontinuity.

(NOTE: If problem does not occur in shop, it is probable that the system is turned on by the in-car sensor. Disconnect control head electrical connector to disarm the in-car switch. If the blower turns off (with the engine warmed up), ground the heater turn-on switch feed wire. If the blower now turns on (in low blower speed), the heater switch is probably malfunctioning.)

IMMEDIATE HEATER TURN-ON IN COLD WEATHER

1. Normal condition in "Off" and "Lo" control heat lever settings.
2. Malfunctioning (closed) heater turn-on switch (remove and check cold).
3. Malfunctioning (closed) in-car switch.
4. If problem persists, refer to electrical circuit diagram, and trace wiring continuity.

A/C DELAYED IN HOT WEATHER UNTIL ENGINE WARMS UP (UNLESS CONTROL LEVER IS IN "LO" OR "DEF"

1. Malfunctioning (open) in-car switch.
2. Open in control head wiring harness (in-car switch circuit).
3. If problem persists, check wiring continuity in the in-car switch circuit. Refer to the wiring diagram, Fig. 1-178.

Auxiliary Vacuum Problem Diagnosis

Auxiliary vacuum functions are defined as those vacuum circuits in the automatic temperature control system which do not affect the temperature of discharge air. Specifically that would include all vacuum functions except the transducer, relay portion of the vacuum checking relay, and the programmer vacuum motor. Included in the theory section are diagrams of the following auxiliary circuits.

1. Upper mode door vacuum circuit.
2. Lower mode door vacuum circuit.
3. Defroster bleed vacuum circuit.
4. Defroster door vacuum circuit.
5. Recirc door vacuum circuit.
6. Heater water valve vacuum circuit.
7. Auxiliary vacuum circuit check valve.
8. Compressor electrical circuit.

Because of the relative simplicity of each of the auxiliary vacuum circuits, the best diagnostic aid will be a clear understanding of the type of problem or complaint which would result from a malfunction in any of the individual circuits. Once the problem has been isolated to a specific circuit diagnosis will generally consist of checking vacuum connections at one or two points. The following chart presents the types of problems most likely to be encountered in each of the auxiliary circuits. For more complex problems a procedure to completely qualify the vacuum system is presented in the last block of the diagnosis chart.

It should be noted that because of the inter-relationship of the vacuum circuits, a leak in one circuit may reduce the vacuum supply to another circuit sufficiently to cause a malfunction of the second circuit. For example, a water valve vacuum hose disconnected may prevent the mode doors from moving full travel causing a split mode condition.

UPPER AND LOWER MODE DOOR ACTUATION PROBLEMS

The most likely malfunctions would be "no air conditioner operation" and "split mode operation". Vacuum is required to get air conditioner mode. Check the hose connections at the mode door upper and lower vacuum actuators. Split modes may occur because of malfunctions in either the upper or lower door circuit, or because of leaks in other auxiliary vacuum circuits. It is recommended that the auxiliary vacuum circuit test procedure listed on the next page be used to isolate mode door vacuum problems.

DEFROSTER BLEED PROBLEMS

Actuation of the side (bleed) port of the defroster diaphragm is delayed by a porous delay plug inserted in the yellow-coded vacuum hose. Complaints relating to defroster bleed operation will generally be of two types:

1. No defroster bleed. Check hose connection at defroster bleed nipple of defroster vacuum actuator. If connections are satisfactory, porous plug is probably too restrictive. Replace plug. (Before installing new plug, check for vacuum in yellow line; and apply hose to nipple, without the plug, to check bleed door operation.)
2. Rapid fogging of windshield when heater turns on. Either there is no porous delay plug or installation of the plug is incorrect.

DEFROSTER DOOR ACTUATION PROBLEMS

The most common problem to be expected in this circuit would be "no air out of defroster outlets in "Def" setting". Vacuum to the defroster actuator is required for defroster operation.

1. Check hose connection (blue) at defroster actuator.
2. Check for vacuum at the control head purple hose.
3. If system stays in A/C mode at "Def", check vacuum circuit to determine why mode override did not occur.

If problem persists, see auxiliary vacuum circuit test on next page.

RECIRC AIR DOOR ACTUATION PROBLEMS

The most likely problem to be encountered will be "no recirc air in Hi or Auto lever settings". Vacuum is required to obtain recirc air. Check hose connection at recirc air door. Remove vacuum delay plug to check for adequate vacuum at "Hi" and "Auto" settings and 65° dial. If vacuum is available but door won't move with plug in circuit after approximately 3 minutes, replace plug.

HEATER WATER VALVE CONTROL PROBLEMS

The water valve is a normally open valve requiring vacuum to close off water flow. It would be very difficult for a driver to recognize a problem in the water valve circuit by "no heater water shut-off"; however, a leak in that circuit may manifest itself by reduced vacuum levels available in other vacuum functions. The most likely such complaint would be a split mode delivery. Use the external vacuum circuit test presented below to isolate vacuum problems.

AUXILIARY VACUUM CIRCUIT CHECK VALVE PROBLEMS

The check valve for the auxiliary vacuum circuit is located in the programmer vacuum checking relay assembly. A malfunction of this check valve will probably result in complaints of loss of a specific function (such as "A/C shuts off") during accelerations or mountain driving. The check valve may be checked with the system operating by disconnecting and plugging the black hose feeding the programmer checking relay. The vacuum functions (a vacuum gage in the purple hose or the system in A/C mode) should hold. If they do not hold, reinstall the black hose, and pinch the purple hose. If the functions now hold, the check valve is bad. If the functions continue to leak down, there is a circuit leak further upstream. Use the auxiliary vacuum circuit test below to locate the leak.

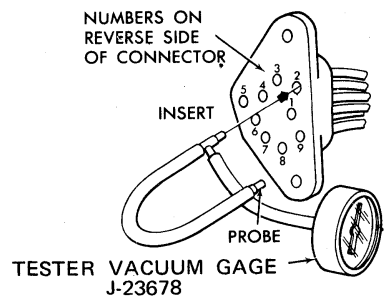
COMPRESSOR ELECTRICAL PROBLEMS

Malfunctions in the compressor electrical circuit would result in complaints of "no cooling", or "insufficient cooling". Perform the following checks:

1. Blown 15 amp fuse in fuse block.
2. Electrical disconnect at compressor clutch coil or low pressure switch in compressor head.
3. Backed-out terminal or disconnect at the control head electrical connector.
4. Malfunctioning low pressure switch.
5. Open in wiring harness. Refer to electrical circuit diagram, Fig. 1-175.

AUXILIARY VACUUM CIRCUIT TEST PROCEDURE

Remove car vacuum harness plug from programmer valve, which should direct all airflow to floor except for defroster bleed air. Connect tee with short hose and union to J-23678 tester vacuum gauge hose as shown in sketch at right, inserting tee in Port No. 2 of harness plug and probing each of the other ports in turn. Make sure that control head lever is set as specified for each step, and cover up probe on Ports 3 and 9 when called for, to seal off other circuit branches. For each step, full vacuum should be read after actuator-travel is completed.



Control Lever	Probe Port:	Hose Color	Cover Up	Other Hoses In Circuit	Action Expected
Bi-Level	None	Black	Probe	Yellow	Defroster door moves to "bleed" position
Bi-Level	1	White	None	None	Hot water valve closes - Check air in "max. heat"
Bi-Level	3	Red	Port 9	Purple, Tan	Lower mode door moves to A/C position
Bi-Level	4	Orange	None	None	Recirc. door opens - 1-2 min. delay
Lo	6	Chartreuse	Port 9	Purple	Checks control head vacuum leakage
Lo	6 or 8	Green	None	None	Upper mode door moves to A/C position
Hi	7	Dark Brown	None	Tan	Lower mode door moves to A/C position
Def	9	Purple	Port 3	Red, Dk. Blue	Defroster door moves to full "DEF" position

A low vacuum reading in any step indicates a leak in control head valve or in the hoses and components listed in that step. If some function is missing even though full vacuum is available, reconnect harness plug to programmer and check vacuum at extreme end of hoses involved, to distinguish between a pinched hose and a mechanical bind in actuator door.

Refrigeration Problem Diagnosis

Refer to page 1-43 for this information.

NOTE: The A.T.C. Tester, J-23678-01, is designed for on-car diagnosis of control problems utilizing car electrical and vacuum supplies. The Tester will not only locate the problem area but will also isolate the individual malfunctioning component. Instructions (J-23468-50A) for the MKII programmer are furnished with the tester and reprinted on pages 1-143 and 1-144.

ON-CAR SERVICE

Refer to page 1-49 for procedures on "Handling Refrigerant and Refrigeration Components."

Control System Functional Test

The following procedure is used to assure correct functional operation and requires approximately two minutes to perform. The system is to be tested at room temperature with the hood down, the doors and windows closed and the engine operating. Engine coolant must be warm. Proceed as follows:

1. Operate car at 1000 RPM or better.
2. Place A/C outlets in wide-open position.
3. Install thermometer in center A/C outlet.
4. Set control lever at "DEF" and temperature dial at 85°.
   a. Air should be delivered out of the defrost outlets.
   b. Blower should operate at high speed.
   c. Some air should come out heater outlet.
5. Set lever at "BI-LEVEL" and temperature dial at 75°.
   a. Air should be delivered from **both** the A/C and heater outlets.
   b. Blower should operate at a lower speed.
   c. Small airflow should come from defroster outlets.
6. Set lever at "HI" and temperature dial at 65°.
   a. Cool to cold air should be delivered from A/C outlets.
   b. Blower should operate at high speed.
   c. Recirc air door should open (will be slightly noisy).
7. Set lever at "AUTO" and temperature dial at 65°. After 45 seconds, discharge air temperature should be 10°C (50°F) or lower may be slightly higher in 32°C (90°F) or above ambient.
8. Set lever at "AUTO" and temperature dial at 85°.
   a. Blower speeds should drop (HI - M_3 - M_2 - M_1 - etc.)
   b. Recirc door should close - noise level will drop.
   c. Discharge air temperature should increase.
   d. Air delivery may change from A/C outlets to bi-level to heater outlet - depending upon ambient temperature.
9. Set lever at "LO" and temperature dial at 85°. Air should be delivered at fixed low blower.
10. Set lever at "ECONOMY" and temperature dial at 65°.
    a. Air discharge should be from A/C outlets heater outlet or both (bi-level) depending on ambient temperature.
    b. Blower speed may vary as in "AUTO".
    c. A/C compressor should not operate.
11. Set lever at "OFF" temperature dial at 65°.
    a. Air discharge should be from heater outlet.
    b. Blower should operate at fixed Lo speed.
    c. A/C compressor should not operate.

Component Adjustments

Be sure to allow sufficient time for the car engine to "warm up" and for the system to "turn-on" before attempting calibration. Do not skip any steps in the Calibration Procedure.

a. Temperature Dial Calibration

1. Disconnect electrical connector from programmer and connect appropriate end of harness adapter J-24774 to the programmer and car harness.
2. Connect the ATC Tester J-23678 into the opposite end of Adapter Harness J-24774.
3. Working through opening in top of glove compartment, disconnect in-car sensor electrical connector and connect harness to double connector (black wires) coming out of Adapter Harness J-24774.
4. Place the "MANUAL-AUTOMATIC" switch on the tester in the "MANUAL" position.
5. Place the "TEMPERATURE DIAL CALIBRATOR" switch on the tester in the "CALIBRATE" position.
6. Note the voltmeter reading.
7. Press the "CALIBRATE" button and note the voltmeter reading.
8. With the "CALIBRATE" button pressed in, rotate the temperature dial on the control head until the voltmeter reading is the same as it was in Step 5 (when the button is not pressed in).
9. The temperature dial should be set at 75°. If it is not, use tool J-21530 to hold the gear on the top of the temperature dial and slip the temperature dial to the correct setting, Fig. 1-179. If the temperature dial cannot be calibrated using this procedure, it is malfunctioning.
10. Remove test equipment and make all normal connections. Make sure in-car sensor aspirator hose is properly attached.



Fig. 1-179 Adjusting Temperature Dial

b. Mix Door Link Adjustment

1. Loosen the hex screw of the door link at the output shaft of the programmer, Fig. 1-180.

2. Place the control head selector lever in the "DEF" position.

3. Remove the electrical connector from the ambient sensor. This results in the proper position of the output shaft of the programmer (full heat position).

4. Check to make sure that the air mix door is in the full heat position. The blower air flow will now hold the mix door in the proper position.

5. Without disturbing the door link or the output shaft position, tighten the hex screw on the door link, Fig. 1-180.

6. To check the Mix Door Link Adjustment, proceed as follows.

a. Connect Tester J-23678 into the wiring harness and the programmer using Harness Adapter J-24774. Place the control head in "AUTO". Place the "MANUAL-AUTOMATIC" switch in the "MANUAL" position. Using the "MANUAL CONTROL", swing the programmer to "Max. Heat" then to "Max. Cold". Hi blower should be obtained in "MAX COLD" and M3 in "MAX HEAT".

b. Check for recirculation operation. Operate the system with the "MANUAL CONTROL" on ".150" for 5 minutes so the restricted vacuum line can move the outside air door to the outside air position. With the control head in "HI", move the "MANUAL CONTROL" to "Max. Cold". **With all the car doors and windows closed,** the blower noise level should increase when recirculation occurs (approximately 3 minute delay due to the restrictor).

c. Programmer Amplifier Calibration (Feedback "Pot" Adjustment)

1. Remove the plastic cover from the programmer while it is still mounted in the car.

2. Connect the Tester J-23678 into the wiring harness and the programmer using Harness Adapter J-24774.

3. Place the control head selector lever in the "AUTO" position.

4. Place the "MANUAL-AUTOMATIC" switch on the tester in the "MANUAL" position.

5. Place the "TEMPERATURE DIAL CALIBRATOR" switch of the tester in the "OFF" position.

6. Rotate the "MANUAL CONTROL" knob on the tester to the "Max. Heat" position. The programmer should move to the full heat position.

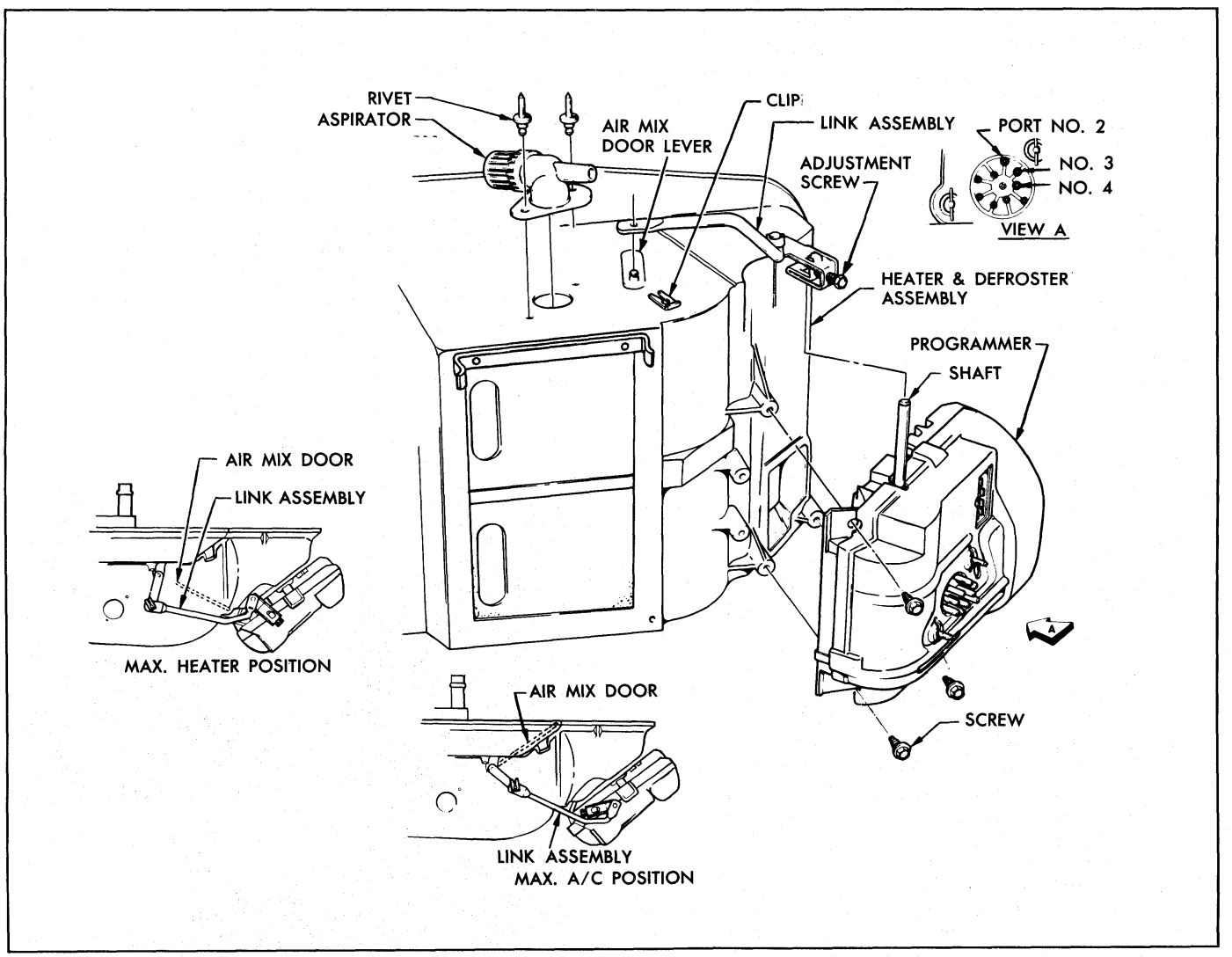


Fig. 1-180 Programmer Installation and Adjustment

7. Rotate the "MANUAL CONTROL" knob to 180 and STOP. **DO NOT OVER-TRAVEL!**

8. Using a blade type screwdriver, slip the shaft of the feedback potentiometer fully counterclockwise to its stop (see Figure 1-183 for location of the feedback potentiometer in the programmer). The vacuum motor mechanism will be "in" the vacuum motor indicating full heat operation.

9. Using the screwdriver, very slowly slip the feedback potentiometer clockwise until the **first movement** of the vacuum motor mechanism can be seen. Stop the adjustment when the movement first occurs. (Do not watch the programmer output shaft.)

10. To check the adjustment, rotate the "MANUAL CONTROL" knob to the "Max. Heat" position. Then slowly rotate the "MANUAL CONTROL" knob counterclockwise and the vacuum motor mechanism should first start to move when the "MANUAL CONTROL" knob is exactly at 180 $\pm$ 1. Touch up the feedback potentiometer adjustment in the programmer so that the mechanism movement occurs at exactly 180. If this adjustment **cannot be made, the programmer is malfunctioning.**

d. Compressor Drive Belt

The compressor drive belt is adjusted at the power steering pump. Follow procedure described on page 6B-12.

Compressor (Complete Removal and Installation)

Refer to page 1-55.

Compressor (Partial Removal and Installation)

Refer to page 1-56.

Evaporator Case

a. Removal

1. Discharge refrigeration system as described on page 1-51.

2. Remove electrical connectors from ambient sensor and auto blower relay, Fig. 1-176.

3. Route harness out from behind accumulator assembly and position out of way.

4. Disconnect ALC compressor hoses and remove hoses from behind accumulator assembly. Position out of way.

5. Remove blower motor as described below.

6. Remove antenna lead-in cable.

7. Remove ALC compressor by removing three screws accessible in wheel opening.

8. Remove high and low pressure lines from accumulator assembly and position out of way.

CAUTION: *All refrigeration system connections must be plugged or sealed immediately to prevent entry of dirt and moisture into system.*

TORQUE SPECIFICATIONS
METAL TUBING

Metal Tube O.D. (Inch Lbs.)	Steel Tubing Torque (Ft. Lbs.)	Alum. Tubing Torque (Ft. Lbs.*)
1/4"	15	7
3/8"	35	13
1/2"	35	13
5/8"	35	21
3/4"	35	28

*Torque taken with crow foot attachment at a 90° angle on torque wrench.

9. Remove two nuts and four screws securing evaporator case to cowl, Fig. 1-145. Remove three screws securing evaporator case to air inlet assembly.

10. Move evaporator case away from cowl and cut gasket at air-inlet-to-evaporator case joint. Push air inlet back into cowl.

11. Remove evaporator case by twisting out from under hood hinge.

b. Installation

1. Position evaporator case to cowl making sure gasket will seal properly where it has been cut. Use sealer as required.

2. Loosely install two nuts and four screws holding evaporator case to cowl, Fig. 1-145. Install three screws securing evaporator case to air inlet assembly.

3. Tighten fasteners installed in Step 2 to 12 in. lbs.

4. Connect high and low pressure lines to accumulator.

5. Install ALC compressor and secure with three screws accessible in wheel opening. Tighten screws to 60 in. lbs.

6. Route ALC vacuum hoses accumulator assembly and connect to compressor. Yellow hose to top port, black hose to bottom port.

7. Install antenna lead-in cable.

8. Install blower motor as described below.

9. Route electrical harness behind accumulator assembly and make connections at ambient sensor, and blower auto relay, Fig. 1-176.

10. Evacuate and charge refrigeration system as described on page 1-51. Leak test all connections.

Condenser Removal and Installation (Partial)

In order to perform certain engine operations, it is necessary to move the condenser out of the way. This can be done without disconnecting any lines as follows.

a. Removal

1. Remove four screws each side securing radiator upper brackets to cradle and fan shroud. Remove brackets.

2. Remove four clips, two each side, securing acromat to condenser frame.

3. Remove fresh air inlet from position on radiator cradle.

4. Remove four nuts, two each side, securing condenser mounting brackets to rubber mounts.

5. Remove clip securing liquid line to radiator cradle.

6. Pivot condenser out of cradle and allow to rest lightly on lines. Secure condenser in this position by fastening to hood.

b. Installation

1. Pivot condenser into position in radiator cradle so that all four mounting brackets are resting on rubber cushions.

2. Secure mounting brackets to rubber cushions with four nuts, two each side.

3. Install two clips at each side securing acromat to condenser frame.

4. Secure liquid line at radiator cradle with clip and screw.

5. Install upper radiator brackets at each side of radiator and secure with two screws to cradle and fan shroud.

6. Position fresh air inlet to radiator cradle and secure with one screw.

Accumulator

Refer to page 1-58 for removal and installation procedure.

Condenser

a. Removal

1. Purge system as described on page 1-51.
2. Remove two screws securing upper radiator mount bracket at each side of radiator cradle and remove two screws, one each side securing wheelhouse brace to bracket. Remove bracket.
3. Disconnect high pressure vapor line.
4. Remove clip securing liquid line to condenser frame.
5. Disconnect liquid line from condenser outlet pipe.
6. Remove four nuts, two each side, securing condenser mounting brackets to rubber mounts.
7. Remove four clips, two each side, that fasten acromat to condenser frame.
8. Remove condenser from chassis.

b. Installation

1. Add refrigerant oil as described on page 1-52.
2. With top of condenser tipped rearward, lower condenser into position until lower mounting brackets will go under upper rubber mounts. Tip condenser vertically and lower until all four mounting brackets are resting on rubber cushions.
3. Secure mounting brackets to rubber mounts with four nuts, two each side.
4. Install four clips, two each side holding acromat to condenser frame.
5. Connect high pressure vapor line to condenser using a new O-ring.
6. Connect liquid line from receiver to condenser at outlet pipe using a new O-ring.
7. Install clip securing the liquid line to condenser frame.
8. Install two upper radiator mount brackets and secure to cradle with two screws. Secure wheelhouse brace to bracket with one screw at each side.
9. Evacuate system as described on page 1-51.
10. Charge system with refrigerant as described on page 1-52 and leak test condenser connections.

Programmer

a. Removal

1. Open glove compartment door and remove compartment liner as described on page 8-32.
2. Disconnect vacuum harness from programmer vacuum valve.
3. Disconnect electrical harness from programmer.
4. Disconnect door link from programmer output shaft.
5. Remove three screws securing programmer to heater case and remove programmer.

b. Installation

1. Position programmer to heater case - secure with three screws.
2. Connect electrical connector to programmer.
3. Connect vacuum harness to programmer vacuum valve. Secure harness with clips on pins of valve.
4. Install door link and adjust as described on page 1-150.
5. Install glove compartment liner as described on page 8-32.

Evaporator Core

a. Removal

1. Discharge system as described on page 1-51.
2. Disconnect evaporator inlet and outlet pipes
3. Remove electrical connectors from thermostatic cycling switch, ambient sensor and blower relay.
4. Remove thermostatic cycling switch as described on page 1-57.
5. Remove right side tie strut at wheel house, position out of way.
6. Remove two nuts and four screws securing evaporator case to cowl.
7. Move evaporator case away from cowl and remove six screws holding halves of case together.
8. Remove case half and remove core from case. Case to cowl gasket must be cut where halves separate.

b. Installation

1. Install evaporator core in position in case. Install evaporator case half and secure with six screws.
2. Seal the junction where the case halves were split with sealer and move evaporator case into position on cowl.
3. Secure evaporator case to cowl with two nuts and four screws.
4. Connect evaporator inlet and outlet pipes.
5. Install thermostatic cycling switch as described on page 1-57.
6. Install electrical connectors on thermostatic cycling switch, ambient sensor and blower relay.
7. Position right-hand tie strut and secure with two nuts.
8. Evacuate and charge refrigeration system as described on page 1-51 and leak test all connections.

Blower Motor

a. Removal

1. Disconnect negative battery cable.
2. Remove rubber cooling hose from nipple and blower motor.
3. Disconnect electrical connector at lead to motor.
4. Remove six screws securing blower to case and remove blower.

b. Installation

1. Install ground wire and capacitor to blower flange screw at 5 o'clock position.
2. Place a bead of sealer around opening where blower will contact case.
3. Guide blower motor against cowl and place on locating dowel.
4. Install five screws securing blower to case.
5. Connect electrical connector at lead to motor.
6. Install cooling hose on motor and nipple.

Heater Case

a. Removal

1. Drain radiator.
2. Remove hoses from heater core nipples and plug nipples to prevent spilling coolant remaining in core.
3. Remove instrument panel pad as described on page 8-21.
4. Remove center A/C outlet support and connector from position between cowl and horizontal support, Fig. 1-181.
5. Remove left a/C outlet hose from A/C distributor.
6. Remove center support and associated braces as shown in Fig. 1-181.
7. Remove two screws securing A/C distributor to heater case and remove distributor, Fig. 1-181.
8. Remove one screw securing defroster nozzle and remove nozzle.

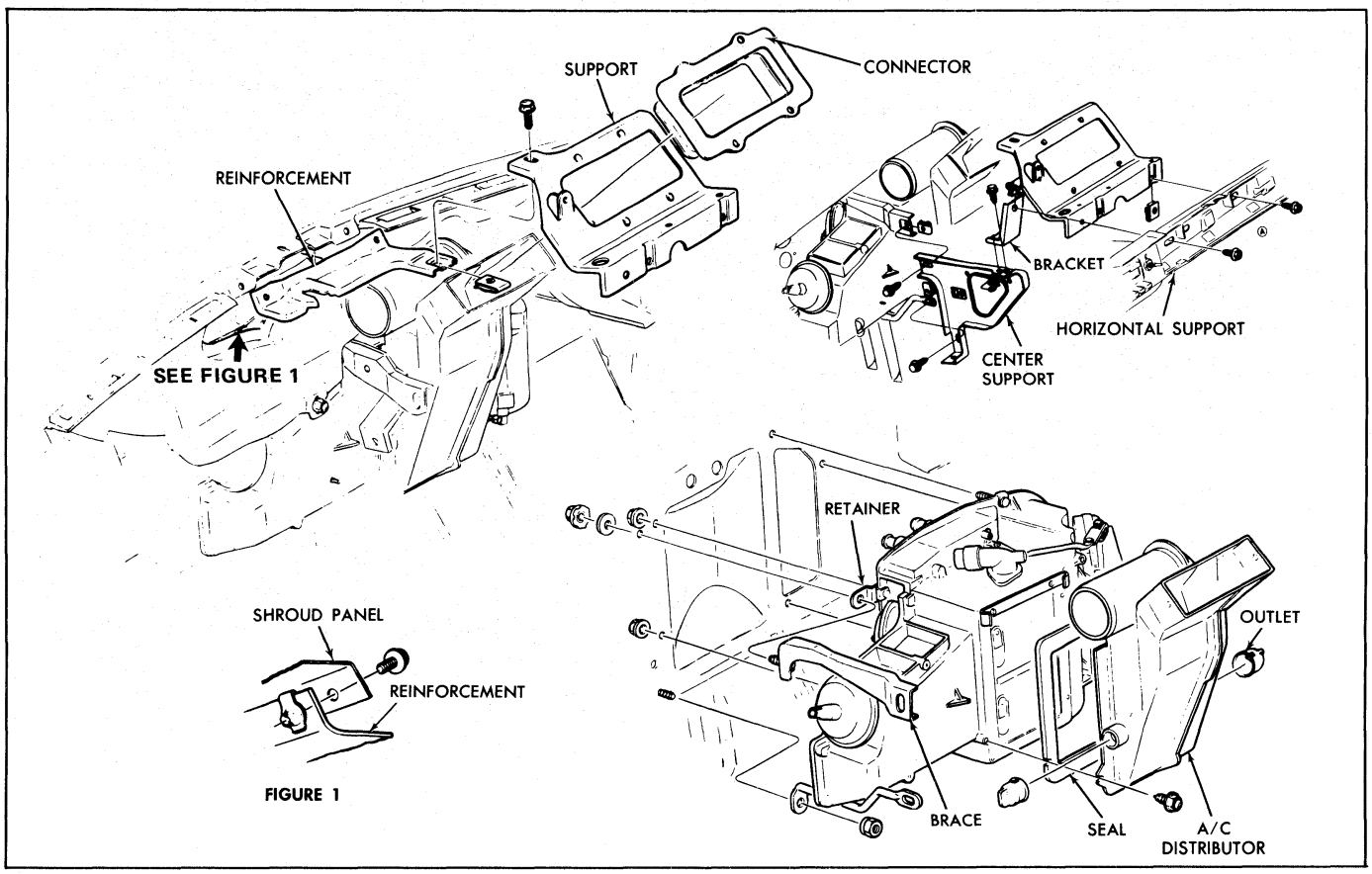


FIGURE 1

Fig. 1-181 Heater Case Assembly

9. Remove glove compartment liner as described on page 8-32.

10. Remove vacuum and electrical connectors from programmer.

11. Disconnect vacuum hose from recirc door actuator, defroster door actuator, mode door actuators and position vacuum harness out of way, Fig. 1-182.

12. Disconnect aspirator hose from in-car sensor.

13. Remove three nuts and one screw securing heater case to cowl on engine side of cowl, Fig. 1-146.

14. Remove heater case from position under instrument panel.

b. Installation

1. Position heater case to cowl as shown in Fig. 1-146.

2. Screw heater case to cowl with three nuts and one screw.

3. Remove plugs from heater core nipples and install heater hoses.

4. Refill cooling system.

5. Connect vacuum hoses to recirc door actuator, defroster door actuator, mode door actuators and programmer vacuum valve, Fig. 1-182. Position vacuum harness as shown in Fig. 1-182.

6. Connect programmer electrical connector.

7. Connect in-car sensor aspirator hose, Fig. 1-148.

8. Position defroster nozzle and secure with one screw.

9. Position A/C distributor to heater case and secure with two screws, Fig. 1-181.

10. Install left hand A/C outlet hose to A/C distributor.

11. Install center support and associated braces as shown in Fig. 1-181.

12. Position center A/C outlet support and secure with three screws. Install outlet connector.

13. Install glove compartment liner.

14. Install instrument panel pad as described on page 8-21.

15. Check A/C controls for proper operation.

Heater Core

Removal

1. Remove heater case as described above.

2. Remove rubber seal from around core water nipples.

3. Remove screw and clip from beneath seal.

4. Remove two screws and clip from opposite end of core and remove core from position in case.

b. Installation

1. Locate heater core in position in heater case.

2. Secure bottom of core with clip and two screws.

3. Secure top of core with clip and screw.

4. Install rubber seal over water nipples.

5. Install heater case as described above.

Water Control Valve

a. Removal

1. Clamp off valve inlet and outlet water hoses.

2. Remove vacuum hose from water control valve.

3. Remove clamps securing hoses to valve, and remove valve from hoses.

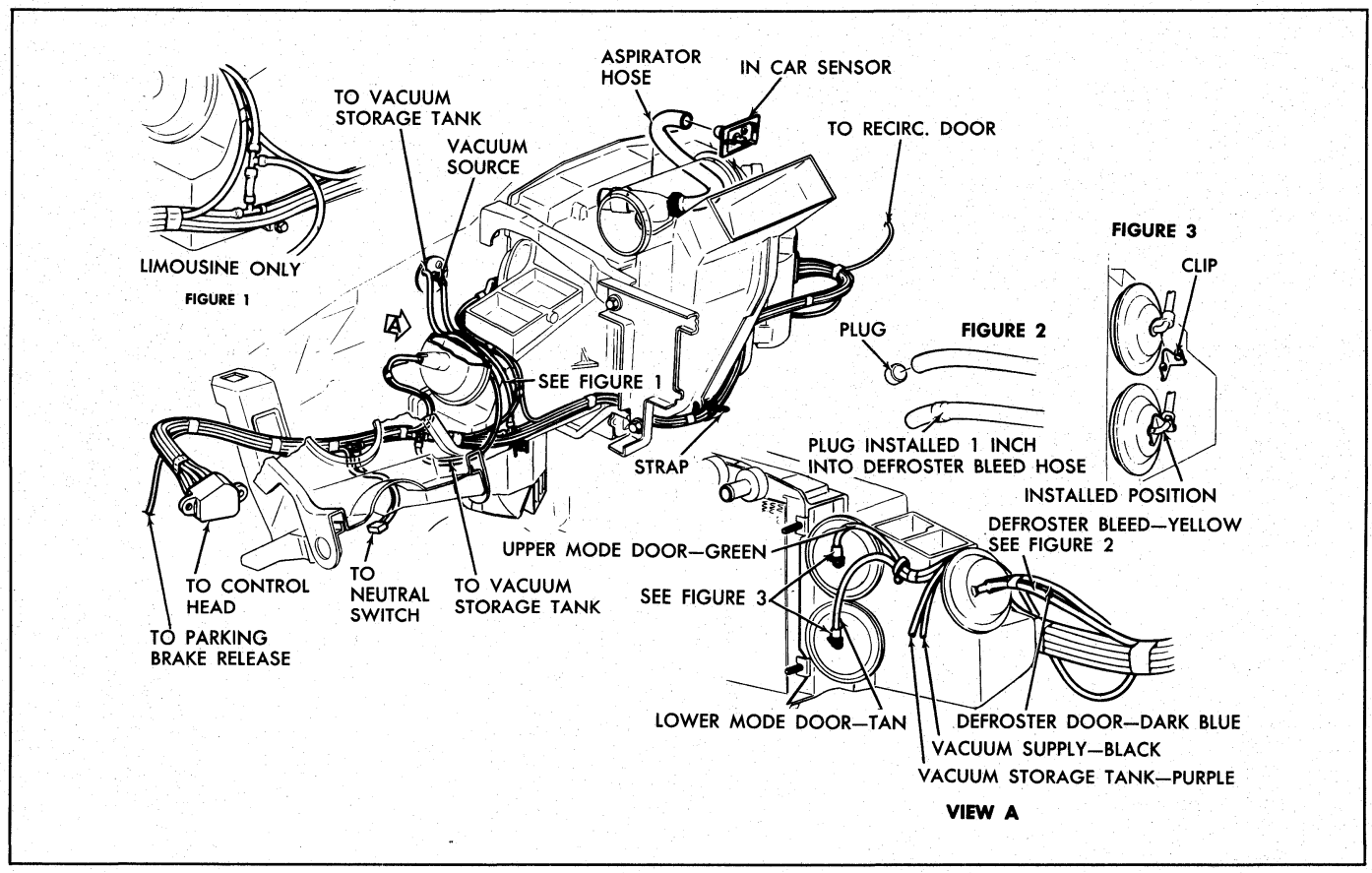


Fig. 1-182 Heater Case Vacuum Connections

b. Installation

1. Install water valve on inlet and outlet hoses and install clamps.
2. Remove clamps from hoses.
3. Install white vacuum hose at water control valve.
4. Replace any coolant lost.

Air Conditioning Outlets

The procedures for removing and installing the outlets are described on page 8-21.

In-Car Sensor

The procedure for removing and installing the in-car sensor is described on page 8-27.

Automatic Climate Control Panel

The procedure for removing and installing the control panel is described on page 8-27.

Thermostatic Cycling Switch

The procedure for removing and installing the thermostatic cycling switch is described on page 1-57.

Low Pressure Switch

The procedure for removing and installing the low pressure switch is described on page 1-57 and 58.

Expansion Tube

The procedure for removing and installing the expansion tube is described on page 1-59.

UNIT REPAIR

Air Conditioning Control Panel Disassembly and Assembly

The control panel must be removed as described on page 8-27 to perform any of the following procedures.

a. Circuit Board Removal

1. Remove one screw securing wire harness clip to control head base plate.
2. Remove two green wires from temperature dial rheostat.
3. Remove three screws on bottom of base plate securing circuit board to base plate.
4. Move control lever to "OFF" position and remove circuit board by sliding out from under control lever.

b. Circuit Board Installation

1. Move control lever to "DEF" position and feed circuit board connector and wires through base plate from bottom.

CAUTION: *This procedure is important to avoid damage to the wiper contacts on bottom of control lever.*

2. Work circuit board into position and secure to base plate with three screws.

3. Working on top side of control head, connect two green wires to temperature dial rheostat, Fig. 1-175.

4. Secure harness clip to base plate with one screw.

c. Temperature Dial Rheostat Removal

1. Disconnect two green leads from rheostat terminals.

2. Remove two screws securing rheostat bracket to mounting plate and remove rheostat.

d. Temperature Dial Rheostat Installation

1. Position rheostat to control panel and install two screws securing rheostat bracket to mounting plate.

2. Connect two green wires to rheostat terminal.

3. After installing control panel on car, adjust temperature dial as described on page 1-149.

e. Control Head Vacuum Valve Removal

1. Loosen two screws securing control vacuum valve to control head and remove valve.

f. Control Vacuum Valve Installation

1. Position control vacuum valve on control head so that pin engages lever arm.

2. Secure with two screws.

Programmer Disassembly

a. Checking Relay Removal

1. Remove programmer as described on page 1-152.

2. Remove programmer cover.

3. Remove four hoses from relay and remove relay.

b. Checking Relay Installation

1. Position checking relay in programmer with ports #1 and #2 towards vacuum motor.

2. Make the following vacuum hose connections:

a. White hose from transducer wraps around vacuum motor and connects to port #2, Fig. 1-183.

NOTE: If this vacuum hose is replaced, the replacement hose must be at least 15" long.)

b. Yellow hose from vacuum motor connects to remaining port (#1) on vacuum motor side of relay, Fig. 1-183.

c. Purple hose from "**Purp**" port of vacuum valve connects to center port on amplifier side of relay, Fig. 1-183.

d. Remaining black hose from center port of vacuum valve connects to outside port on amplifer side of relay, Fig. 1-183.

3. Install programmer cover.

4. Install programmer as described on page 1-152.

c. Vacuum Motor Removal

1. Remove programmer as described on page 1-152.

2. Remove programmer cover.

3. Remove two screw/studs securing vacuum valve and swing valve out of way with hoses still attached.

4. Remove vacuum valve actuating link.

5. Remove spring from over blower contact assembly.

6. Remove spring and clip from end of vacuum motor operating link.

7. Remove three output shaft retaining screws and retainers. Disconnect output shaft from vacuum motor mechanism.

8. Disengage bushing from vacuum motor to output shaft pin and from vacuum motor to blower contact mechanism.

9. Remove two screws securing vacuum motor to housing.

10. Remove yellow vacuum hose between checking relay and vacuum motor.

11. Remove vacuum motor.

12. Blower contact may be removed. However, be sure to handle assembly carefully as detent balls may fall out.

NOTE: If blower contact is not being replaced, mark a tooth on the feedback pot and a corresponding notch on the blower switch gear.

d. Vacuum Motor Installation

NOTE: During assembly of vacuum motor apply lubriplate or equivalent on all sliding surfaces.

1. If blower contact assembly was removed, position assembly to circuit board. Check for presence of ball in casing pivot hole. Use care to be sure that the two balls do not fall out of blower contact assembly.

2. Align marks on feedback pot and blower contact gear if parts are being reused.

3. With white vacuum hose in position, install vacuum motor to housing. Engage output shaft to blower contact assembly and secure vacuum motor with two screws.

4. Engage output shaft pin in slot of vacuum motor mechanism and vacuum motor mechanism pin in slot of output shaft, being certain vacuum motor mechanism is above retaining post.

5. Install two output shaft retainers and secure with three screws being certain that lower retainer falls into undercut of output shaft.

6. Position spring over circuit board and position drive arm over pins on vacuum motor mechanism and circuit board.

7. Position vacuum valve to housing and secure with two screw/studs.

8. Connect yellow vacuum hose from checking relay to vacuum motor.

9. Hook spring over hook in vacuum motor mechanism and stretch spring so that clip may be installed on opposite end.

e. Blower Circuit Board Removal

1. Remove programmer as described on page 1-152.

2. Remove programmer cover.

3. Remove vacuum motor as described in Part c. above.

4. Remove three screws securing circuit board to housing.

5. Remove two screws securing electrical connector to housing on amplifier.

6. Remove circuit board and electrical connector as an assembly.

f. Blower Circuit Board Installation

1. Position circuit board to programmer and connector over pins on amplifier. Secure circuit board with three screws (short screw closest to amplifier) and connector with two screws.

2. Install vacuum motor as described in Part d. above.

3. Install programmer cover.

4. Install programmer as described odn page 1-152.

g. Vacuum Valve Removal

1. Remove programmer as described on page 1-152.

2. Remove programmer cover.

3. Remove three vacuum hoses from vacuum valve.

4. Remove two screw/studs securing vacuum valve to housing and remove valve.

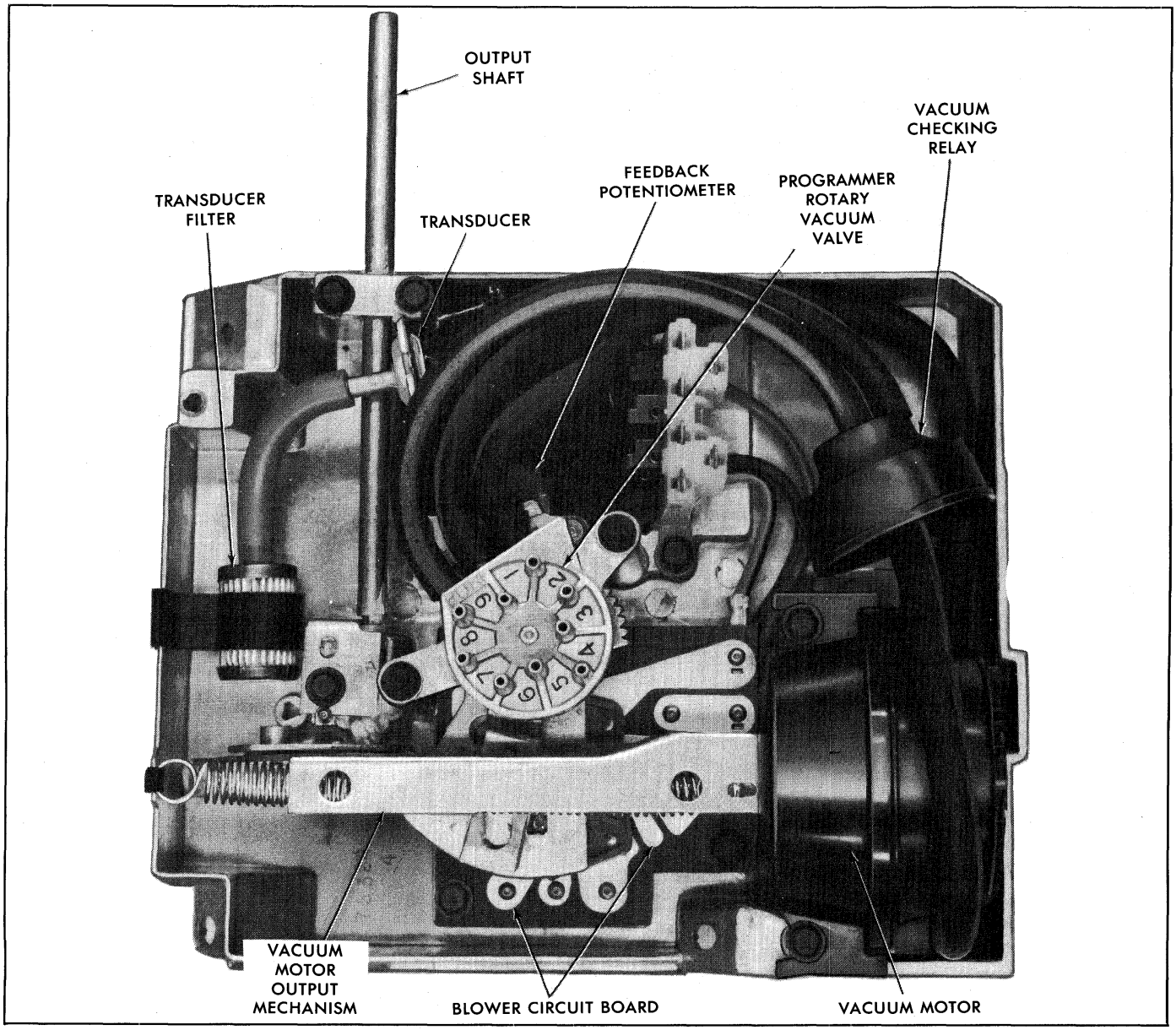


Fig. 1-183 MKII ATC Programmer Components

h. Vacuum Valve Installation

1. With vacuum valve spring in place, position vacuum valve to housing with pins on bottom engaged in drive arm and drive arm engaged in pins on vacuum motor mechanism and blower contact.
2. Secure vacuum valve with two screw/studs.
3. Make the following vacuum hose connections:

a. Purple hose from checking relay connects to port marked "Purp", and Fig. 1-183.

b. Black hose from checking relay connects to center port of vacuum valve, Fig. 1-183.

c. Small black hose from transducer connects to remaining port of vacuum valve, Fig. 1-183.

NOTE: Do not replace this hose with hose from 1971-1974 programmer as system will lock in full heat due to absence of porous plug.

4. Install programmer cover.
5. Install programmer as described on page 1-152.

i. Amplifier-Transducer Removal

1. Remove programmer as described on page 1-152.
2. Remove programmer cover.
3. Remove vacuum hoses from transducer.
4. Remove two screws securing electrical connector to housing and remove connector from position over amplifier contacts.
5. Remove two screws securing potentiometer and amplifier to housing and remove amplifier-transducer assembly.

j. Amplifier-Transducer Installation

1. Position amplifier-transducer to housing and secure with two screws at potentiometer.
2. Position electrical connector over amplifier terminals and secure connector with two screws.
3. Connect vacuum hoses to transducer.
4. Install programmer as described on page 1-152.
5. Calibrate feedback pot as described on page 1-150.
6. Install programmer cover.

COMPRESSOR SERVICE

Refer to page 1-55 for compressor service procedures.

TORQUE SPECIFICATIONS
ELDORADO

MATERIAL	APPLICATION	SIZE	INCH POUNDS
6010M	Ambient Sensor Attach. Screw	10-16	13
6010M	Auto Relay to Evaporator Screws	10-16TS	13
300M	Compressor Front Mounting Support to Compressor Bolt	5/16-24	25*
300M	Compressor Front Mounting Support to Crankcase Bolt	3/8-16	40*
300M	Compressor Rear Mounting Support to Compressor Bolt	3/8-16	40*
300M	Compressor Rear Mounting Support to Intake Manifold Bolt	3/8-16	40*
300M	Connector Shell Assemly Retaining Screws	1/4-20	10*
300M	Compressor Mounting Brackets to Engine	3/8-16	40*
	Compressor Mounting Bracket to Compressor		
300M	Front	5/16-24	25*
300M	Rear	3/8-16	40*
286M	Condenser to Radiator Cradle Nut	5/16-18	10*
6010M	Control Head to Horizontal Support Screw	10-24	35
6010M	Control Head Support to Control Head Screw	10-24	25
6010M	Defroster Nozzle Screw	10-16TS	13
6010M	Distributor Attach. Screw	10-16	13
6010M	Evaporator to Cowl Screw	1/4-14TS	60
Special	Evaporator Gage Valve Core	—	30 ounce in.
Aluminum	Evaporator Inlet Connection	3/4-18	18*
Aluminum	Evaporator Outlet Connection	1-1/16-16	31*
1022N	Heater Outlet Attach. Screw	11-16	13
6010M	Heater Case to Cowl Screws & Nut:		
	Left Hand Screw	10-16TS	13
	Right Hand Screw	1/4-14TS	13
	Nut	1/4-20	65
6010M	inst. Panel Low Cover to A/C Duct. Screw	8-18	18
Special	Liquid Bleed Valve Core	—	30 ounce in.
Aluminum	Liquid Bleed Line Connection	7/16-24	30
1022N	LH Adapter to Inst. Panel Screw	10-16	20
6010M	Programmer Attach. Screw	10-16	13
6010M	Relay to Evaporator Screw	10-16TS	13
280M	Refrigerant Hose Manifold to Compressor Screw	3/8-24	30*
6010M	Vacuum Storage Tank (Trailer Tow)	1/4-14TS	60

*Foot Pounds TS-Self Tapping

SEVILLE

TABLE OF CONTENTS

SEVILLE
General Description 1-158
Diagnosis 1-188
On-Car Service 1-197
Unit Repair 1-204
Specifications 1-210
Special Tools 1-211

GENERAL DESCRIPTION

Air Delivery System

In normal operation, air utilized by the system is drawn into the body air plenum through openings at the base of the windshield and directed to the blower on the right side of the body. The blower directs it through the evaporator where it is filtered, dehumidified and cooled to approximately 2°C (35°F). It is then "reheated" as required by being passed through and around the heater core. This air is then directed by air doors in the heater assembly to the air conditioner outlets in the instrument panel, to the heater distributor at floor level or to the defroster outlets. Air exhausts from the body by passing through the air exhaust grilles located in the door lock pillars. This provides positive air flow even when windows are closed. The components comprising the air delivery system are listed and described below.

Air Inlet

Air entering the plenum is controlled by the outside air door and the recirc air door. Both doors move in unison and each has two positions. During most modes of operation the outside air door is open and the recirc door is closed. This position provides 100% outside air to the blower. When vacuum is applied to the actuators (both doors are supplied from the same hose thru a "tee") the outside air door closes and the recirc door opens. With the doors in this position, 80% of the air to the blower comes from inside the car thru the recirc door while the remaining 20% is bypassed around the outside air door.

b. Blower and Evaporator

The blower and evaporator, shown in Fig. 1-185, is located in the engine compartment on the right side of the cowl. This assembly consists of a plastic housing, a squirrel-cage type blower, the evaporator core and the accumulator.

The evaporator core, which is aluminum and similar in construction to the car radiator, is the actual cooling unit of the system. The blower forces air through the evaporator core where it is cooled and dehumidified. Condensate is allowed to drain from the housing through a small hole in the bottom. The blower is air cooled - a small portion of blower output air is circulated through the motor housing via a rubber tube.

c. Heater

This assembly, shown in Fig. 1-186, is located inside the passenger compartment under the right-hand side of the instrument panel. It consists of a sheet metal and plastic housing, a heater core, an air-mix door which is controlled by the ATC (automatic temperature control) programmer, mode door, controlled by a push-pull vacuum actuator, and a defroster door which is controlled by a two-stage vacuum actuator.

Cold, dehumidified air from the evaporator enters this assembly and is reheated, as required, by the heater core. The *air-mix* door controls the amount of reheat that takes place. In one of its end positions it forces all the air from the evaporator to flow through the hot heater core - the resulting air stream is very hot. In the extreme opposite position, the door forces all the air to bypass around the heater core so that no reheat takes place and the resulting air stream is very cold. In intermediate positions, some of the air passes through the heater core and some bypasses it, so that the resulting air stream is mixed to the desired temperature.

The air stream is next directed by *a mode* door so that it either flows out an opening in the rear surface of the heater case and into the A/C distributor or it continues to flow to the left toward the heater distributor. The mode door allows air to be discharged either from A/C outlets or from the heater distributor; however, when the control head lever is set at "Bi-Level", the mode door allows part of the air stream to continue on to the heater distributor while the remainder of the air stream enters the A/C distributor and is delivered from the A/C outlets. This type of air delivery is referred to as bi-level delivery.

The defroster door located at the left-hand end of the heater is operated by a two-stage vacuum actuator and has three positions. With vacuum applied to the side port of the actuator, the door is pulled down slightly so that it intercepts only a small amount of air to be diverted to the defroster outlet. When vacuum is applied to both the side and center ports, the door is pulled full down and intercepts most of the air that would normally go to the heater distributor.

d. Air Conditioner Distributor

The A/C distributor is a large plastic duct attached to the rear surface of the heater. It receives air from the heater and distributes it to the left-hand and right-hand A/C outlets through flexible air hoses and to the center outlet, Fig. 1-186.

e. Air Conditioner Outlets

Four outlets, Fig. 1-187, are located in the instrument panel; one at the left side of the cluster, one in the center of the pad and one at the right-hand side. Each outlet provides an air stream whose direction can be controlled independently. The outlet may be rotated to provide a vertical air adjustment while the knob is used to provide horizontal adjustment. Air flow may be stopped altogether from each outlet by moving the shut-off knob beside the outlet.

A moderate flow of cool air to the floor is provided by two small plastic outlets located on the sides of the A/C distributor (Fig. 1-186). The right hand outlet can be rotated to obtain a more indirect flow of air to the floor area, if desired.

f. Heater Outlet

The heater outlet, (See Fig. 1-219) is attached to the bottom surface of the heater case at centerline of car. It distributes air to the left-hand and right-hand sides of the front floor and also directs two heavy streams of air under

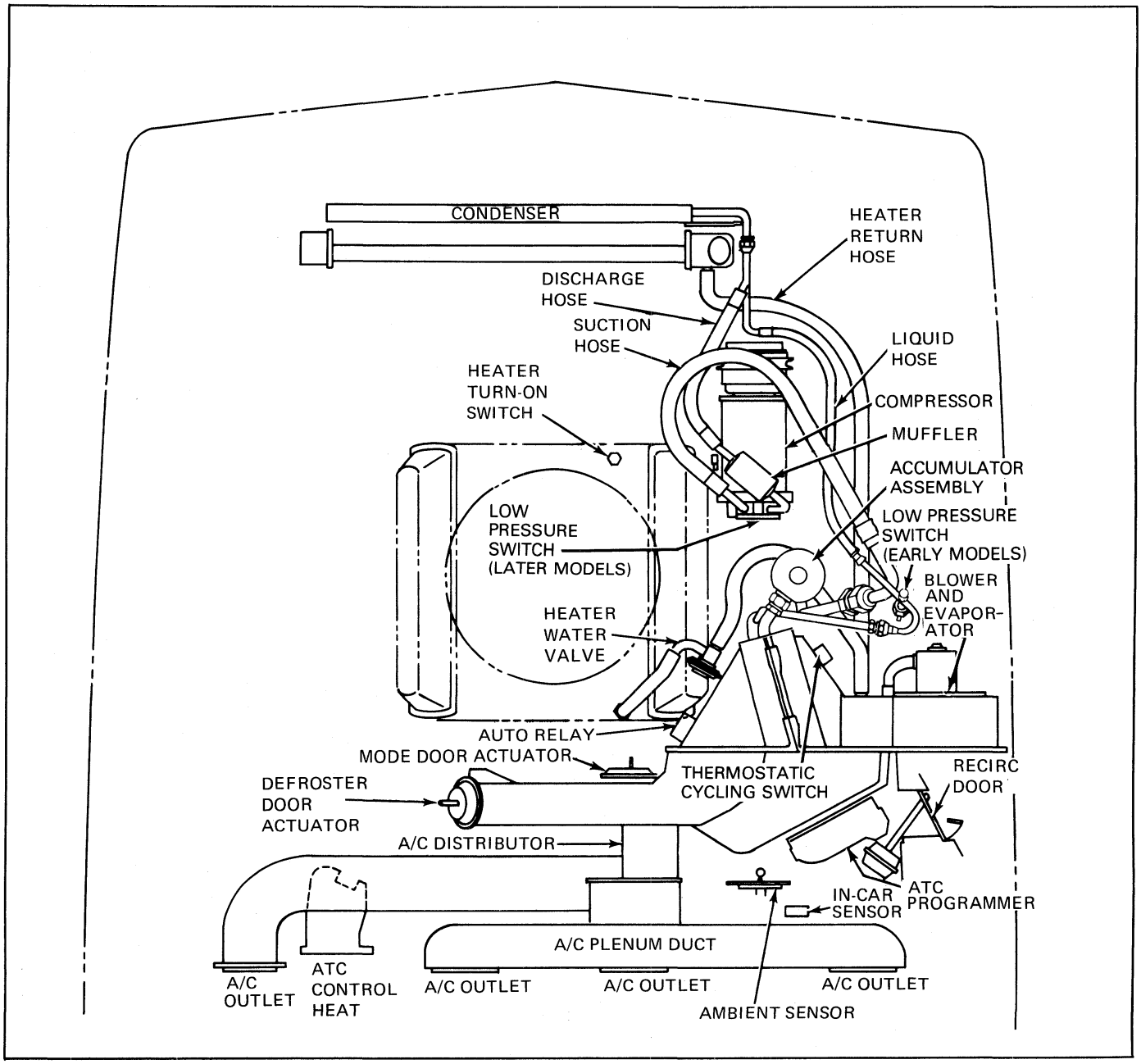


Fig. 1-184 Location of Air Conditioner Components

the front seat to heat the rear compartment.

g. Defroster Nozzle

A unitized defroster nozzle, shown in Fig. 1-188, delivers defrosting air to both sides of the windshield. It is attached to the top of the heater case near centerline with one screw and to the lower windshield frame.

Temperature Control System

The temperature control system provides automatic regulation of the car interior temperature regardless of outside temperature changes. The control panel, Fig. 1-189, consists of a temperature dial with a range of 18°C to 29°C (65°F to 85°F) and a single sliding lever to permit the customer to choose various modes of operation. Either the "Economy" or "Auto" settings are recommended for most situations. There are 5 additional settings which provide customer control for unusual conditions. An explanation of the system operation at various lever settings begins on page 1-168.

Control System Components

Following is a complete list of the components which comprise the temperature control system. The location of the part is given together with a brief description of how the part works. System operation and how the various components interact within the system is explained in a subsequent section.

a. Control Panel

The control panel, Fig. 1-189, is located in the instrument panel cluster to the left of the steering column and consists of a plastic bezel and baseplace, an acrylic lens and the functional components described below.

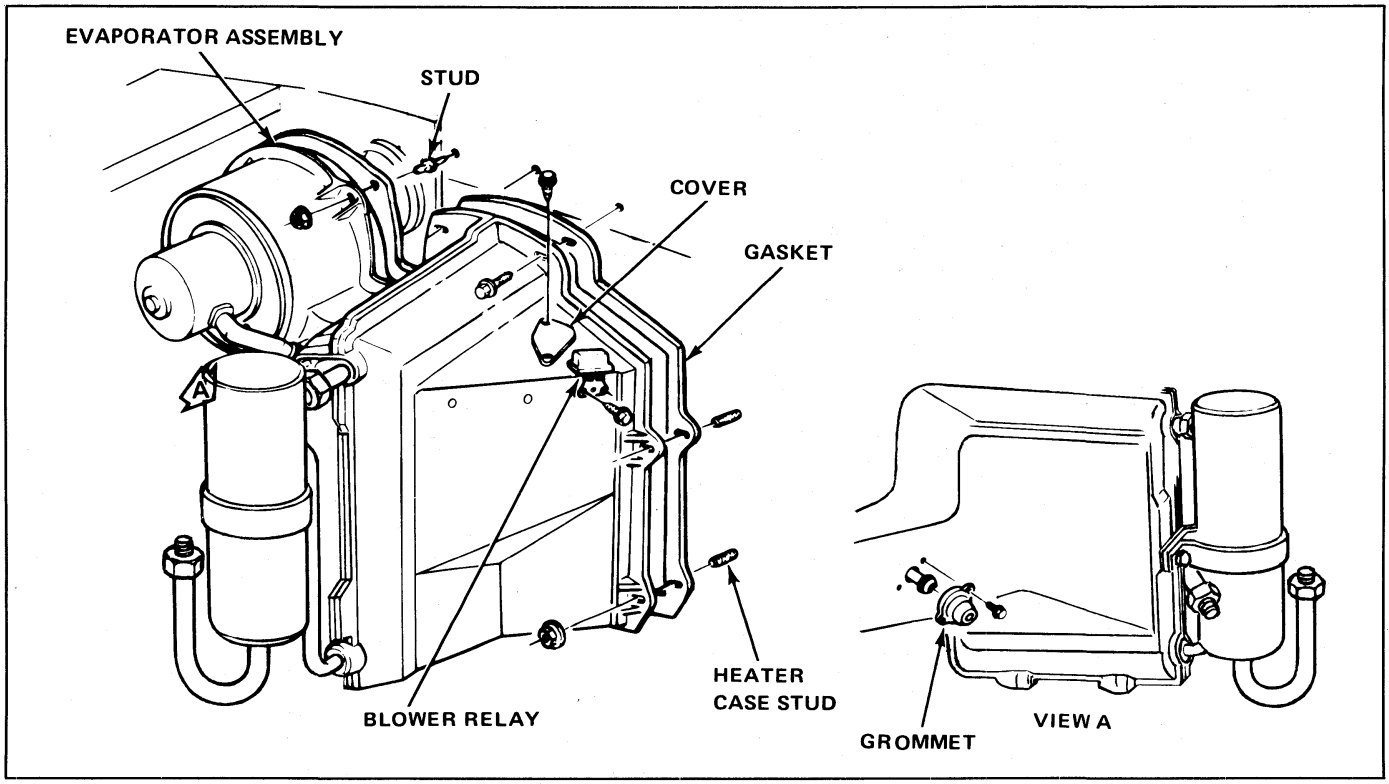


Fig. 1-185 Evaporator Assembly

The *temperature dial* is graduated in 5°F increments between 18°C to 29°C (65°F to 85°F) and is color-coded -- red for hot blue for cold and white for moderate temperatures - to facilitate adjustments. The dial actuates and varies the resistance of a wire-wound rheostat mounted directly above it.

The *circuit board electrical switch* is mounted on the underside of the baseplate. Attached to and positioned by the control lever are wiper contacts which ride on the circuit board pads to provide the required electrical circuit connections. How these connections are made in described on page 1-175. Electrical wires from the switch and from the temperature dial rheostat are brought to two six-way connectors.

The *in-car turn-on switch* is a thermostatic switch enclosed in a small plastic cylinder located just forward of the wire-retaining clip on the baseplate. It senses car interior temperature and will close and turn the system of if that temperature is above approximately 24°C (75°F), even if engine water is cold and the other turn-on switch, located in the intake manifold, is cold. This provides immediate cooling in a hot car that has not been run for some time.

The *control vacuum valve,* located at the forward edge of the baseplace, is a nine-port rotary valve which interconnects or vents the vacuum hoses attached to it to perform various vacuum functions required in the system. How the valve performs these functions is described in Figs. 207-214.

The control lens and the temperature dial are illuminated by a single bulb located on the right side of the control.

b. Sensors

Two sensors are used, one sensing outside air temperature and the other the car interior temperature. Both are disc-type thermistors approximately .30″ in diameter and .060″ thick. (A thermistor is a special resistor whose value changes markedly with temperature change - it also differs from an ordinary resistor in that its resistance decreases as it gets hotter). The changes in resistance of these units forms the basic input to the control system.

The *in-car sensor* is located behind the perforations on the instrument panel cover.

The *ambient sensor* is mounted on a flat phenolic board that attaches to the plenum surface. The sensor protrudes into and senses the temperature of the air stream entering the evaporator core. Fig. 1-217 shows sensor characteristics. The thermostatic cycling switch is mounted on the evaporator case as shown in Fig. 1-184. This cycles the compressor on and off as a function of evaporator inlet temperature as described on page 1-12.

c. Aspirator

To provide accurate sensing of the car interior temperature, a small amount of air is drawn into the in-car sensor housing and passed over the thermistor. See Fig. 1-190. This air movement is accomplished by the use of an aspirator mounted on top of the heater assembly and a rubber hose that connects the in-car sensor housing to the aspirator. The aspirator is a tube-within-a-tube arrangement; air from the heater case is discharged out the main, outer tube - this air stream causes a suction at the end of the inner tube so that air flows out it also. The aspirator is equipped with a shield to prevent its outlet end from being blocked.

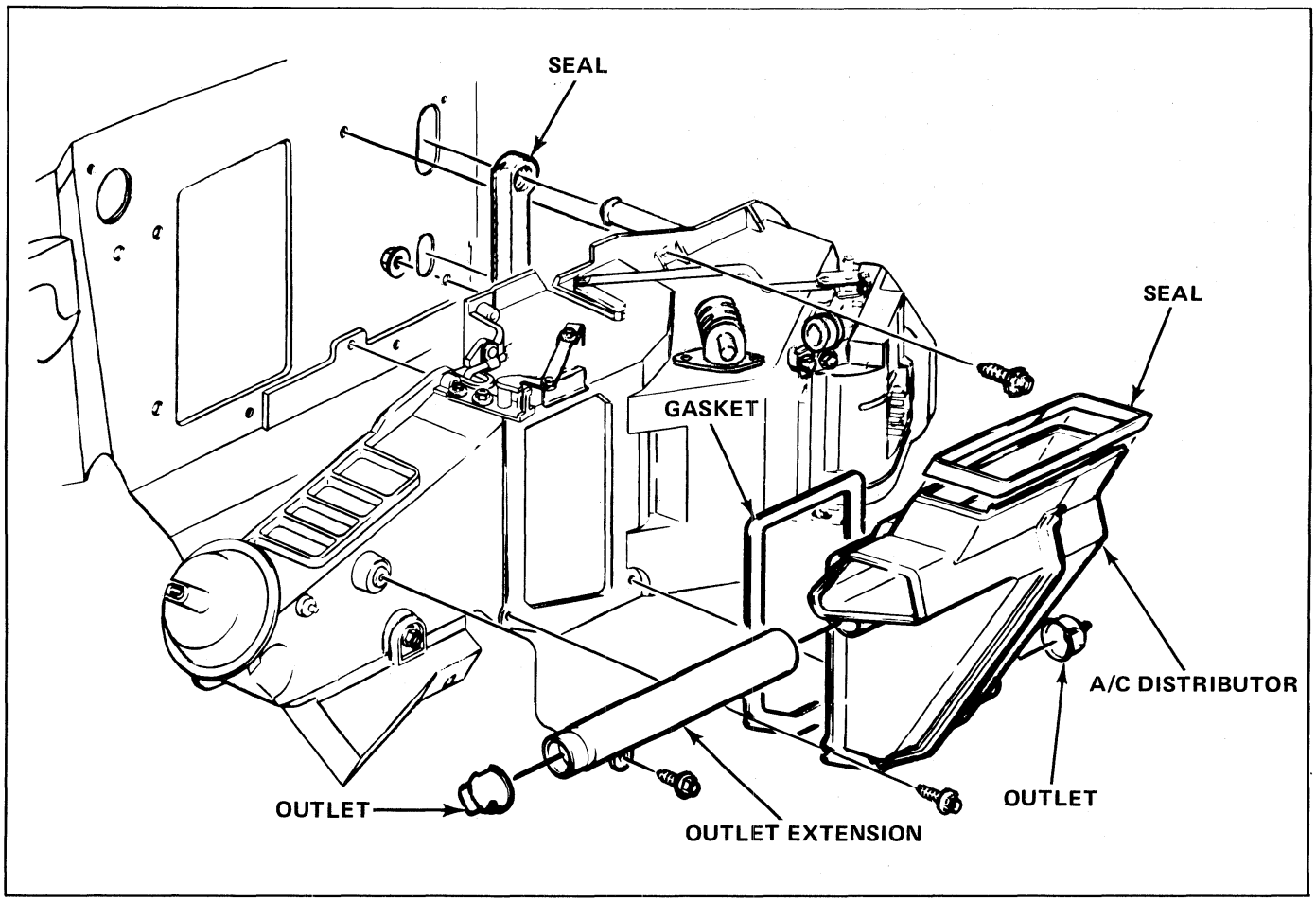


Fig. 1-186 Heater Assembly

d. Programmer

The programmer designated MKII, contains the bulk of the temperature control components, and is located in the passenger compartment on the right-hand end of the heater case. It is secured to an adapter with three screws. It consists of a zinc die-cast chassis, a removable plastic cover and the functional components described below. See Fig. 1-191.

The *amplifier,* mounted to the programmer chassis, is a three-stage D-C amplifier that accepts a weak electrical signal from the sensors and the temperature dial and provides a strong output signal proportional to input. The amplifier should be serviced only as an assembly. No attempt should be made to repair an amplifier except by an experienced

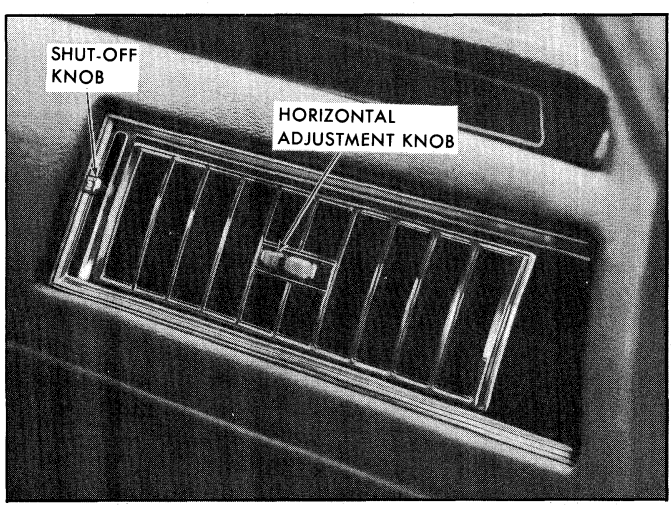


Fig. 1-187 Air Conditioner Outlet

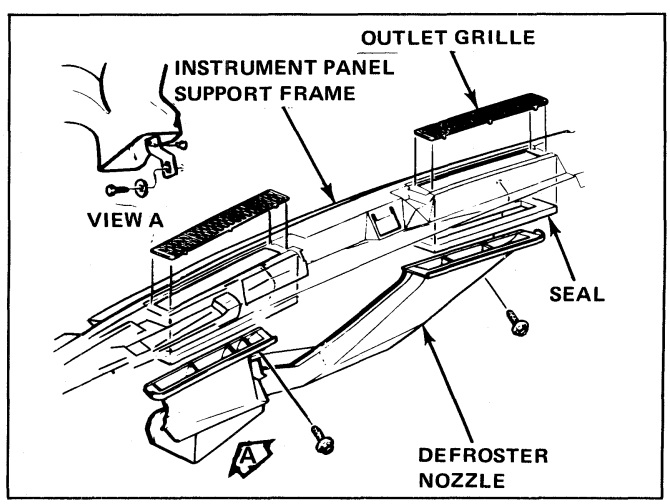


Fig. 1-188 Defroster Nozzle



Fig. 1-189 Control Panel Face

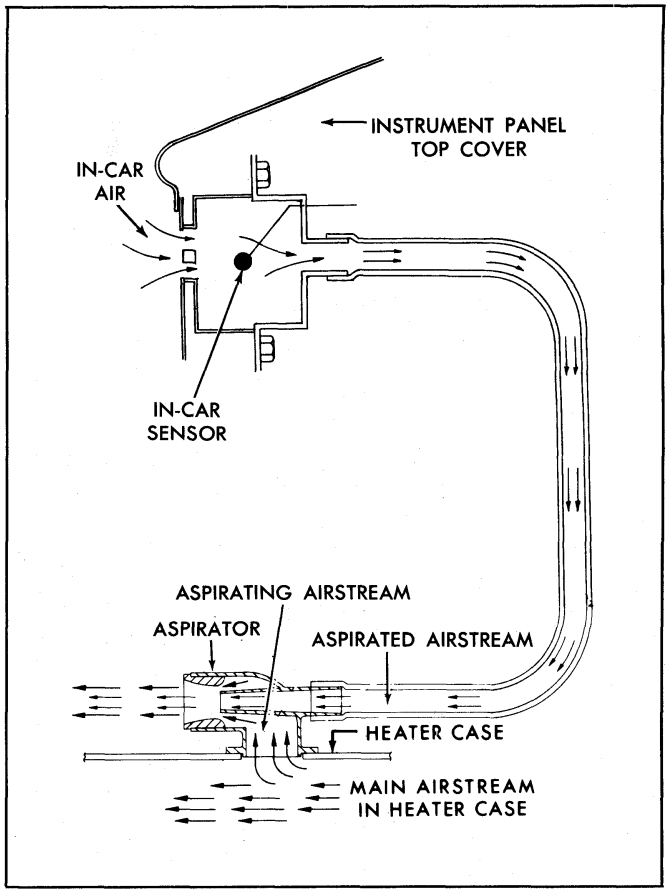


Fig. 1-190 In-Car Sensor Aspirator

electronics technician with the proper service aids for calibration.

The *transducer,* is mounted directly to the amplifier board and is essentially a throttling device with the vacuum level set by balancing an air force against a ball with a magnetic attraction between the armature and pole piece. Output current from the amplifier flows through the solenoid coil to control the vacuum level of the transducer. This component, in effect, transforms the electrical signal from the amplifer to a vacuum signal which is fed to the vacuum motor.

The *vacuum checking relay* provides two separate vacuum checking functions. See Fig. 1-192. In the upper part of the relay is a conventional rubber check valve which is opened by engine vacuum applied at port 5, allowing port 3, which supplies vacuum to the rotary vacuum valve on the programmer and the control head, to be evacuated. If engine vacuum drops because of acceleration or steep grades, the check valve closes, maintaining the vacuum level at port 3.

In the lower part of the relay is a spring-loaded diaphragm which blocks or passes regulated vacuum from the transducer which is connected at port 2 to the vacuum motor which is connected to port 1. When engine vacuum at port 5 is high, the diaphragm is pulled upward allowing regulated vacuum to pass to the vacuum motor. When engine vacuum drops, the diaphragm moves downward blocking passage and maintaining vacuum in the vacuum motor.

The *vacuum motor,* produces all mechanical motion within the programmer. It positions the vacuum motor mechanism which actuates the rotary shaft which drives the air-mix door link. This same mechanism moves the blower circuit board wiper, the vacuum valve operating arm and the feedback potentiometer. The vacuum motor mechanism is spring-loaded by a spring at its left-hand end so that with no vacuum it is fully extended out of the vacuum motor. This is the "Max A/C" position. When vacuum is applied to the vacuum motor, the mechanism is pulled into the vacuum motor -- approximately 8" of mercury vacuum is required to pull the mechanism all the way to the "Max Heat" position. In order to prevent the loss of position during stop/restart operations, it is necessary to add a restrictor between the vacuum relay and motor. This is a sintered plug-in hose type.

The *blower circuit board switch* is located in the center part of the programmer. Spring-loaded contacts move across the board making the required blower circuit connections. The configuration of this switch is similar to that of the circuit board switch on the control head. Three resistors are attached to the underside of the circuit board and protrude through into the programmer adapter. Air from the evaporator is ducted to the adapter to provide cooling for them. The junction of the switch is to place these restrictors into the blower circuit at the required points in the program to control blower speed. A low blower resistor is also attached to the circuit board. Refer to the electrical circuit diagram contained on page 1-218.

The *vacuum valve,* located in the center of the assembly, is a nine-port rotary valve which makes connections between the various ports or vents them, as required, to move air doors, operate the heater water valve, etc. Refer to vacuum circuit on page 1-206 for additional information.

The *feedback potentiometer* is located just above the vacuum valve. Its function is to snub movement of the vacuum motor so that a small signal from the sensors does not drive the motor all the way, one way or the other. The feedback pot is located, electrically, in the sensor string circuit and operates in opposition to the sensors -- if a sensor drives the vacuum motor toward "Max Heat", for example, when the motor starts to move, it will rotate the potentiometer so that its resistance change tends to offset the resistance change of the sensor. This unit is adjustable -- follow procedure on page 1-199 carefully when adjusting it.

The sequence of events in the control program as the programmer moves from "Max A/C" to "Max Heat" is given below:

1. Possibility of recirculated air is terminated.

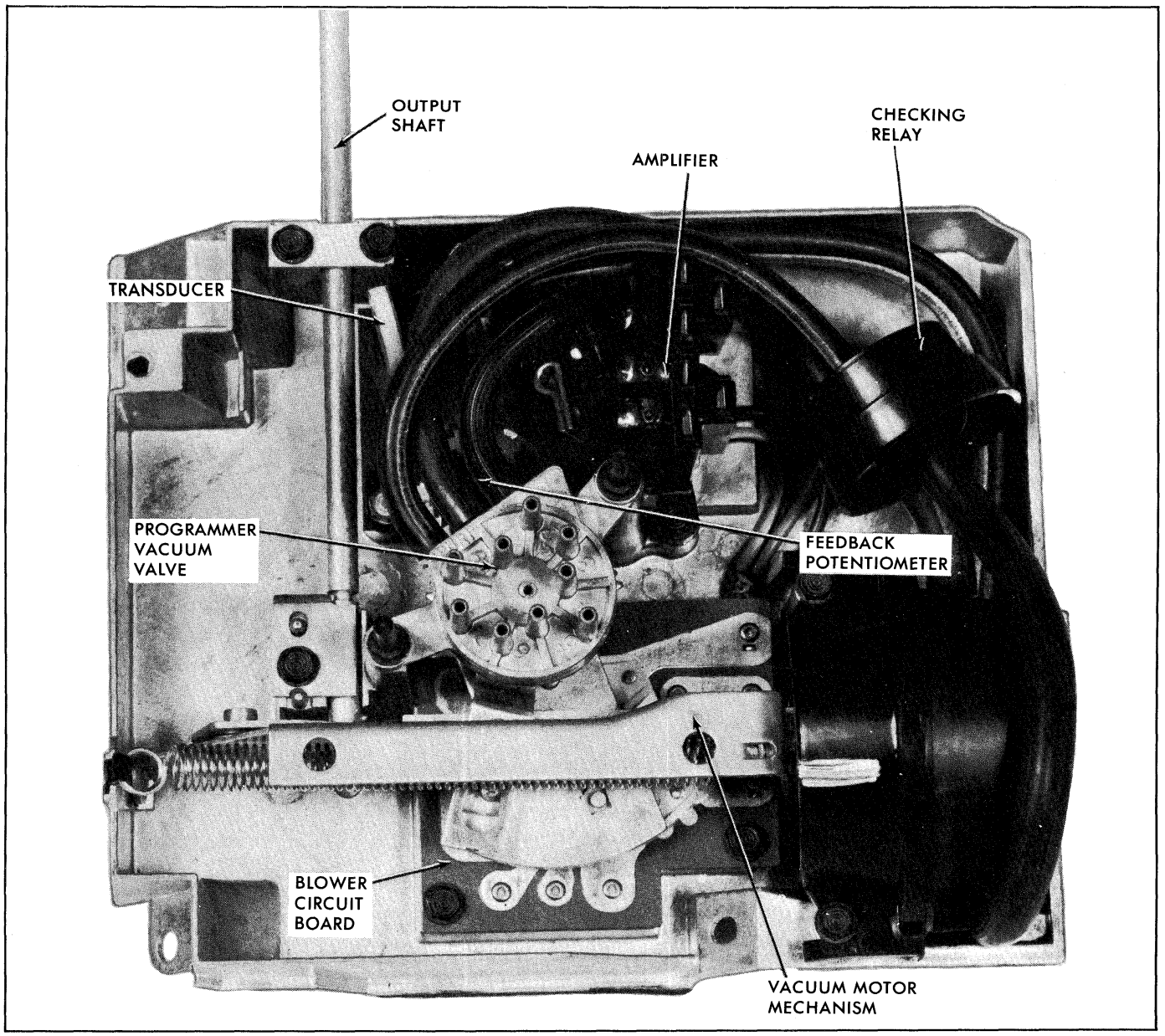


Fig. 1-191 Programmer

2. Heater water valve opens.
3. Blower speed drops from HI to M_3.
4. Air-mix door starts to move, blending in hot air.
5. Blower speed drops to M_2.
6. Blower speed drops to M_1.
7. Mode of air delivery changes from A/C to Bi/Level.
8. Mode of air delivery changes from Bi/Level to heater.
9. Blower speed increases to M_2.
10. Air-mix door reaches "Max Heat" position.
11. Blower speed increases to M_3.

The sequence of events is reversed as the programmer moves from "Max Heat" to "Max A/C".

e. Air-Mix Door Link

The air-mix door link consists of a spring steel crank arm which slips down over the top of the output shaft of the programmer and a rod riveted to the crank arm. The other end of the rod attaches to the air-mix door crankarm and is retained to it with a clip. The spring steel crankarm is attached to the output shaft with a set screw which is tightened when the link is adjusted. The programmer positions the air-mix door by this link. See page 1-198 for adjustment procedure.

f. Blower Relay

A single-pole, single throw relay is used to supply power to the blower. It is located on the evaporator case in the engine compartment and supplies power to the blower for all positions of the control lever except "Off" and "Lo".

g. Heater Turn-On Switch

This switch is a bi-metal, snap-action switch located in front of the intake manifold. It senses engine coolant temperature; it is closed above approximately 49°C (120°F) and is open below that temperature.

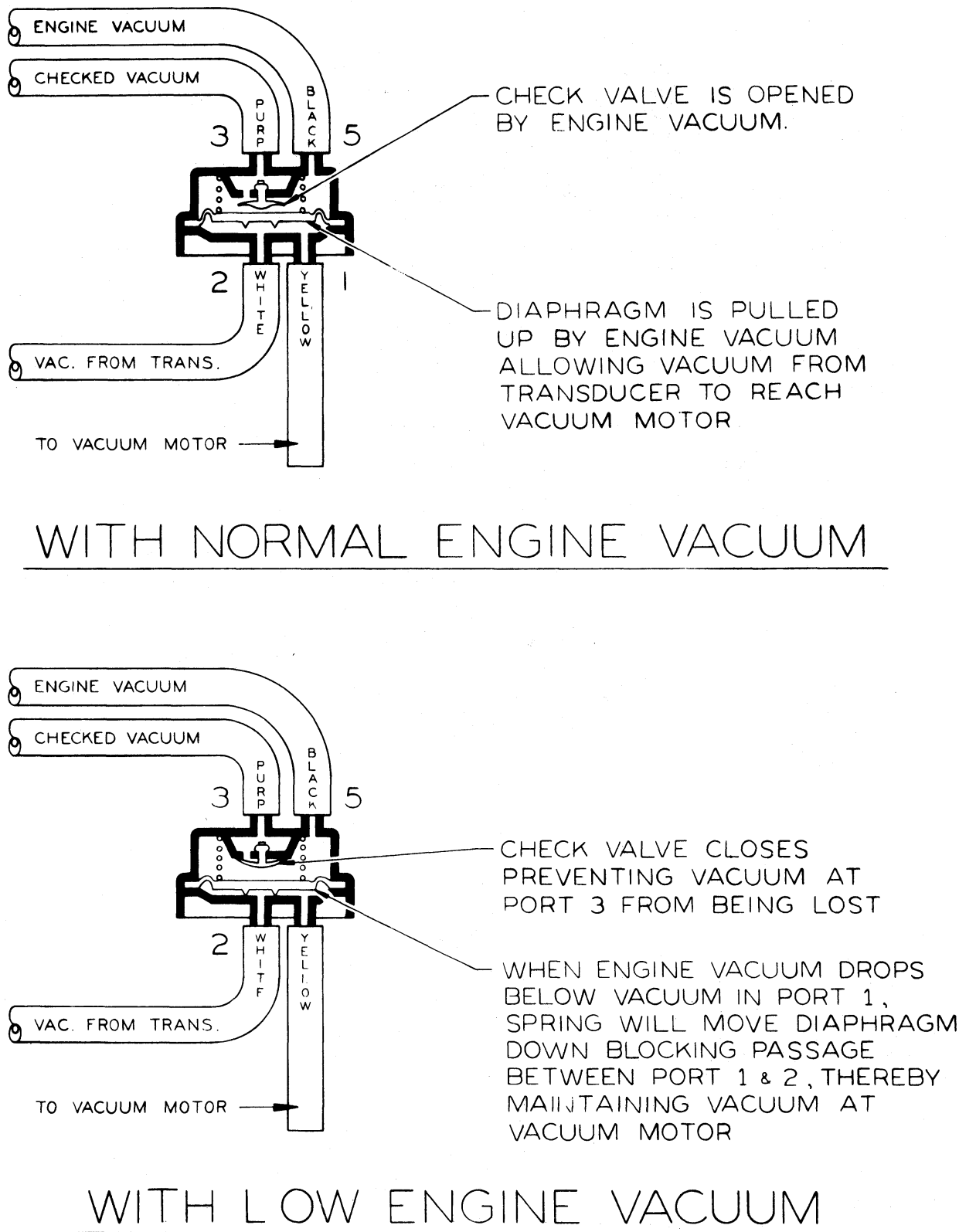
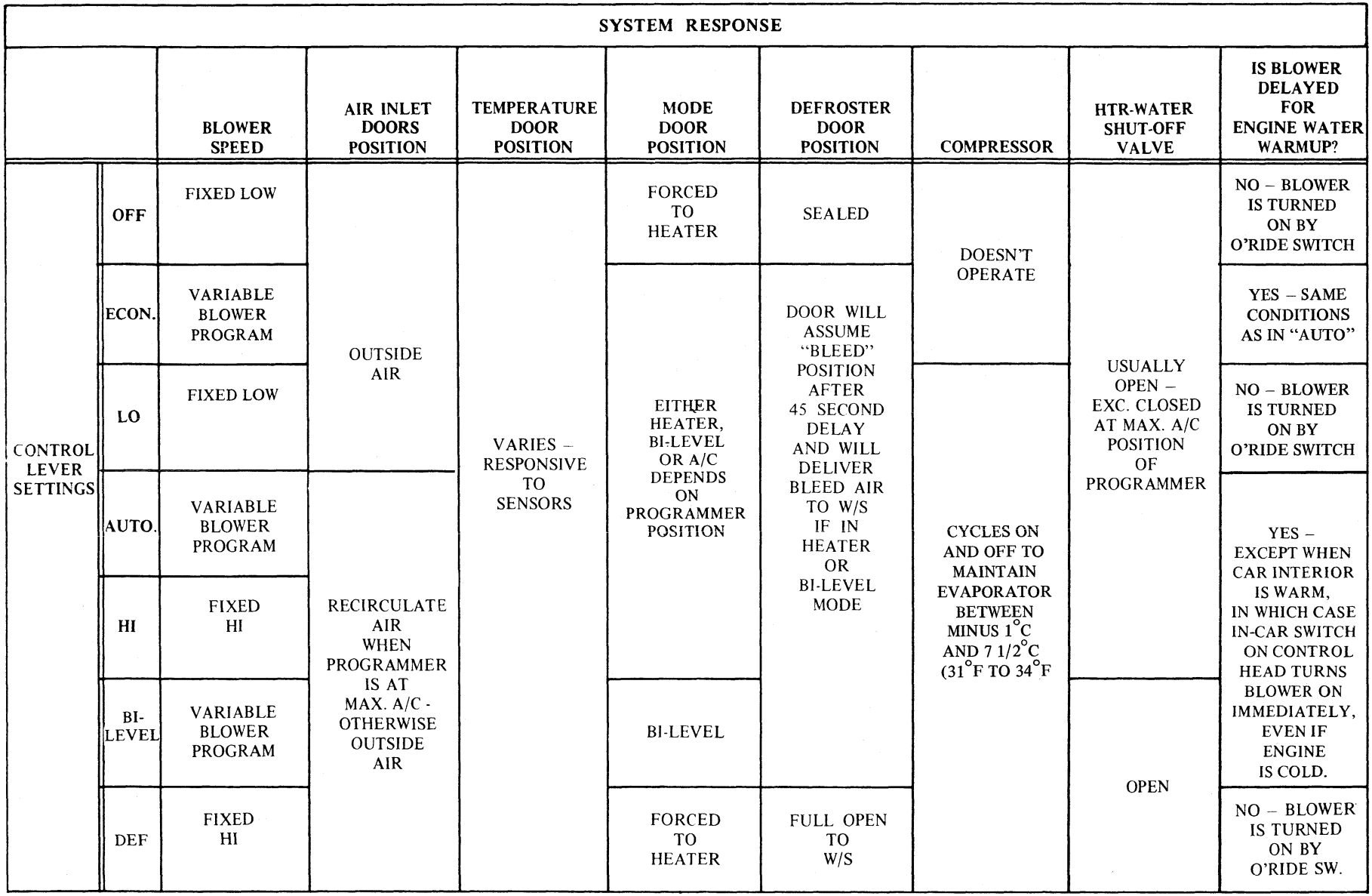


Fig. 1-192 Operation of Vacuum Checking Relay



SYSTEM RESPONSE									
		BLOWER SPEED	AIR INLET DOORS POSITION	TEMPERATURE DOOR POSITION	MODE DOOR POSITION	DEFROSTER DOOR POSITION	COMPRESSOR	HTR-WATER SHUT-OFF VALVE	IS BLOWER DELAYED FOR ENGINE WATER WARMUP?
CONTROL LEVER SETTINGS	OFF	FIXED LOW	OUTSIDE AIR	VARIES – RESPONSIVE TO SENSORS	FORCED TO HEATER	SEALED	DOESN'T OPERATE	USUALLY OPEN – EXC. CLOSED AT MAX. A/C POSITION OF PROGRAMMER	NO – BLOWER IS TURNED ON BY O'RIDE SWITCH
	ECON.	VARIABLE BLOWER PROGRAM			EITHER HEATER, BI-LEVEL OR A/C DEPENDS ON PROGRAMMER POSITION	DOOR WILL ASSUME "BLEED" POSITION AFTER 45 SECOND DELAY AND WILL DELIVER BLEED AIR TO W/S IF IN HEATER OR BI-LEVEL MODE			YES – SAME CONDITIONS AS IN "AUTO"
	LO	FIXED LOW					CYCLES ON AND OFF TO MAINTAIN EVAPORATOR BETWEEN MINUS 1°C AND 7 1/2°C (31°F TO 34°F		NO – BLOWER IS TURNED ON BY O'RIDE SWITCH
	AUTO.	VARIABLE BLOWER PROGRAM	RECIRCULATE AIR WHEN PROGRAMMER IS AT MAX. A/C - OTHERWISE OUTSIDE AIR						YES – EXCEPT WHEN CAR INTERIOR IS WARM, IN WHICH CASE IN-CAR SWITCH ON CONTROL HEAD TURNS BLOWER ON IMMEDIATELY, EVEN IF ENGINE IS COLD.
	HI	FIXED HI							
	BI-LEVEL	VARIABLE BLOWER PROGRAM			BI-LEVEL			OPEN	
	DEF	FIXED HI			FORCED TO HEATER	FULL OPEN TO W/S			NO – BLOWER IS TURNED ON BY O'RIDE SW.

Fig. 1-193 System Operation at Various Lever Settings

h. Heater Water Valve

This valve is located on the evaporator assembly. Its function is to pass or block flow of water to the heater. It is normally open but is closed by vacuum from the programmer vacuum valve when the programmer is positioned at "Max A/C".

Control System Operation

The automatic temperature control system is made up of three major sections which perform the following operations:

A. Temperature Control
B. Blower Control
C. Auxiliary Electrical and Vacuum Functions

The above sections will be described separately and in detail to aid system understanding and service diagnosis. System response at various lever settings is shown in Fig. 1-193.

a. Temperature Control Circuit

This circuit is comprised of the following parts, described in the preceding section and shown in Fig. 1-218.

- Ambient Sensor
- In-Car Sensor
- Temp Dial

} Input to Programmer

- Feedback Pot
- Amplifier
- Transducer
- Vacuum Relay
- Vacuum Motor

} Programmer

The resistance of the two sensors varies with their temperature. Their resistance, plus that of the temperature dial, form the input to the programmer. This weak electrical signal, which varies with the temperature of the sensor or with temperature dial movements, is amplified by the amplifier to produce a relatively strong current flow through the transducer that varies in accord with input signal changes. The transducer converts this electrical signal to a proportional vacuum signal which is routed through the vacuum relay to the vacuum motor. The vacuum motor performs the following five output functions.:

1. Positions the air-mix door
2. Positions the wiper on the blower circuit board switch
3. Controls mode door operation
4. Controls heater water valve
5. Controls recirc and outside air doors

} Through Vacuum Valve

Input-output characteristics of the programmer are shown in Fig. 1-194. Input is resistance in ohms; output consists of the five functions listed above. Several examples are listed below to provide further understanding.

1. Assume the car is stabilized on a sunny 27°C (80°F) day with the in-car sensor being maintained at 24°C (75°F) with a 75° temp dial setting. The resistance of the ambient sensor at 27°C (80°F) is 32 ohms, the in-car sensor resistance at 24°C (75°F) is 68 ohms, and the temp dial resistance at the 75° setting is 36 ohms. These three resistances total 136 ohms. Referring to Fig. 1-194, this resistance will position the programmer to produce M_1 blower speed, an intermediate discharge air temperature (approximately 16°C (60°F), A/C mode, an open heater water valve and outside air.

2. If the ambient temperature were to increase to 32°C (90°F) the ambient sensor resistance would *decrease* to 26 ohms. This change in resistance would cause amplifier output current to increase which would cause the transducer output vacuum to the vacuum motor to decrease so that the new point of operation would be at the 130 ohm point in Fig. 1-194, producing M_2 blower speed and colder discharge air. The system would still be in A/C mode, with the water valve open, utilizing outside air. In this way, the in-car temperature is maintained at 24°C (75°F) despite the change in ambient temperature.

3. If heat load on the car were to be decreased, by driving under cloud cover, for example, the in-car sensor temperature would tend to decrease. This would cause its resistance to *increase* so that the total resistance to the programmer would increase. This would cause the programmer to move back to the right on the chart to a warmer position.

NOTE: In the foregoing examples that an increase in amplifier output current cause a decrease in transducer output vacuum. Understanding this and similar relationships is important in problem diagnosis - for that reason they are listed below.

- *Hot* sensors result in *low* sensor string resistance which results in *high* amplifier output current which results in *low* transducer output vacuum which positions the vacuum motor in the *cool* or cold area of operation.
- Conversely, *cold* sensors operate at *high* resistance which results in *low* amplifier output which causes a *high* transducer vacuum which positions the vacuum motor in the *warm* or hot area of operation.

It is worth noting that an open sensor (disconnected, etc.) would represent a high resistance (as though the sensor were very cold) which would drive the programmer to maximum heat, while a shorted sensor would produce low resistance and drive the system to "Max A/C".

b. Blower Control Circuit

Three modes of blower speed control are available to the customer.

1. Fixed low blower speed
2. Four blower speeds automatically controlled by the programmer, ranging from M_1, which is slightly higher than the fixed low speed, through M_2 and M_3 to high.
3. Fixed high blower speed (approximately the same as the high in the automatic range).

Blower turn-on occurs in the following ways:

1. Delayed turn-on in cold weather until warm water is available from the engine.
2. Immediate turn-on in warm weather when the car interior is warm, regardless of engine water temperature.
3. Immediate turn-on regardless of temperatures, by owner override to the "Vent" or "Def" lever settings.

c. Auxiliary Electrical and Vacuum Functions

The *Compressor Clutch Circuit* is shown in Fig. 1-218. When the ignition switch is closed, current flows through two pads on the control head which are inter-connected at all lever settings except "Off" and "Economy" and through the thermostatic cycling switch, clutch coil and compressor mounted low pressure switch to ground. On early models with the low pressure switch located in the evaporator inlet line, current flows from the control head as described above through the low pressure switch, thermostatic cycling switch and clutch coil to ground.

Auxiliary vacuum circuits are those which provide vacuum to operate the various air doors and the heater water valve. They do not include vacuum circuitry connected with the transducer and vacuum motor which functions

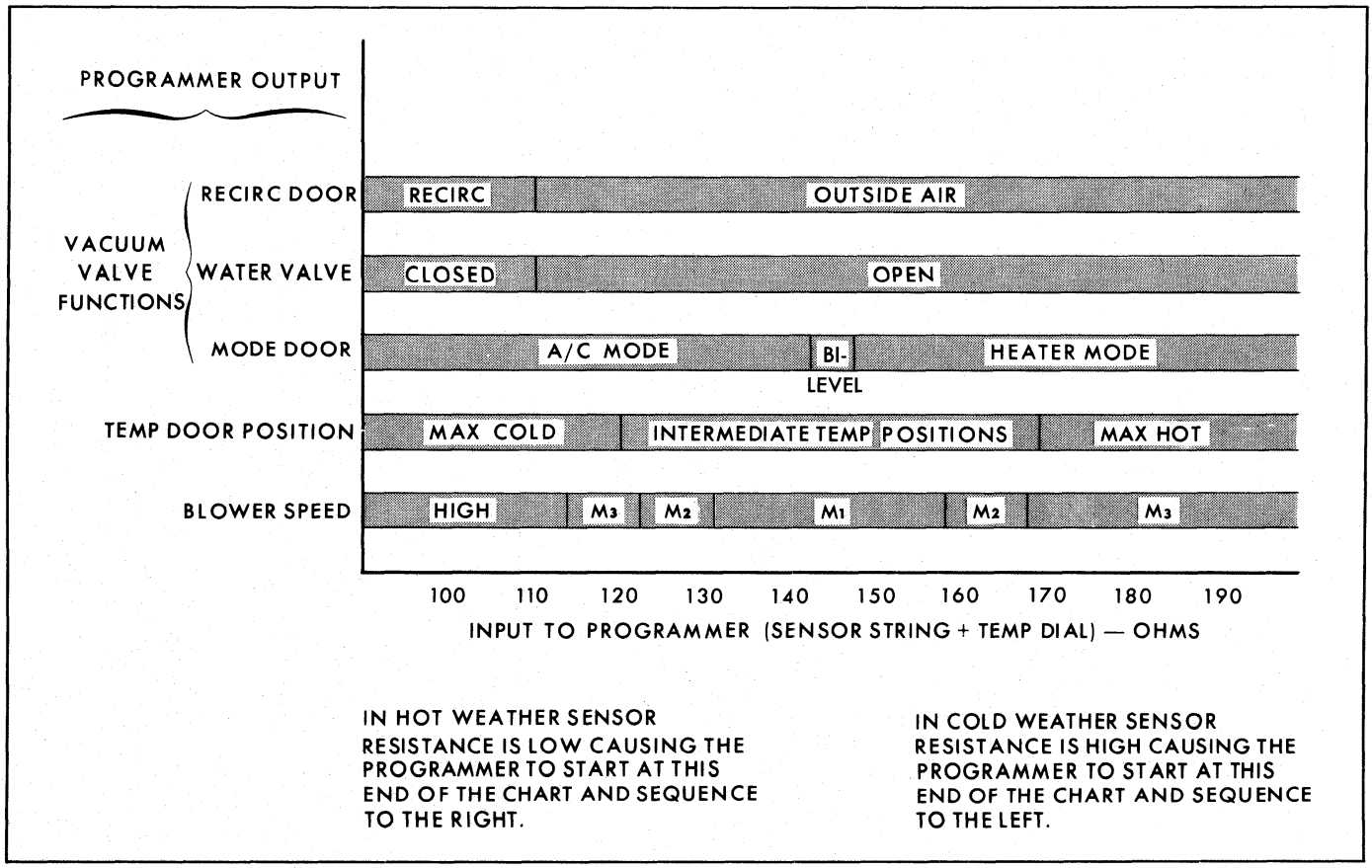


Fig. 1-194 Programmer Input - Output Chart

independently and was explained in a previous section.

Complete Vacuum Circuit Diagram

A complete vacuum circuit diagram is shown in Fig. 1-227. Included are "clocks" which show the internal connections of the programmer and control head vacuum valves at various positions and settings.

Complete Electrical Circuit Diagrams

Fig. 1-218 shows a complete circuit diagram in a form to permit easy tracing of circuits. Fig. 1-228 is a wiring circuit diagram that shows actual wiring arrangements, such as connectors, bulkhead connectors, location of splices, etc. The two circuits are in agreement in everything except the form in which they are presented. If there is any question regarding correctness of connections, use Fig. 1-228.

Refrigeration System

Refer to Page 1-8.

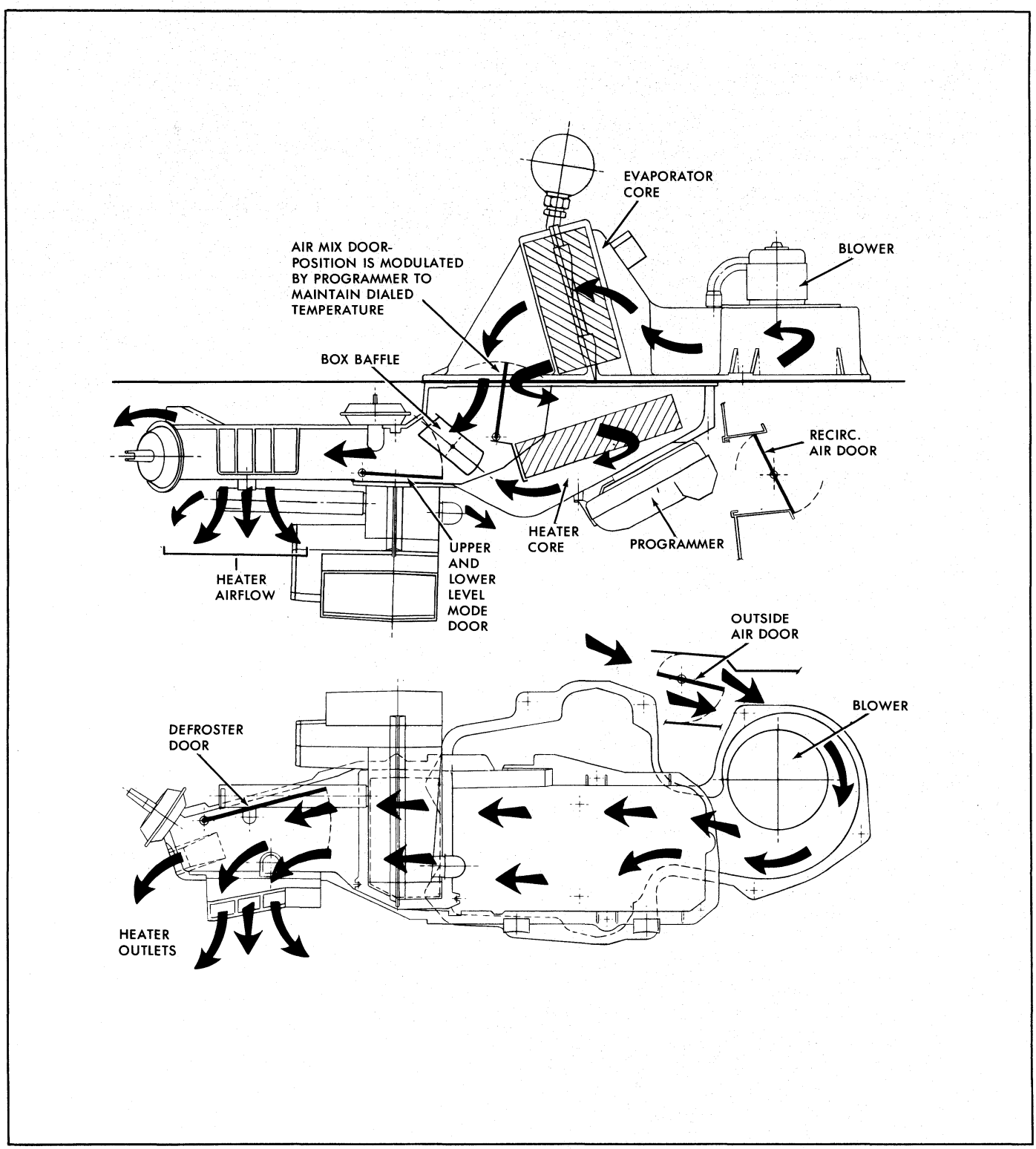


Fig. 1-195 Air Flow at Off

SYSTEM OPERATION AT VARIOUS LEVER SETTINGS

Airflow at Off (Fig. 1-195)

Outside air is circulated at a fixed low blower speed with immediate turn on and no delay provisions through the evaporator and heater assembly and discharged into the passenger compartment from the heater outlet when the ignition switch in the "Run" position. The temperature of the air is modulated to maintain the temperature on the dial; the ability of the system to maintain this temperature in warm weather is restricted, however, since the compressor is disengaged at this setting.

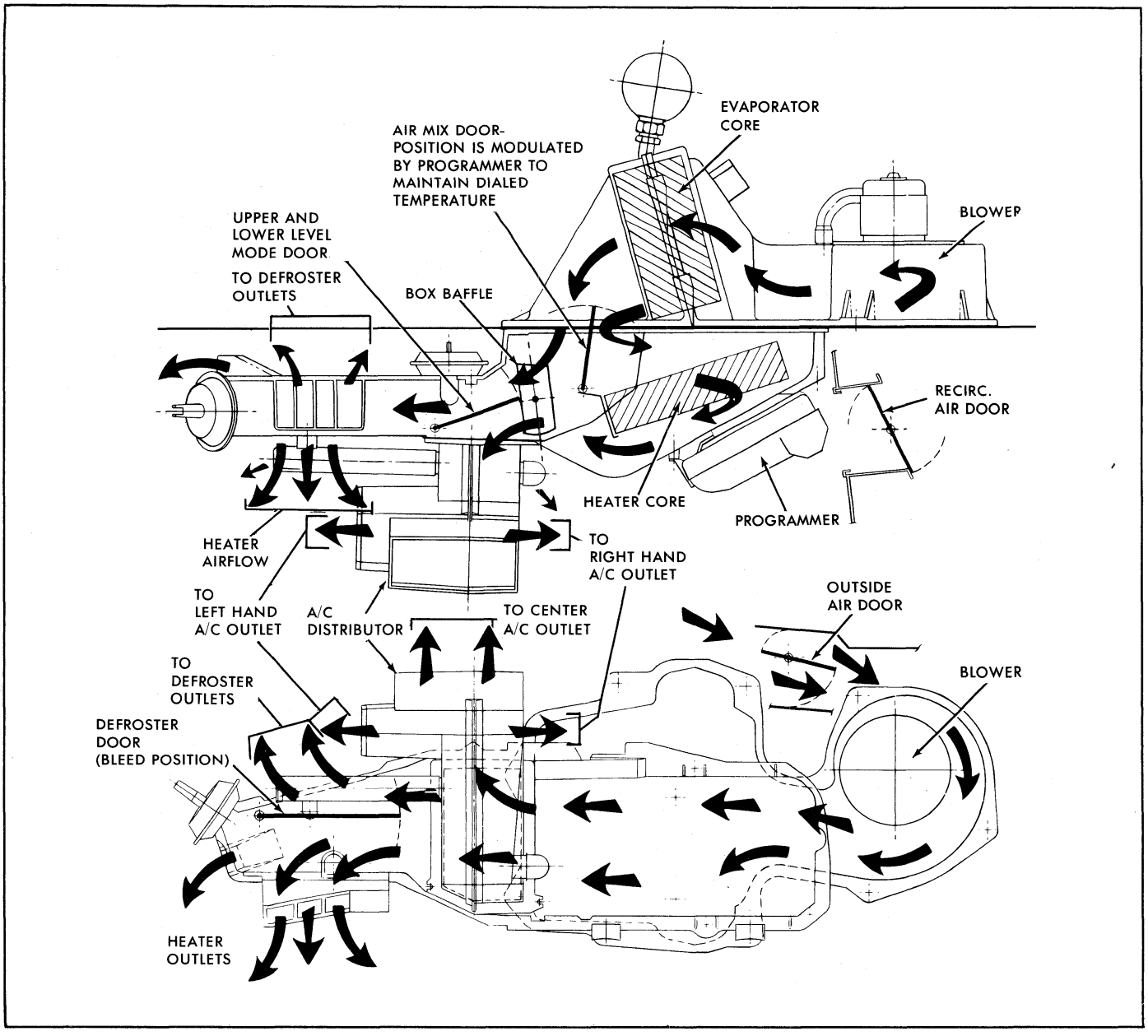


Fig. 1-196 Air Flow at Economy

Airflow at Ecomony (Fig. 1-196)

Outside air is circulated at an automatically selected blower speed through the evaporator and heater assembly and discharged into the passenger compartment from the air conditioning or heater outlets. Since the compressor is disengaged at this setting, the ability of the system to maintain the dial temperature is restricted. It may be necessary to set the dial approximately 3°C (5°F) cooler than normal to maintain comfort at 10°C (50°F) to 21°C (70°F) ambient temperatures.

Four blower speeds, HI, MED_3, MED_2, and MED_1 are utilized. If the car interior is significantly hotter than the temperature on the dial, the blower will start at high and then sequence down to lower speeds as the dial temperature is approached. With a colder interior temperature, the blower will start at MED_3 and sequence down to lower speeds.

In the upper part of the usable range of this setting approximately 10°C (50°F) to 21°C (70°F), air is delivered from the air conditioner outlets. Below 10°C (50°F) air is delivered in BI-LEVEL fashion - from both the air conditioner and heater outlets or from the heater outlet only in cold weather. Blower will be delayed, if the engine is cold, until engine coolant reaches approximately 49°C (120°F) or in car temperature reaches 23°C (73°F).

The Economy setting is designed so that it is possible to maintain comfort at ambient temperatures below approximately 21°C (70°F) without having the compressor operate.

In some situations (high sunload or excessive humidity) this setting may not provide comfort or windows may tend to become fogged. Under these conditions, the control lever should be returned to the "AUTO" setting.

Airflow at Lo

Operation at this setting is identical to that provided at "Auto" except that the blower operates at a fixed low speed with immediate turn on and no delay provisions. Also, there is no recirculation of passenger compartment air.

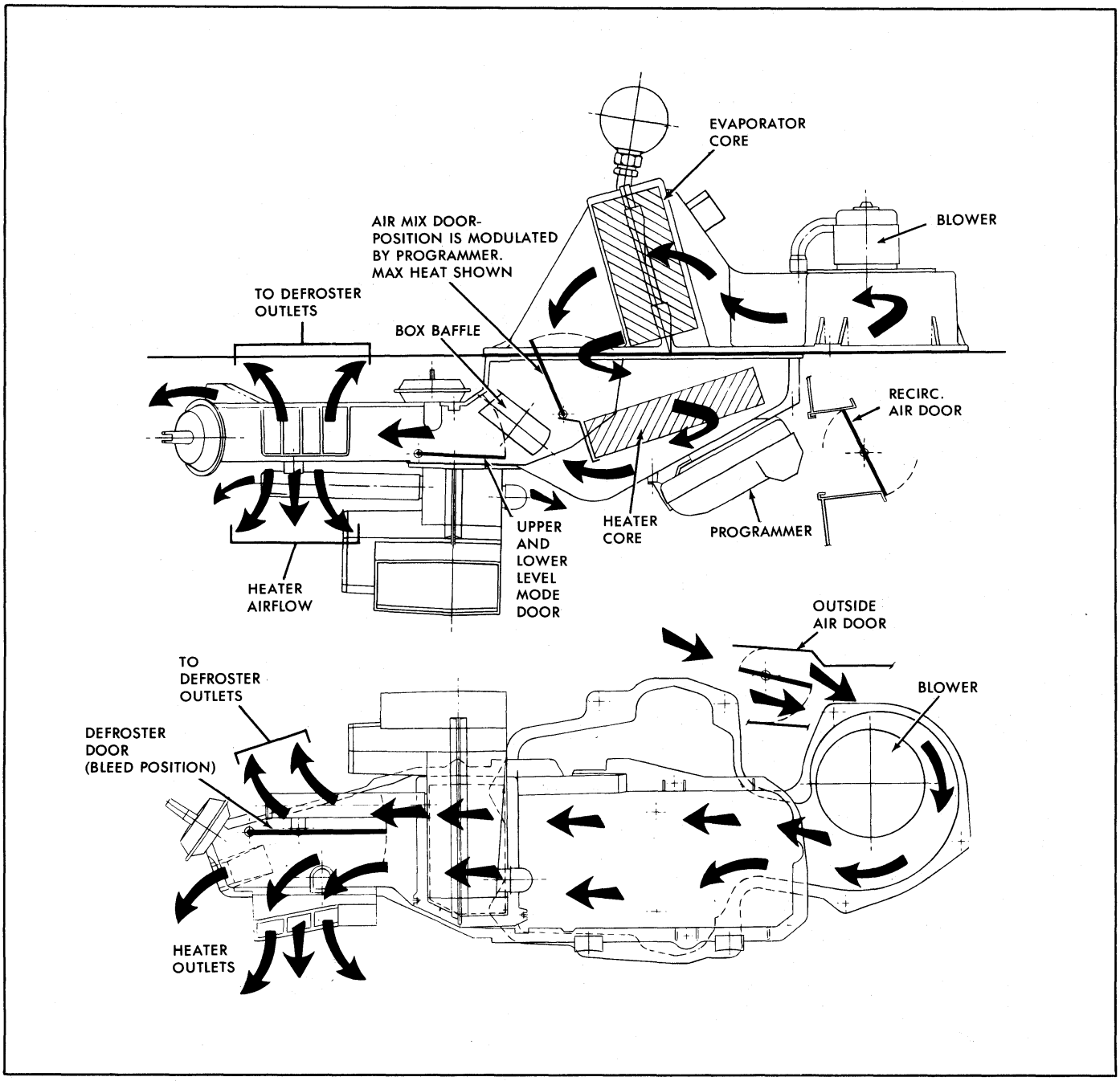


Fig. 1-197 Air Flow at Auto - Heat Mode

Airflow at Auto (Figs. 1-197 and 1-198)

Regulation of blower speed, discharge air temperature, air delivery mode, system turn-on and compressor operation is accomplished automatically to maintain the temperature on the dial and to provide comfort.

Four blower speeds, HI, MED_3, MED_2, and MED_1 are utilized. If the car interior is significantly hotter or colder than the temperature on the dial, the blower will start at high and then sequence down to lower speeds as the dial temperature is approached.

Discharged air temperature will be varied automatically between approximately 7°C (45°F) and 66°C (150°F). If the discharge air temperature is above approximately 32°C (90°F) the air will be delivered from the heater outlet (Fig. 1-197), below approximately 24°C (75°F) it will be delivered from air conditioner outlets (Fig. 1-198). Between these temperatures, air is provided from both the heater and air conditioner outlets (Bi-Level operation).

Blower will be delayed, if the engine is cold, until engine water reaches approximately 54°C (130°F) or in-car temperature reaches 49°C (120°F).

Compressor operation is provided at all ambient temperatures above approximately 0°C (32°F) even when not required for cooling, to assure maximum dehumidification of the air.

Recirculated air is used when maximum cooling is required.

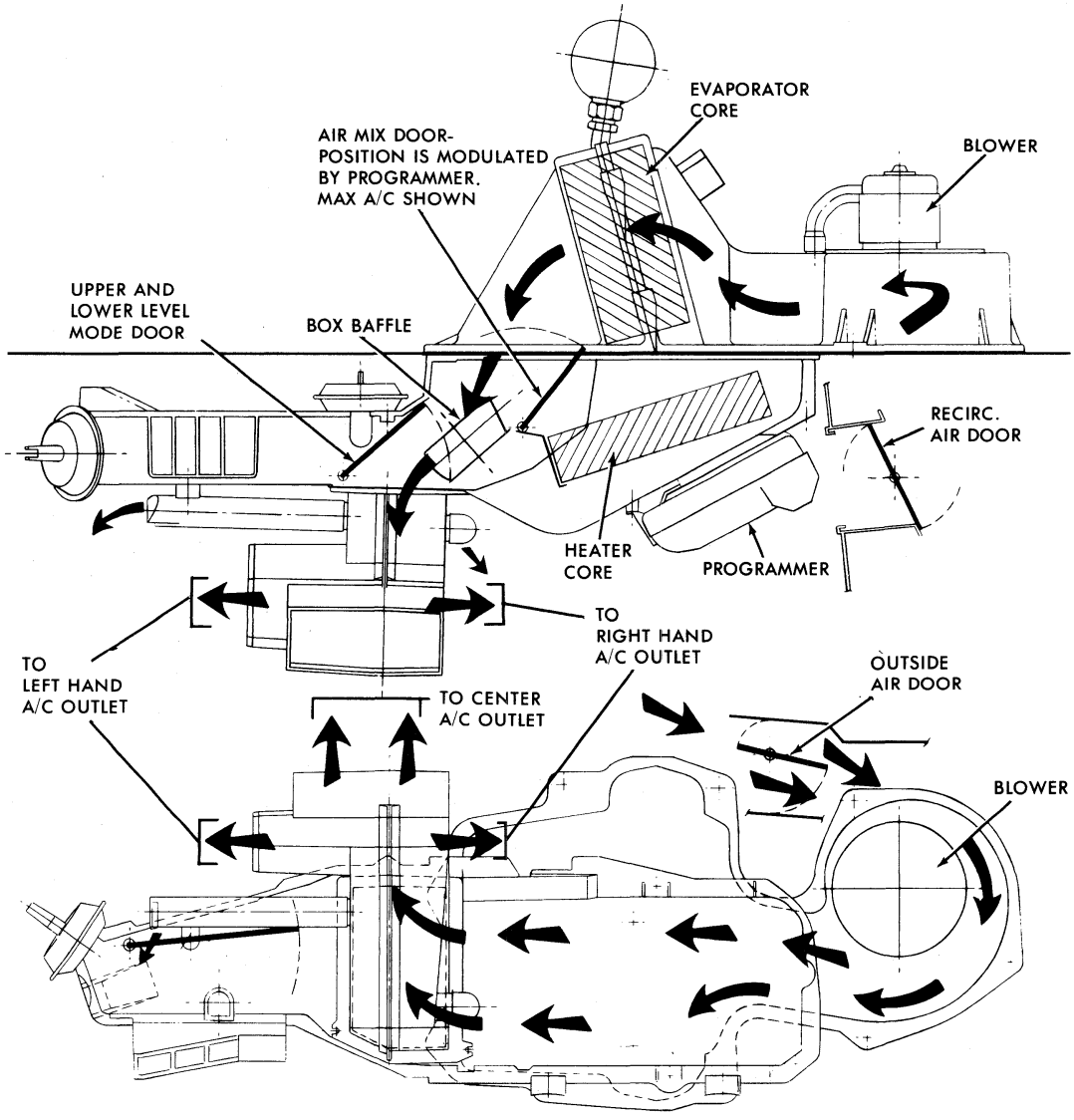


Fig. 1-198 Air Flow at Auto - A/C Mode

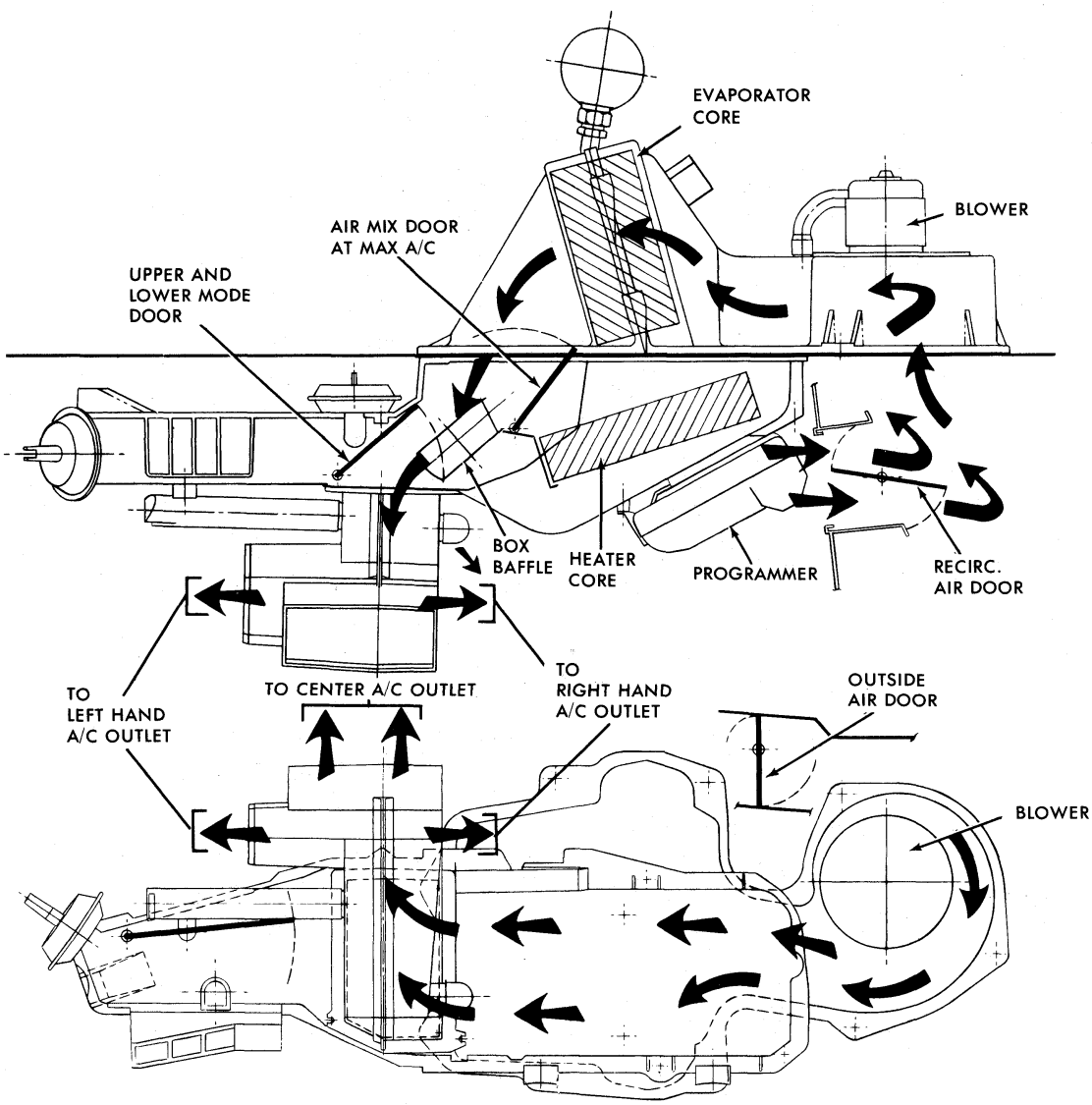


Fig. 1-199 Air Flow at Hi

Airflow at Hi (Fig. 1-199)

Operation at this setting is identical to that provided at "Auto" except that the blower operates at a fixed maximum speed. Recirculated air is also used when maximum cooling is required. This setting is provided for quickest possible cool down under extremely hot ambient conditions.

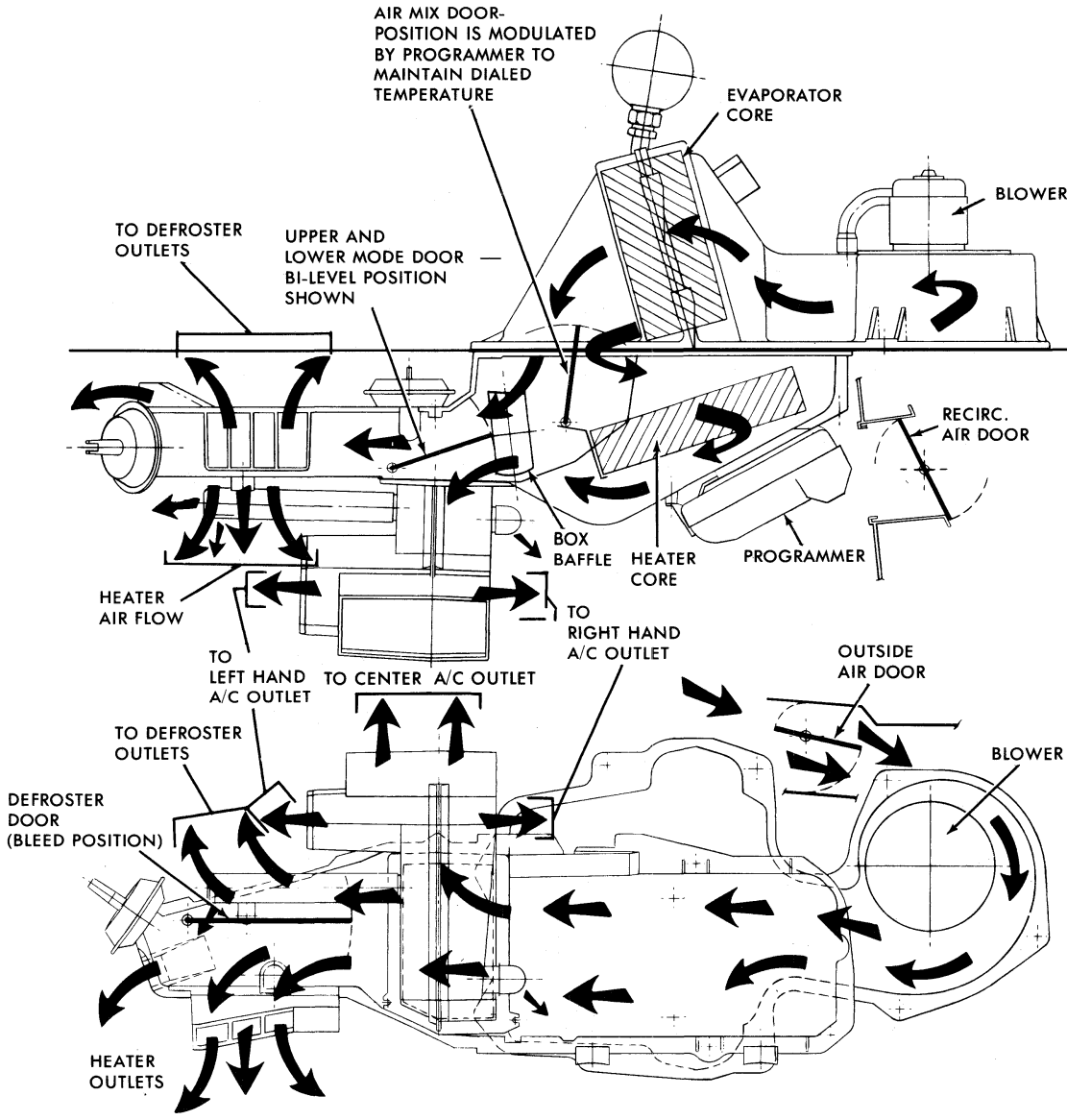


Fig. 1-200 Air Flow at Bi-Level

Airflow at Bi-Level (Fig. 1-200)

Operation at this setting is the same as at "Auto" except *bi-level* air delivery is provided -- approximately half the air is delivered from the heater outlet and the other half is discharged from the air conditioner outlets. This provides a pleasant, draft-free mode of operation in mild weather; it also permits defrosting of the side windows by the air streams from the end air conditioner outlets in cold weather.

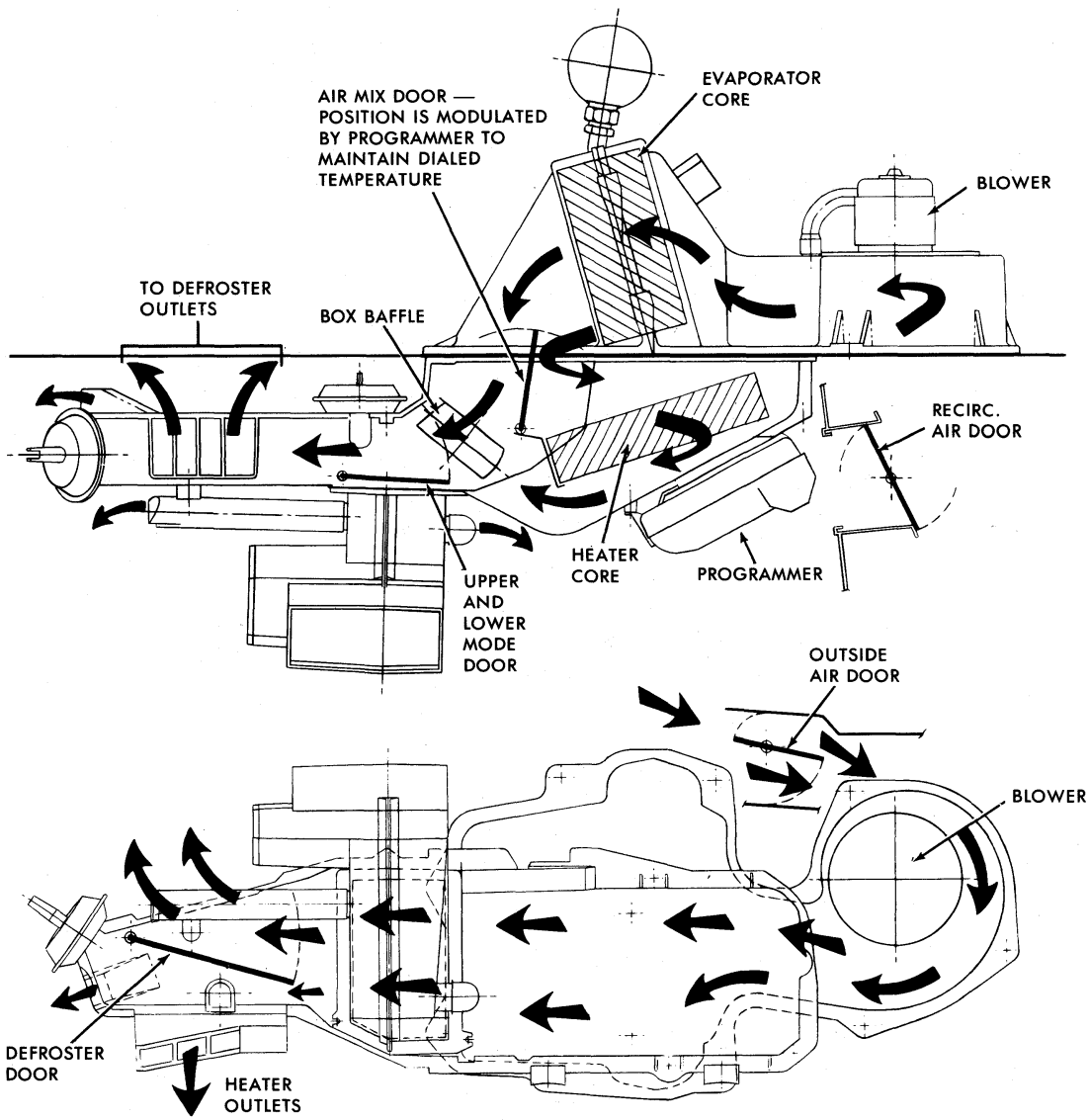


Fig. 1-201 Air Flow at Def

Airflow at Def (Fig. 1-201)

At this setting all the air is delivered to the windshield and the blower operates at a fixed high speed. Temperature regulation is maintained. Blower turn-on is immediate.

How the system operates at the various lever settings is depicted in organized fashion in the chart in Fig. 1-193.

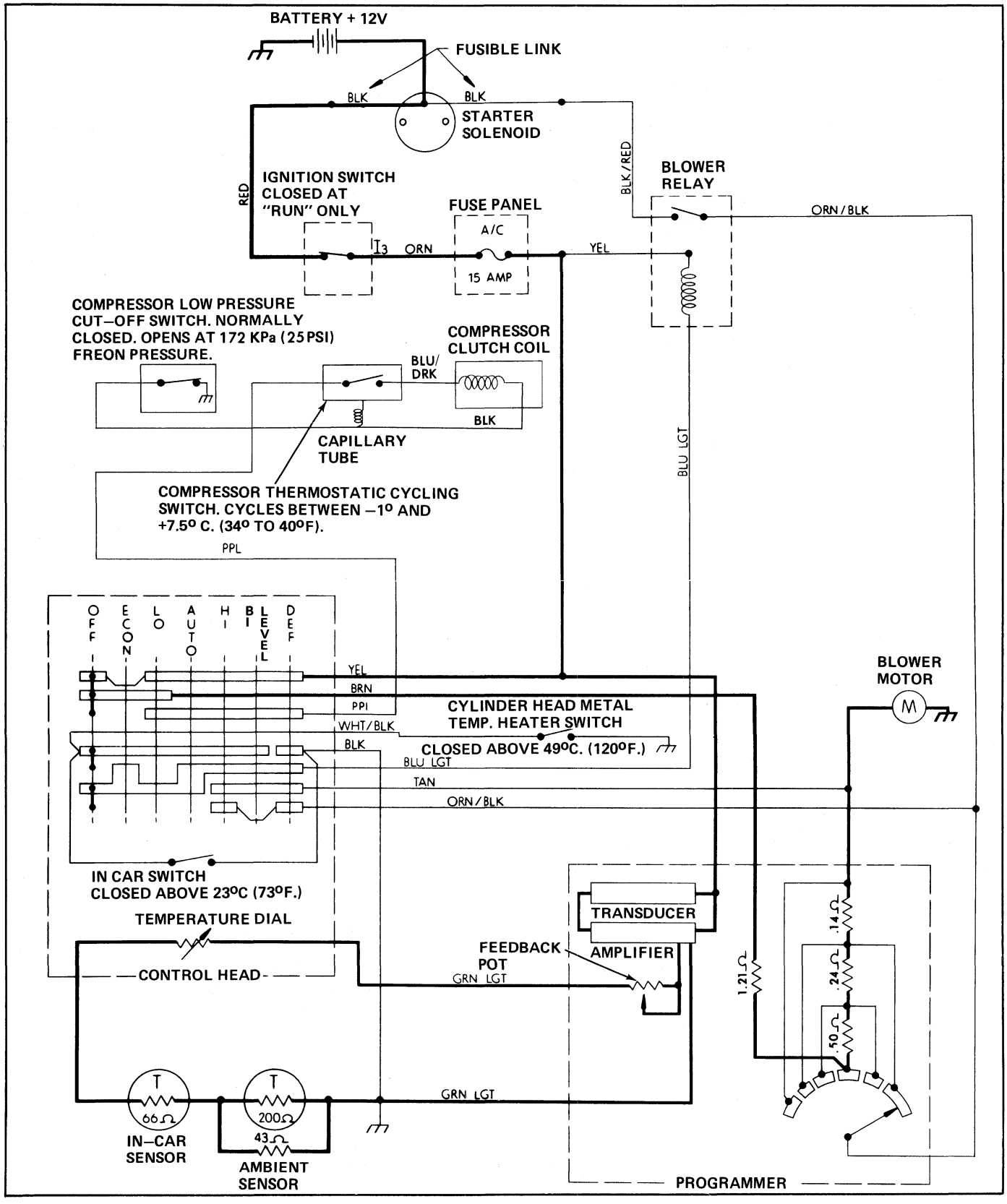


Fig. 202 Blower Operation at "Off"

Blower Circuit at Various Lever Settings

Blower Operation at Off (Fig. 1-202)

Current flows through the ignition switch and fuse block and through two inter-connected pads on the control head to ground at the blower motor after passing through all four blower resistors in the programmer. The blower operates at a fixed low speed with immediate turn on and no delay provisions for in-car or engine coolant temperatures. There is no compressor operation at this setting.

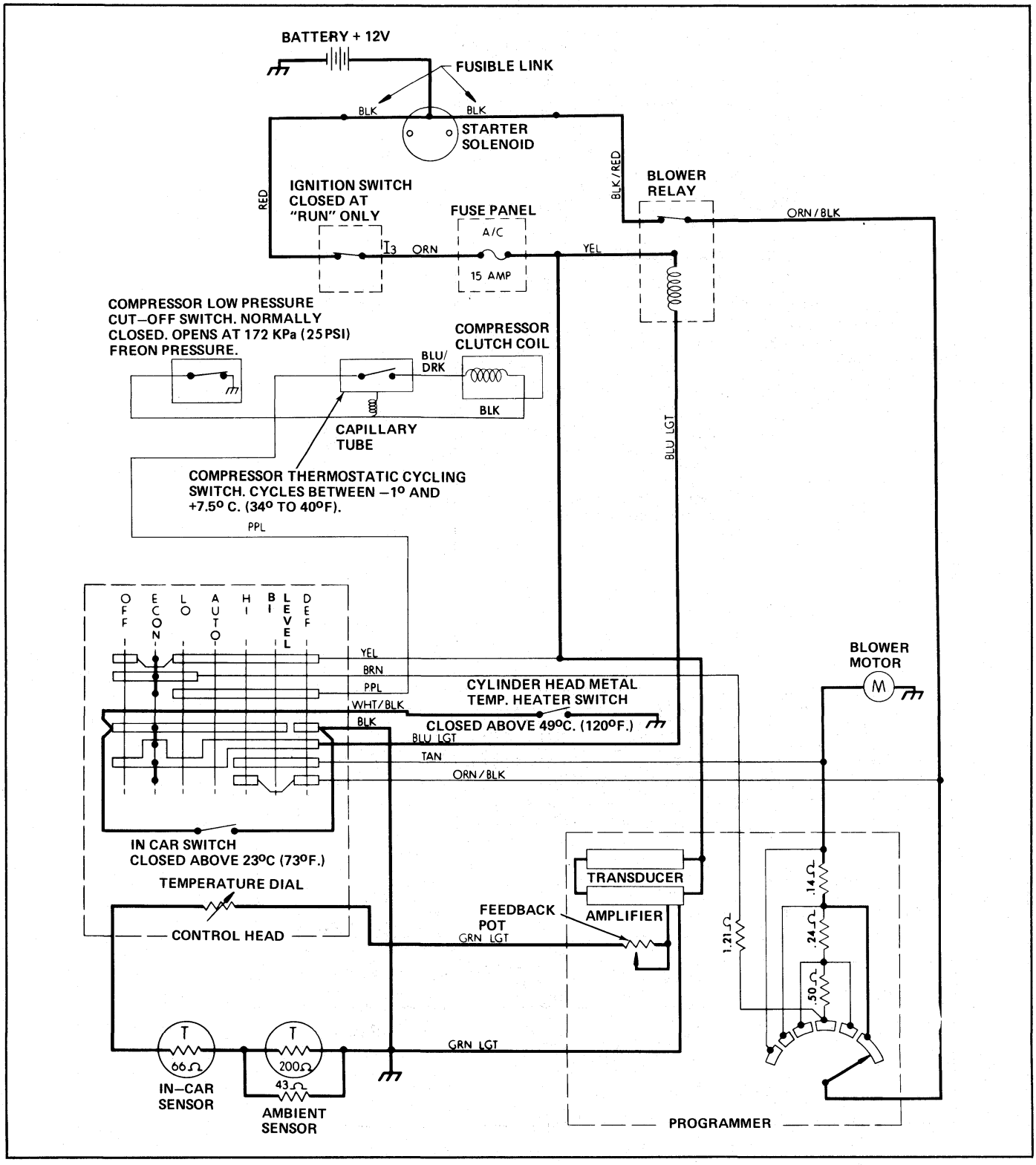


Fig. 1-203 Blower Operation at Economy

Blower Operation at Economy (Fig. 1-203)

Current flows through the ignition switch, fuse block and relay coil to ground through either the engine temperature switch or the in-car switch. There is no grounding connection on the control head circuit board switch for blower current from the relay so that multiple blower speeds will delay in cold weather. Blower current flows through the fusible link and relay contacts to the center point of the wiper on the programmer and through one, two or three resistors, depending on the position of the programmer, to the blower motor, after 49°C (120°F) coolant temp.

There is no compressor operation at this setting.

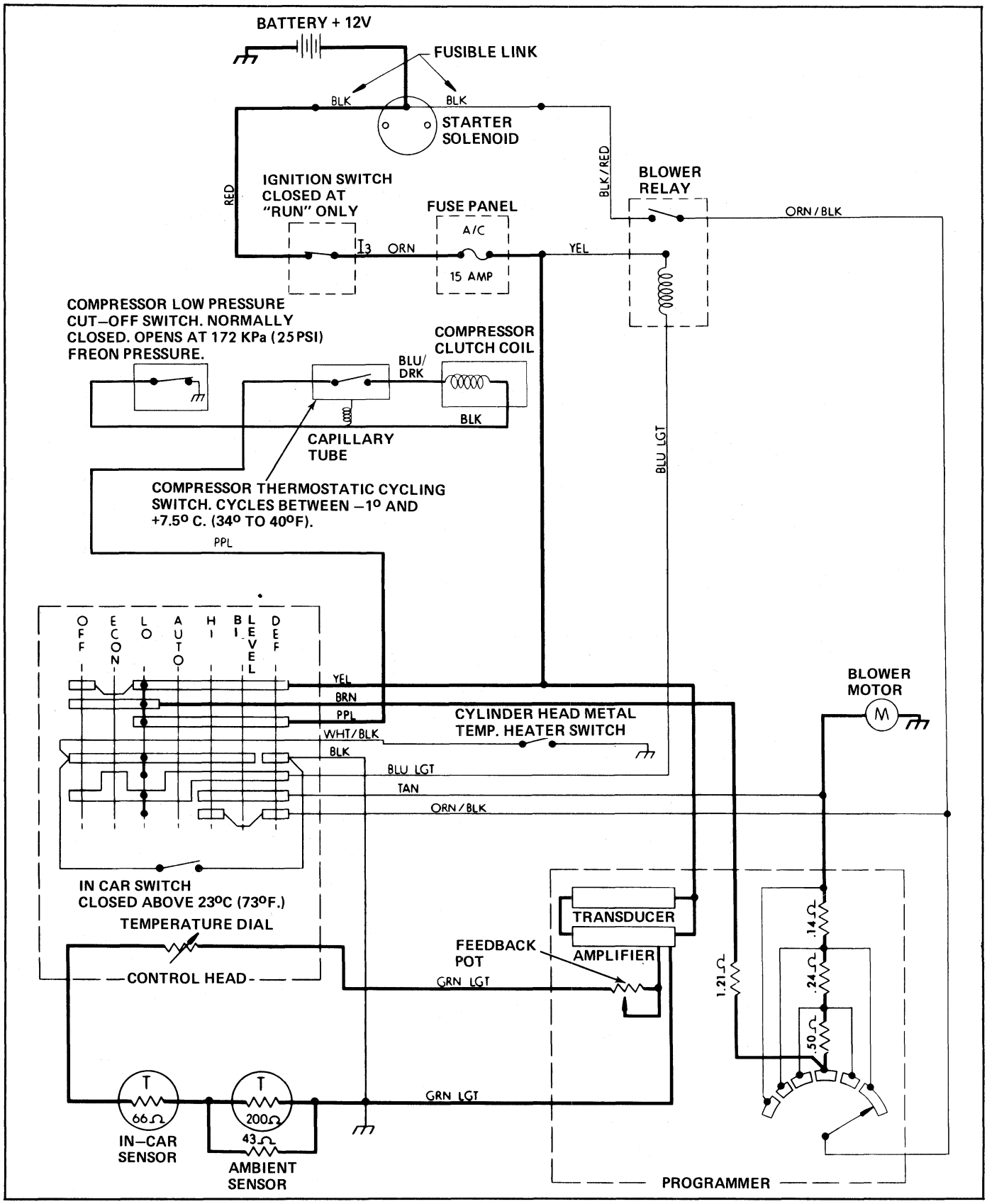


Fig. 1-204 Blower Operation at Lo

Blower Operation at Lo (Fig. 1-204)

Blower operation is the same as in "Off" except that the compressor is operational.

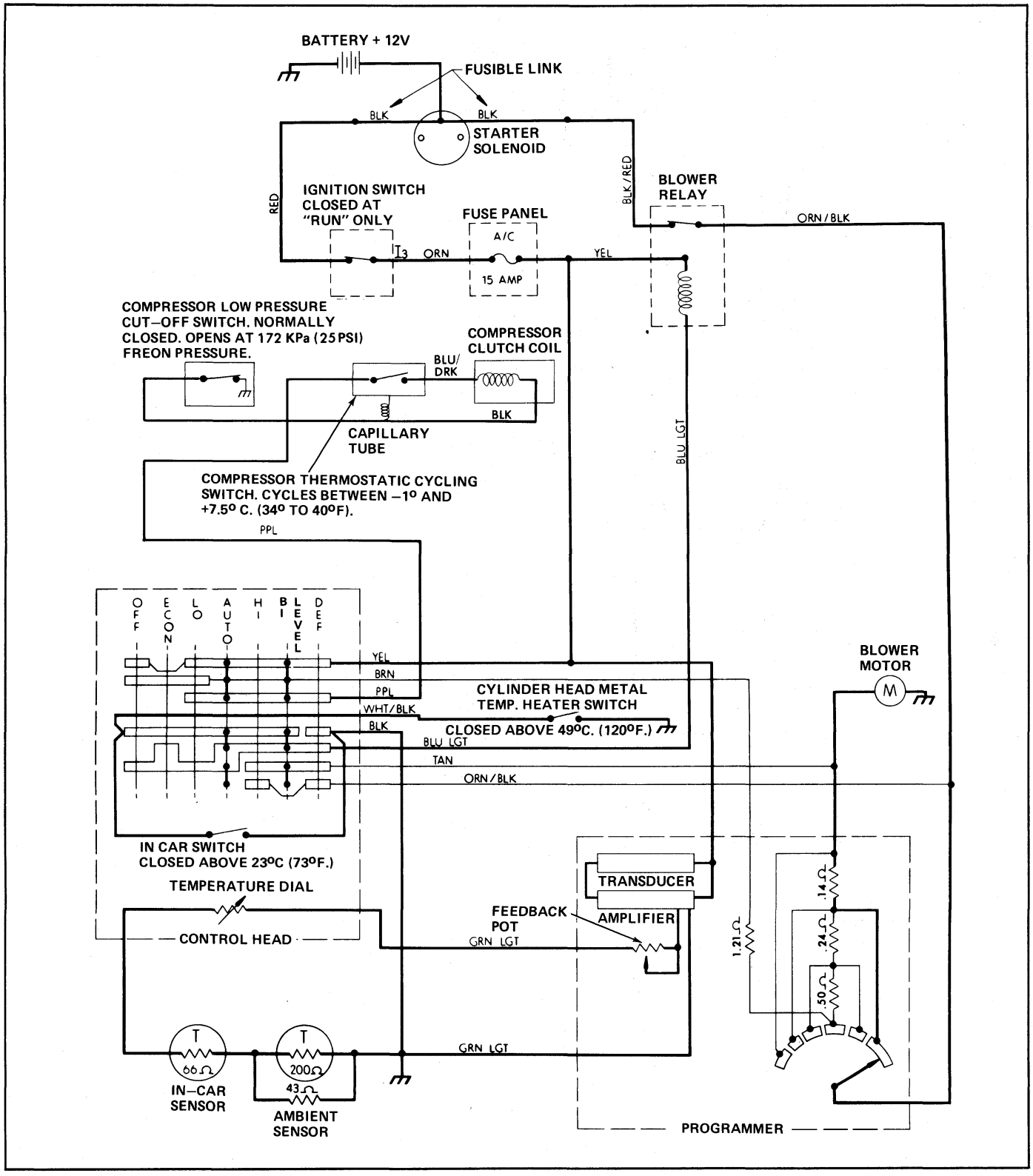


Fig. 1-205 Blower Operation at Auto and Bi-Level

Blower Operation at Auto (Fig. 1-205)

Current flows through the ignition switch, fuse block and relay coil to ground through either the engine temperature switch or the in-car switch. There is no grounding connection on the control head circuit board switch for blower current from the relay so that multiple blower speeds will delay in cold weather. Blower current flows through the fusible link and relay contacts to the center point of the wiper on the programmer and through one, two or three resistors, depending on the position of the programmer, to the blower motor, after 49°C (120°F) coolant temperature.

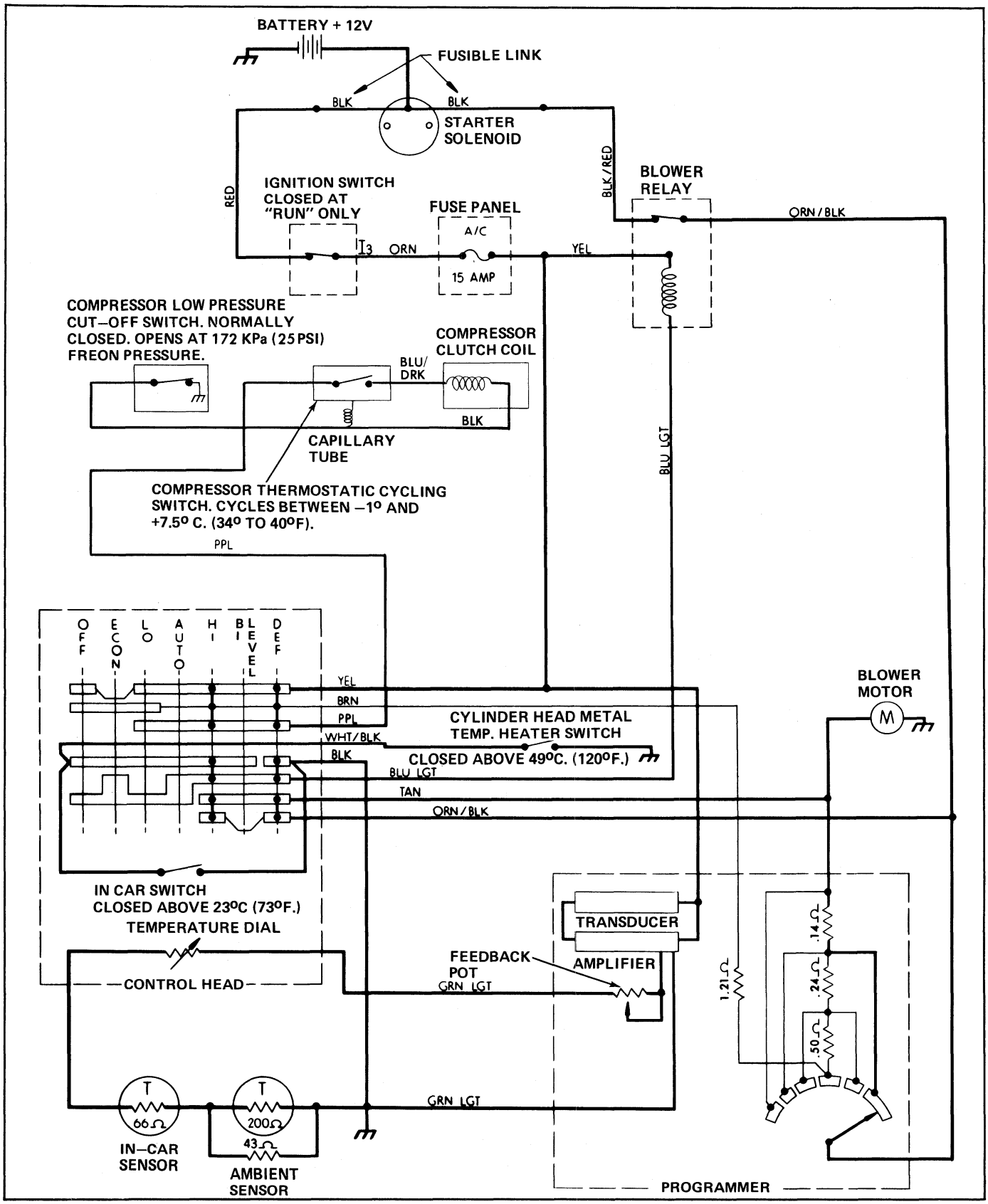


Fig. 1-206 Blower Operation at Hi and Def

Blower Operation at Hi (Fig. 1-206)

Current flow through the relay coil circuit is the same as at "Auto". Blower current, however, does not go through the programmer but is routed through two inter-connected pads on the control head directly to the blower motor. There is minimal resistance in the circuit so that the blower operates at a fixed high speed, with no programmer control over its operation.

Blower Operation at Bi-Level (Fig. 1-205)

Current flows through the ignition switch, fuse block and relay coil to ground through either the engine temperature switch or the in-car switch. There is no grounding connection on the control head circuit board switch for blower current from the relay so that multiple speeds will delay in cold weather. Blower current flows through the fusible link and relay contacts to the center point of the wiper on the programmer and through one, two or three resistors, depending on the position of the programmer, to the blower motor, after 49°C (120°F) coolant temp.

Blower Operation Def (Fig. 1-206)

The Relay Coil is grounded through two pads on the control head so that there is immediate turn-on even with a cold engine. Blower current flows to two inter-connected pads on the control head and to the blower. The blower operates at a fixed high speed.

Vacuum Circuits

Figure 1-227, shows the complete vacuum circuit including the internal connections at the programmer and control head valves. The "clocks" show which ports are vented and which are connected for all possible combinations of conditions.

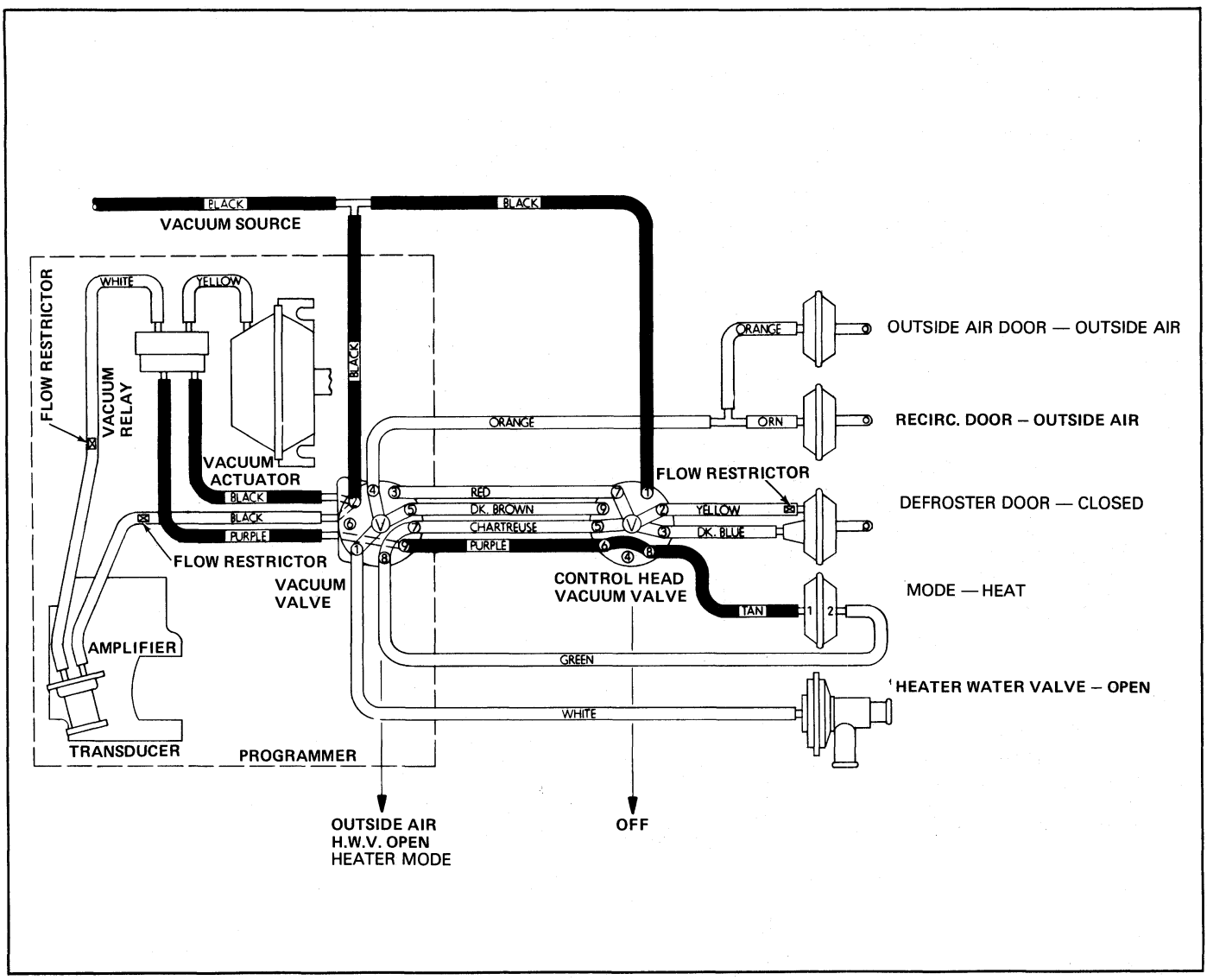


Fig. 1-207 Vacuum Circuit at Off

Vacuum Circuit at Off (Fig. 1-207)

When the control lever is in "Off" the control head vacuum valve is positioned as shown and vacuum is applied to the number one port of the mode door actuator. This places the mode door in the heater position resulting in air flow being directed to the heater outlets. Vacuum is not applied to any of the other actuators. Both the outside air and recirc doors are in the outside air position. Air from the passenger compartment is not being recirculated through the system. The defroster door is closed which augments air flow out of the heater. The hot water valve is open allowing water to flow through the heater core except when the control system is specifying maximum air conditioning where the valve is closed.

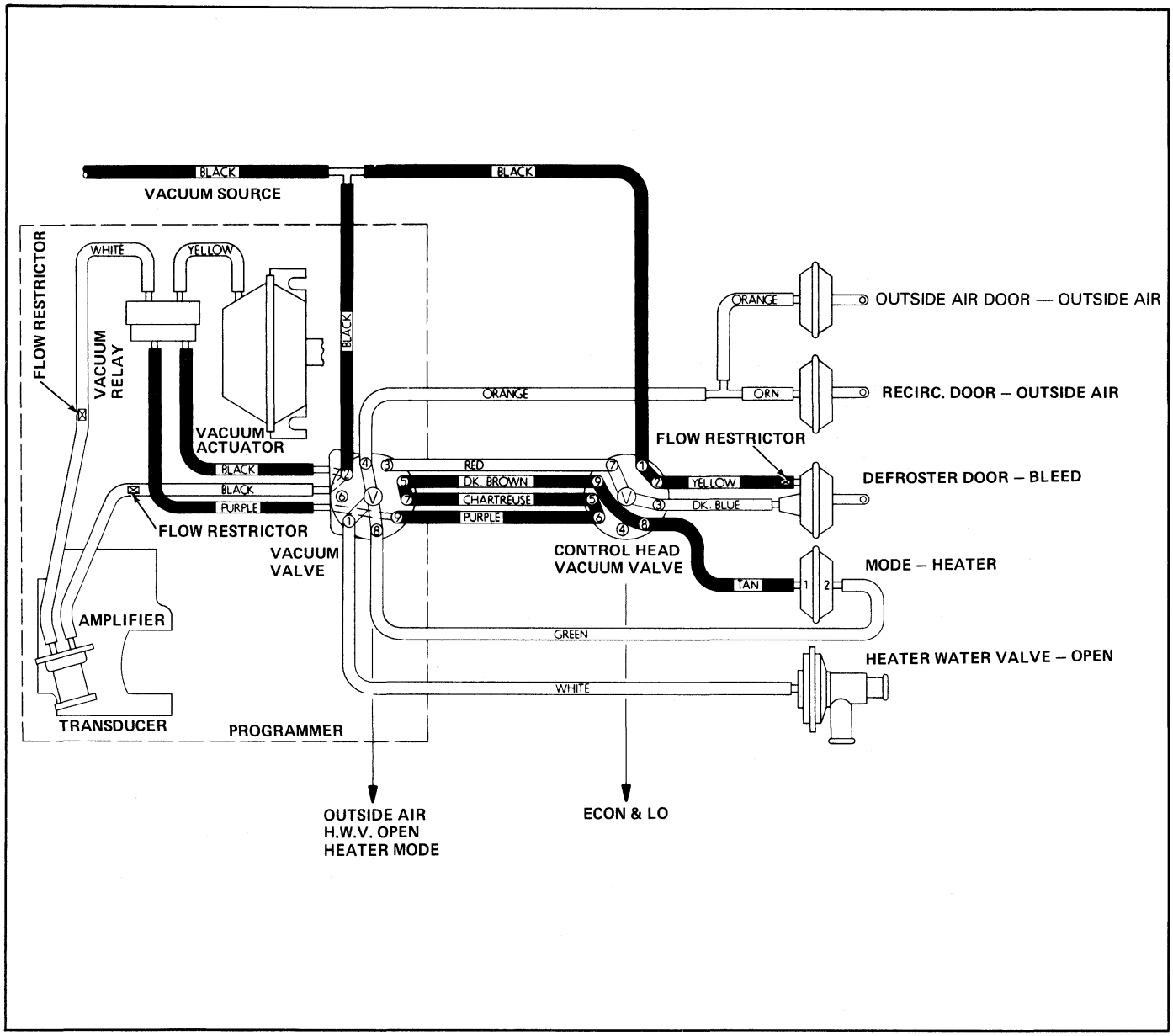


Fig. 1-208 Vacuum Circuit at "Economy and Lo" - Heater Mode

Vacuum Circuit at Economy and Lo - Heater and Air Conditioning Modes (Figs. 1-208 and 1-209)

When the control lever is in either the "Economy" or "Lo" position and the temperature control system is specifying the heater mode, the control head vacuum control valve is positioned as shown in Fig. 1-208. Vacuum is applied to the number one port on the mode door actuator which places the mode door in the heater position resulting in air being directed to the heater outlets. Both the outside air and recirc doors are in the outside air position. Air from the passenger compartment is not being recirculated through the system.

To provide a small "bleed" of air to the defroster outlet the defroster door is opened approximately 3/4 inch. This is accomplished by applying vacuum to the outer port of the two stage defroster actuator. The flow restrictor in the hose provides a delay of approximately 45 seconds in the operation of the door. Note that the defroster bleed port is connected to full engine vacuum, not checked vacuum. This is done so that the line will immediately return to atmospheric pressure when the engine is stopped causing the defroster door to close and seal quickly. These two features are used to prevent fogging of the windshield which sometimes can occur when the car is restarted.

The water valve is open allowing water to flow through the heater core.

When the control lever is in either the "Economy" or "Lo" position and the temperature control system is specifying the air conditioning mode, the control head vacuum control valve is positioned as shown in Fig. 1-209. System operation is the same as in the heater mode as described above except that vacuum is applied to the number two port of the mode door actuator which places the mode door in air conditioning position providing air flow from the air conditioning outlets. Also, the programmer valve directs vacuum to the water valve which closes preventing water flow through the heater core.

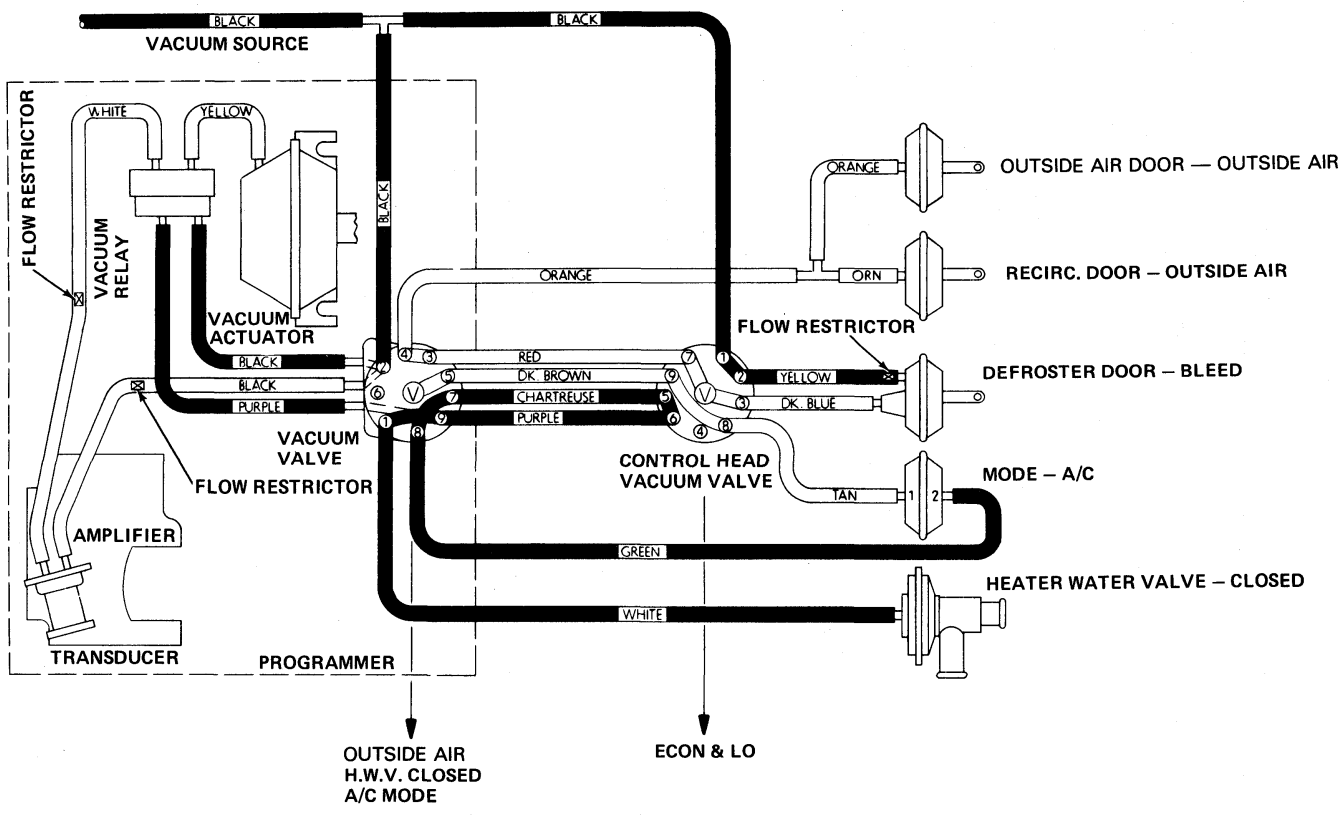


Fig. 1-209 Vacuum Circuit at Economy and Lo - A/C Mode

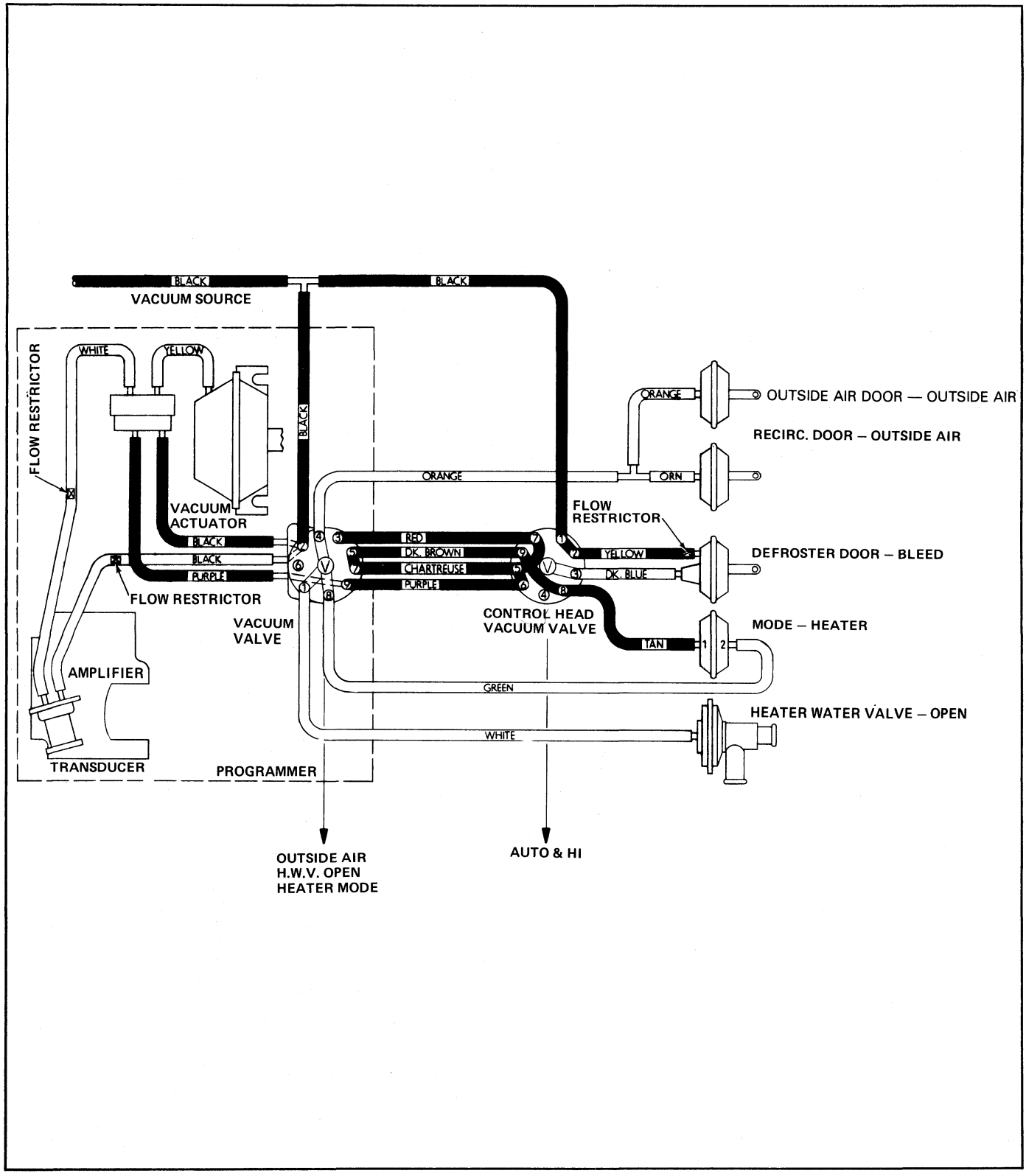


Fig. 1-210 Vacuum Circuit at Auto and Hi - Heater Mode

Vacuum Circuit at Auto and Hi - Heater Mode (Fig. 1-210)

When the control lever is in either the "Auto" or "Hi" position and the temperature control system is specifying the heater mode, the control head vacuum control valve is positioned as shown. Only slight differences exist between this vacuum circuit and the circuit for "Economy" and "Lo", Fig. 1-208. Door positions and air flow are unaffected. If exact porting needs to be analyzed, refer to Fig. 1-227.

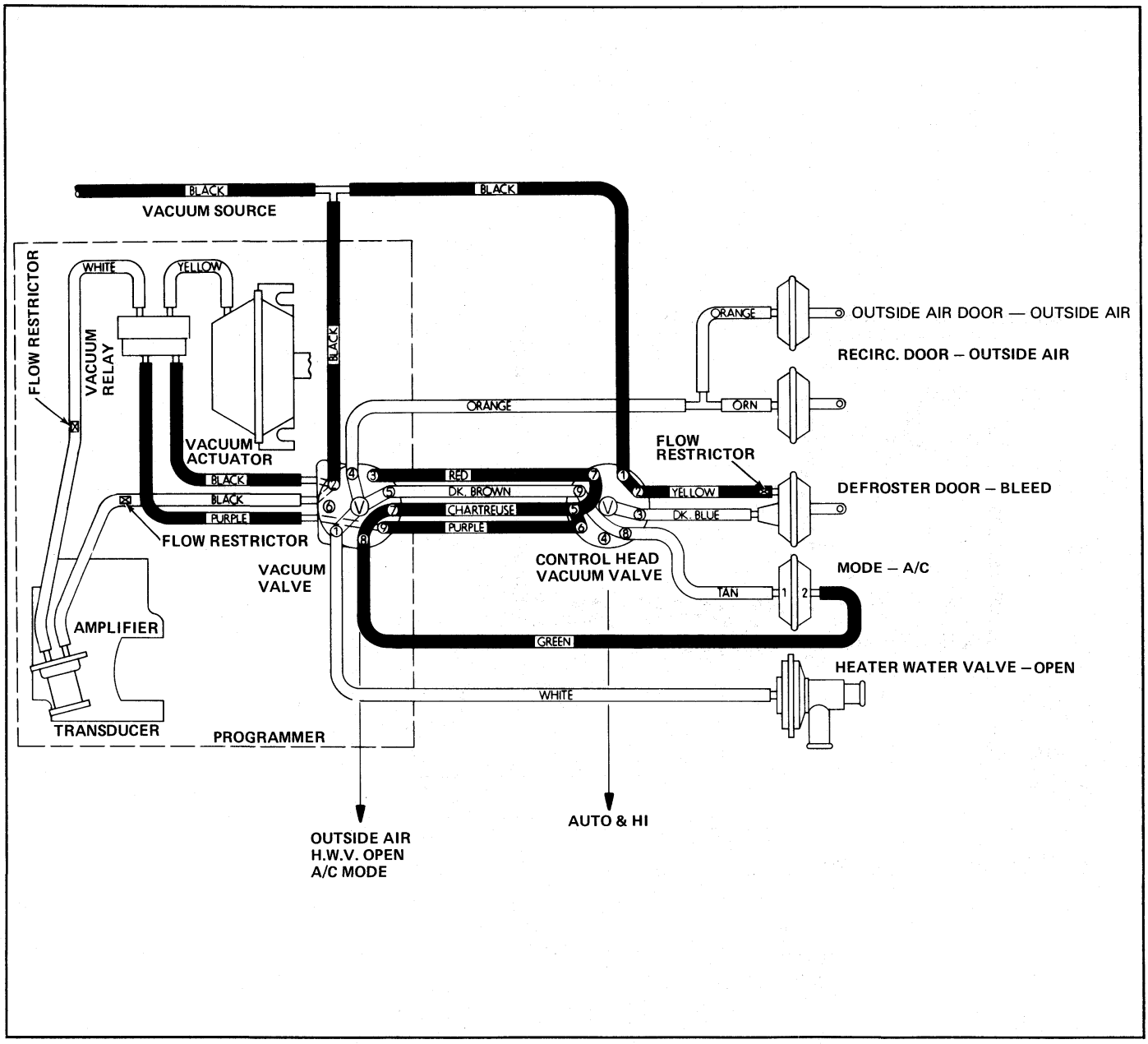


Fig. 1-211 Vacuum Circuit at Auto and Hi - A/C Mode

Vacuum Circuit at Auto and Hi - Air Conditioning and Maximum Air Conditioning Modes (Fig. 1-211 and 212)

When the control lever is in either the "Auto" or "Hi" position and the temperature control system is specifying the air conditioning mode, the control head vacuum control valve is positioned as shown in Fig. 1-211. Vacuum is applied to the number two port on the mode door actuator which places the mode door in the air conditioning position providing air flow from the air conditioning outlets. Both the outside air and recirc doors are in the outside air position. Air from the passenger compartment is not being recirculated through the system. Vacuum is applied to the outer port of the defroster actuator however there is no air flow out of the defroster outlets because the mode door is in the air conditioning position blocking flow to the defroster outlets. The water valve is open allowing water to flow through the heater core for any reheat that may be required.

Fig. 1-212 shows the programmer positioned for maximum A/C. In this position, the programmer valve provides vacuum to the recirc and outside air door actuators which position the outside air door to the recirc position for 20% outside air and moves the recirc door to a position where 80% of the air is drawn from the passenger compartment (recirculated). As the sensor string senses the passenger compartment temperature is cooling down, the programmer valve moves and vents the recirc actuators to again allow 100% outside air. If exact porting of this position needs to be analyzed, refer to Fig. 1-227.

The mode door and defroster door are positioned the same as described above under the air conditioning mode, Fig. 1-211. The water valve is closed preventing the flow of water through the heater core.

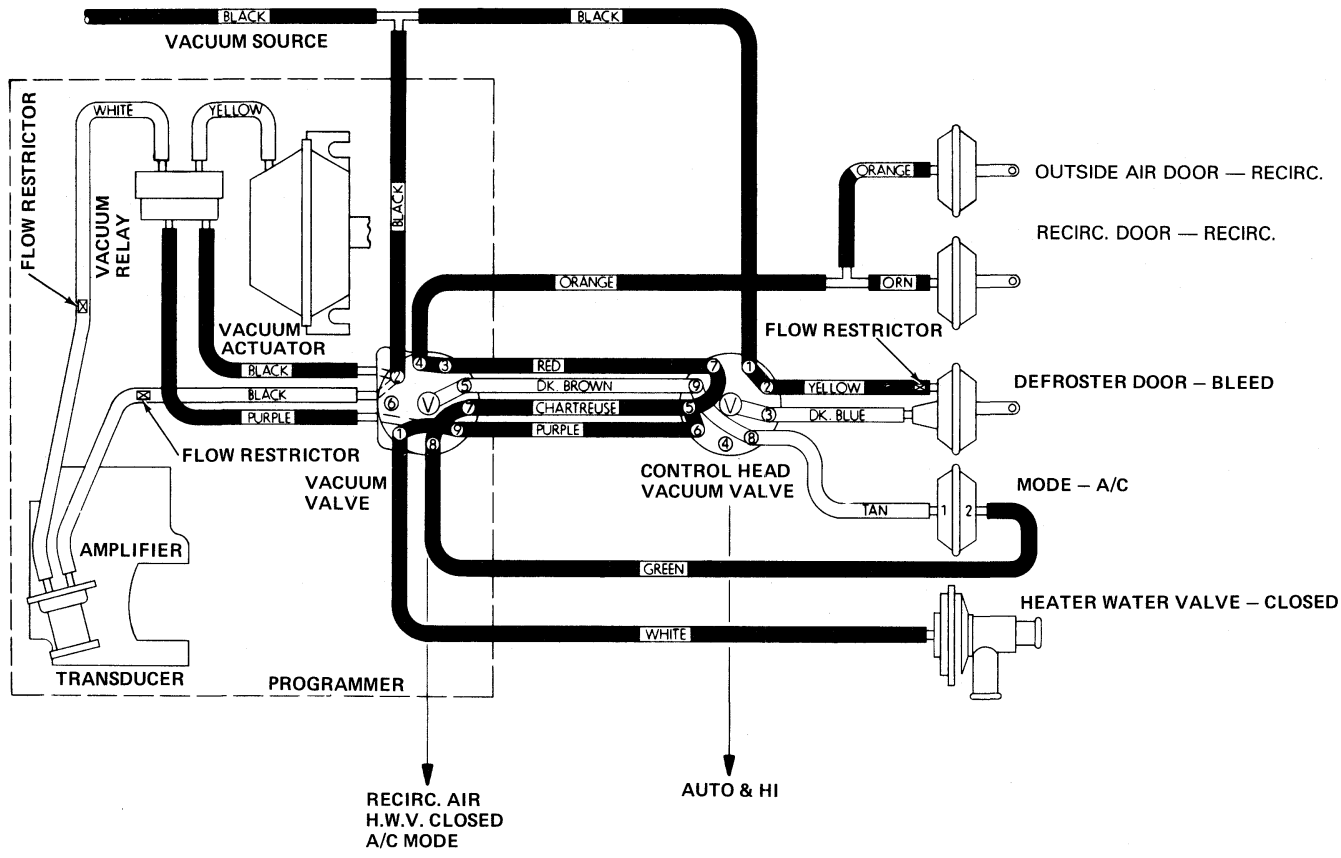


Fig. 1-212 Vacuum Circuit at Auto and Hi - Max. A/C Mode

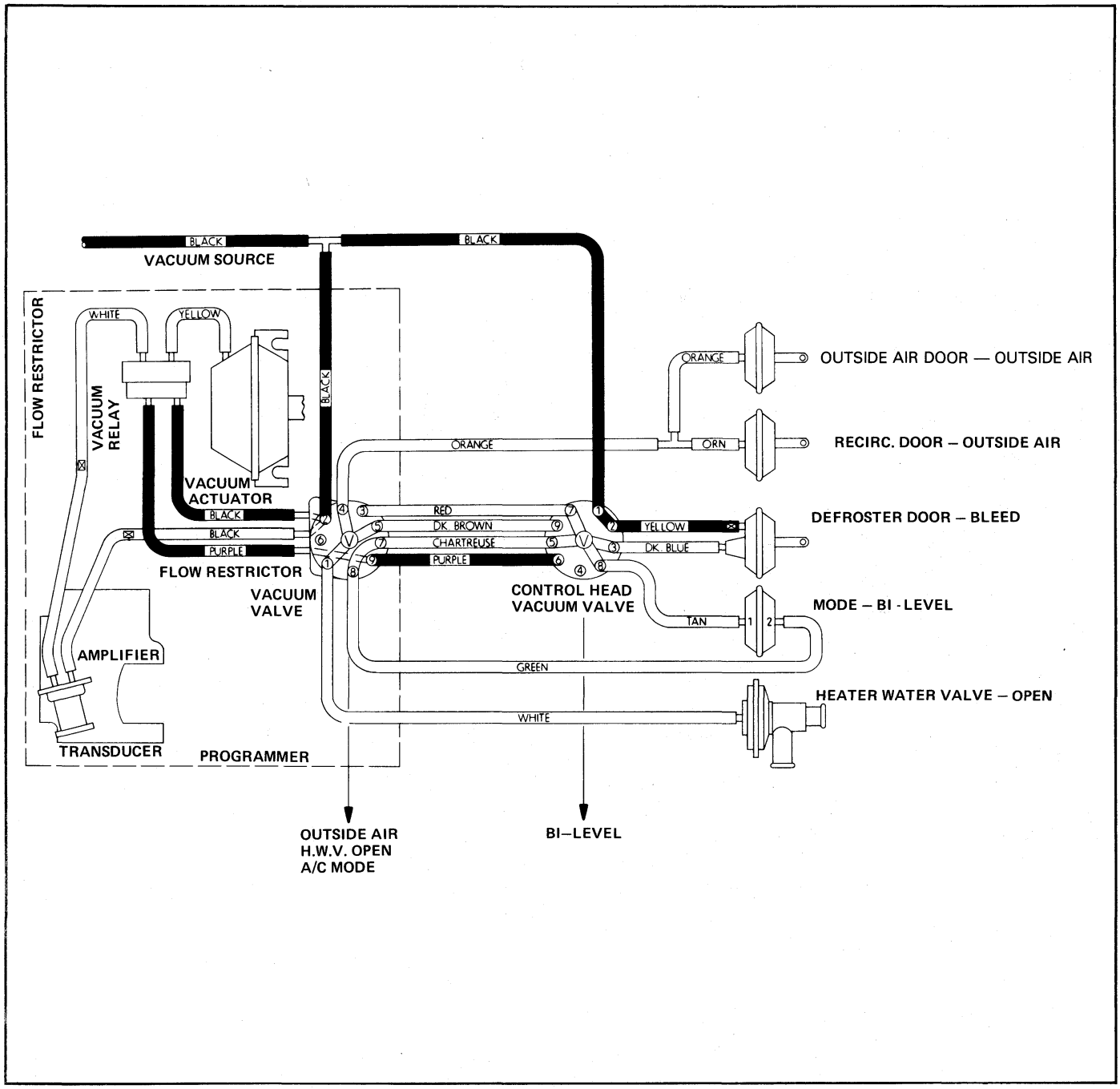


Fig. 1-213 Vacuum Circuit at Bi-Level - Air Conditioning Mode

Vacuum Circuit at Bi-Level - Air Conditioning Mode (Fig. 1-213)

When the control lever is in the "Bi-Level" position and the temperature control system is specifying the air conditioning mode, the control head vacuum control valve is positioned as shown. Vacuum is not being applied to the mode door actuator. This places the door in the bi-level position which allows air to flow out of both the air conditioning outlets as well as the heater outlets. Both the outside air and recirc doors are in the outside air position. Air from the passenger compartment is not being recirculated.

To provide a small "bleed" of air to the defroster outlet the defroster door is opened approximately 3/4 inch. This is accomplished by applying vacuum to the outer port of the two-stage defroster actuator. The flow restrictor in the hose provides a delay of approximately 45 seconds in the operation of the door. Note that the defroster bleed port is connected to full engine vacuum, not checked vacuum. This is done so that the line will immediately return to atmospheric pressure when the engine is stopped causing the defroster door to close and seal quickly. These two features are used to prevent fogging of the windshield which sometimes can occur when the car is restarted.

The water valve is open allowing water to flow through the heater core for any reheat that may be required.

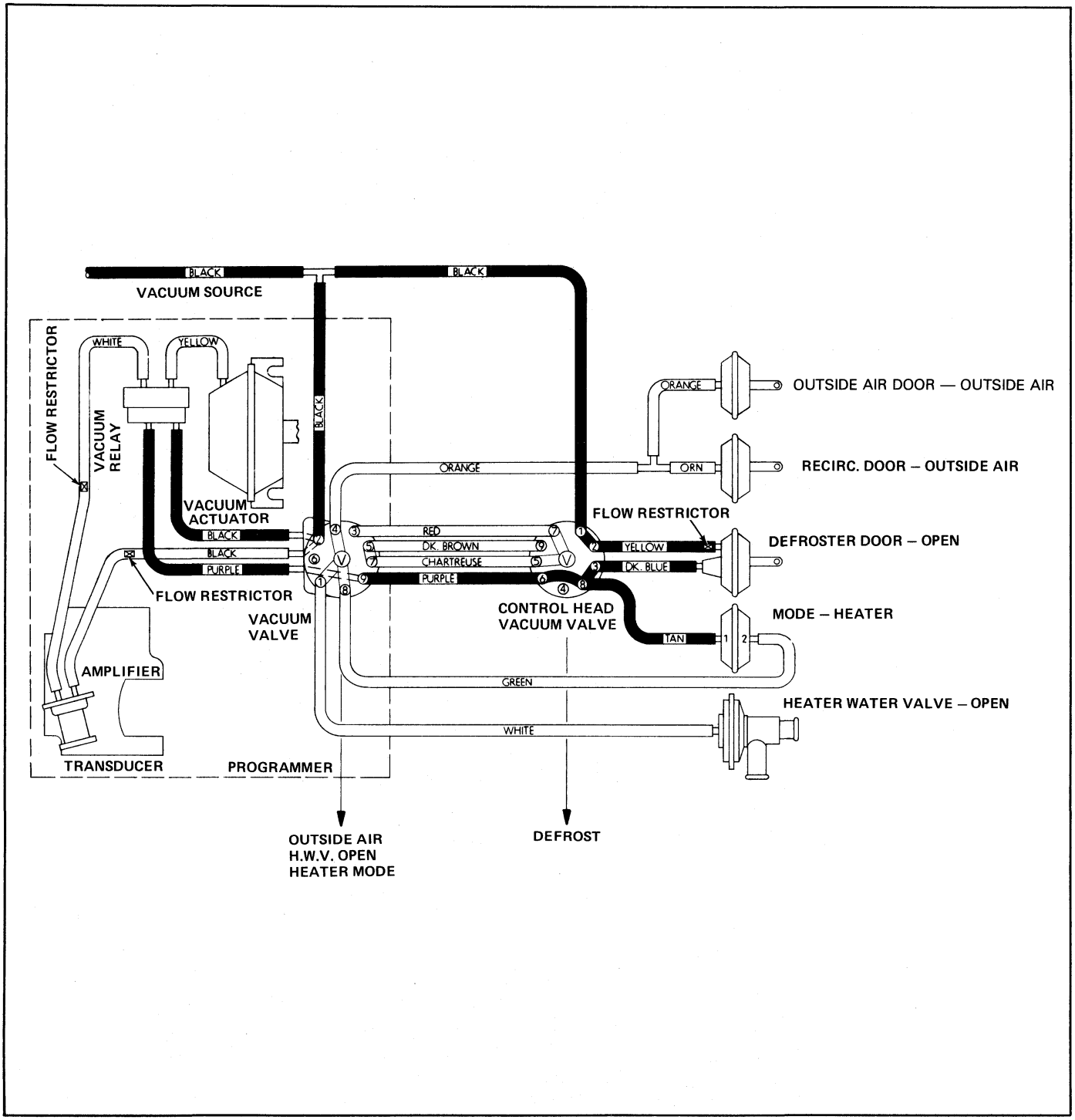


Fig. 1-214 Vacuum Circuit at Defrost - Heater Mode

Vacuum Circuit at Defrost - Heater Mode (Fig. 1-214)

When the control lever is in the "Defrost" position and the temperature control system is specifying the heater mode, the control head vacuum valve is positioned as shown. Vacuum is applied to the number one port of the mode door actuator which places the mode door in the heater position directing the flow of air towards the heater outlets. However, since vacuum is applied to both the outer and center ports of the defroster door actuator, the defroster door is in the full open position and very little heater air flow results. Most all of the air flow is from the defroster outlets directly to the windshield. Both the outside air and recirc doors are in the outside air position. Air from the passenger compartment is not being recirculated through the system. The water valve is open allowing water to flow through the heater core.

DIAGNOSIS

How to Isolate the Problem

To diagnose an air conditioner problem in the shortest time and with the least effort, it is essential to follow a logical service procedure. Time spent in conducting a system functional performance test and analyzing the defect in order to isolate it to a specific control function area will be repaid in reduced repair time. A recommended diagnosis procedure follows:

STEP 1 - Attempt to get an accurate, detailed description of the owner's complaint in writing on the repair order. "A/C inop." or "erratic operation" do not provide much information to the repairman.

STEP 2 - To confirm the system defect make a brief check of system operation by sitting in the car and operating the controls, with the engine warmed up and running at 1000 RPM or higher, in the following sequence:

During these tests, be sure to note the following:

CONTROL SETTING	SYSTEM SHOULD OPERATE AS FOLLOWS:
"DEF" DIAL @ 85°F	Air should be delivered out of defroster outlets at a fixed high blower speed. Some floor bleed out heater.
"BI-LEVEL" DIAL @ 75°F	Air should be delivered from *both* the A/C and heater outlets at a reduced blower speed. Only a small portion of air will come out the defroster outlet.
"HI" DIAL @ 65°F	Air should be delivered out the A/C outlets at a fixed high blower speed and cool to cold temperature. The recirculating air door should open (blower noise increases).
"AUTO" DIAL @ 85°F	Blower speeds should drop (Hi - M_3 - M_2 - M_1 - etc.). Recirc air door should close (noise level will drop). Discharge air temperature should increase. Depending on the temperature in the work area, the air delivery mode should change from the A/C outlets to the heater outlets.
"LO" DIAL @ 85°F	Air should be delivered at a fixed low blower speed with immediate turn on regardless of engine coolant temperature.
"ECONOMY" DIAL @ 65°F	Blower speeds should increase (M_1 - M_2 - M_3 - etc.) Depending on the temperature in the work area, the air delivery mode should change from the heater outlets to both heater and A/C outlets or the A/C outlets only. The A/C compressor should not operate.
"OFF" DIAL @ 65°F	Air should be discharged out the heater outlet at a fixed low blower speed. No A/C compressor operation. Blower will turn on immediately regardless of engine coolant temperature.

a. Check to assure that air delivery is *not* coming from both the A/C and heater outlets when only one mode is indicated. A split air delivery is indicative of a vacuum leak.

b. Note whether program events (air delivery mode change, blower speed change, recirc air, etc.) occur without change in discharge air temperature. This would indicate the programmer is operating without moving the temperature air door. Check the air mix door link to programmer connection.

c. If neither the program events nor the discharge air temperature change, a faulty vacuum or electrical signal to the programmer or a programmer malfunction is indicated.

d. Failure of a specific vacuum operated door function could indicate a vacuum disconnect of the vacuum diaphragm at that door. See illustrations for locations of the different function doors.

STEP 3 - Perform the easiest checks first! A simple, visual inspection of the easily accessible underhood and instrument panel electrical and vacuum connections will, in many instances, reveal the defect on the spot. The areas indicated in Fig. 1-215 can be inspected without removing any car parts:

STEP 4 - Based on information gained during the functional test performed in step 2, try to relate the problem to one of the following areas:

1. Temperature Control Problems
2. Blower Control Problems
3. Auxiliary Vacuum Problems
4. Refrigeration System Problems

Once a problem has been isolated to one of the areas listed above, refer to that diagnosis section on the following pages. Diagnosis charts and control circuit illustrations are provided. *It is of special importance to be familiar with the general description of the major sections of the system as presented beginning on page 1-158.*

STEP 5 - After the problem has been properly diagnosed and the repair made, it is important to run through the brief check listed in Step 2 in order to assure that the system is now performing correctly.

Temperature Control Problem Diagnosis

The temperature control circuit consists of the components shown in Fig. 1-216. The primary function of the temperature control circuit is to determine the correct temperature of the air to be discharged into the passenger compartment and to set the air mix door position to accomplish that function. The signal used for this purpose (vacuum to position the programmer vacuum motor) is also used in the blower speed control circuit, and the auxiliary vacuum function circuit. Those uses may be disregarded when dealing with problems which relate only to the temperature control circuit.

Examples of temperature control problems are: "System operates at maximum air conditioning (no heat) or only at maximum heating (no air conditioning)", "Temperature dial does not provide comfort", "Poor heating or poor cooling" Blower cycling and mode cycling are also caused by a malfunction in the temperature control circuit. For a brief, detailed explanation of how the temperature control circuit operates, refer to the operation section on page 1-166.

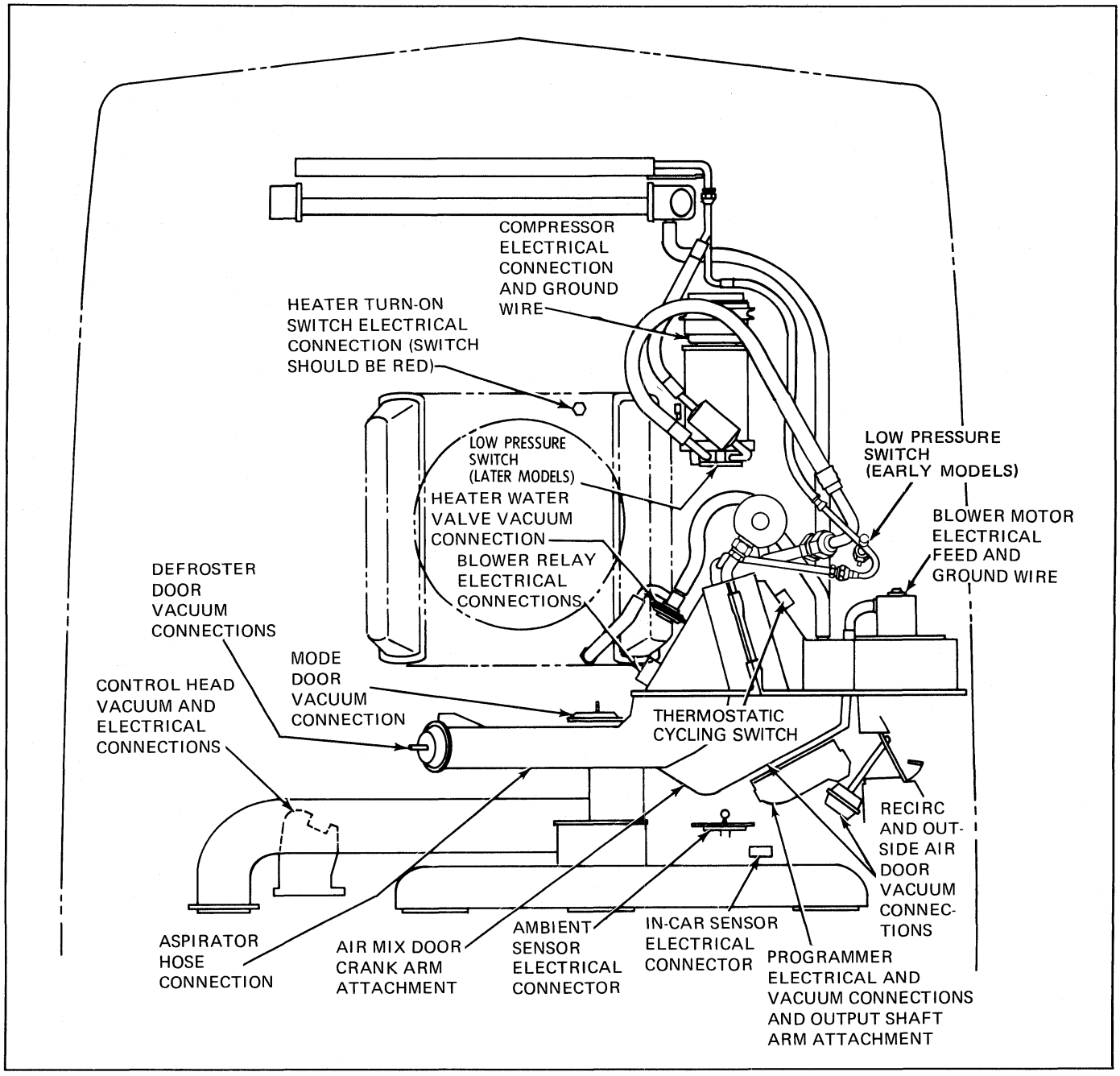


Fig. 1-215 A/C Diagnosis Areas

It is important to separate temperature control circuit problems from refrigeration or heater circuit problems. If the complaint is "poor" or "no" heating or cooling and the programmer moves to both extremes of travel with the air mix door and program functions known to follow, the problem probably lies in the refrigerant or heater water circuits. Refer to that section on page 1-197.

Many temperature control problems result from poor electrical or vacuum line connections. The following relationships may aid diagnosis:

- A *disconnected sensor or temperature dial* interrupts the elctrical signal and drives the programmer to maximum heating.
- A *poor sensor connection* adds resistance to the sensor string driving the system hotter.
- An *open amplifier power feed* eliminates the output signal and drives the programmer to maximum A/C.
- A *disconnected vacuum hose* supplying the vacuum checking relay actuating nipple will lock the relay in an intermediate position.
- A *disconnected vacuum hose* in the transducer - programmer vacuum motor line will drive the system to maximum cooling.

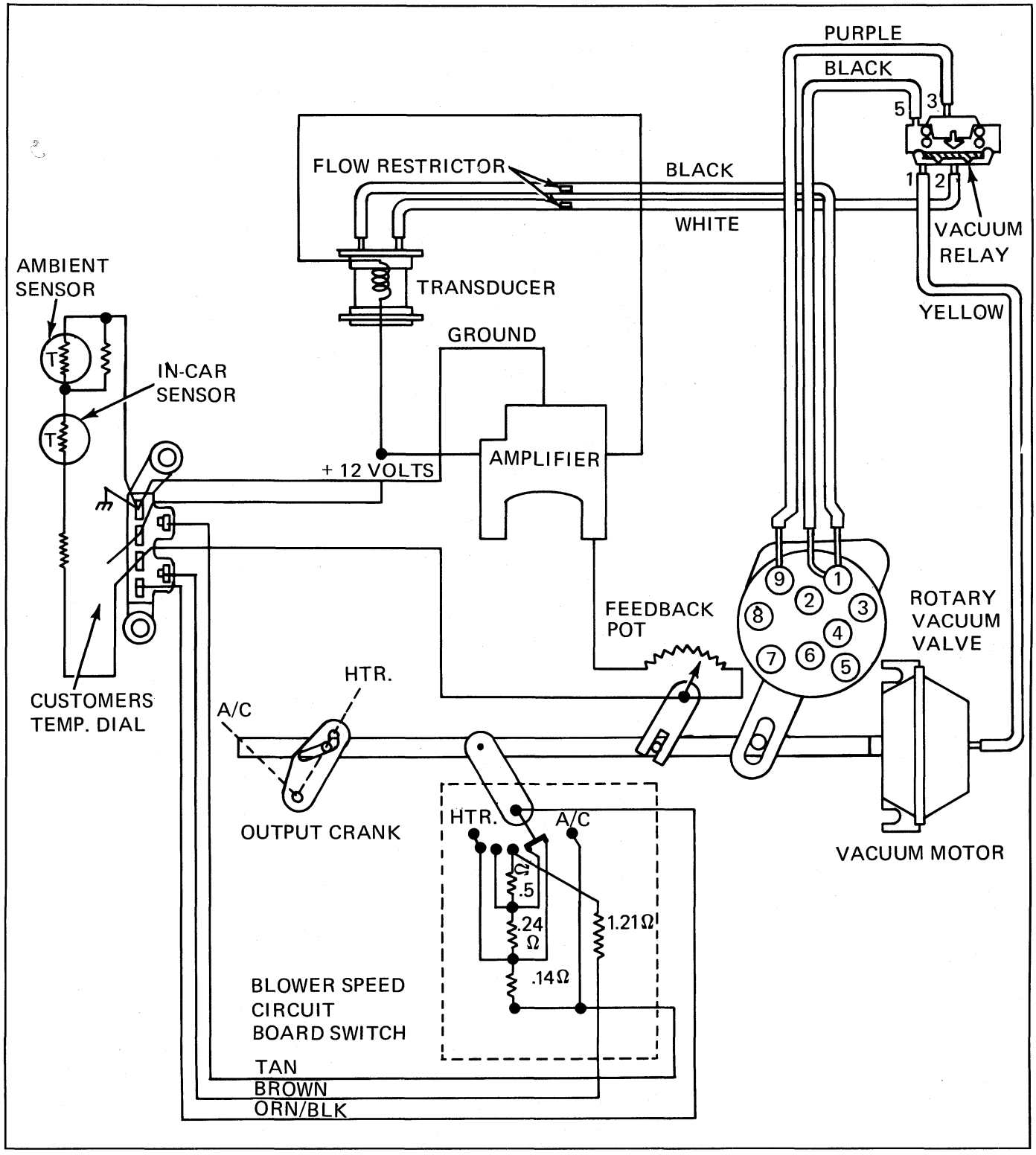


Fig. 1-216 Temperature Control Circuit

• A *leak* in the auxiliary vacuum circuit may reduce the transducer vacuum supply level below control requirements, causing an "off-calibration" or "poor heating" type of complaint.

• A *loss* of supply vacuum usually results in cold air flow in the bi-level mode.

Diagnosis of most of the problems encountered in the temperature control circuit will be greatly aided by use of tester, J-23678. However, the following charts represent specific problem areas which should be checked before connecting tester.

SYSTEM OPERATES ONLY AT MAXIMUM AIR CONDITIONING

This can be a vacuum or electrical problem. The problem can be separated into problems of erroneous signal external to the programmer or internal programmer malfunctions. With the system operating, disconnect the ambient sensor electrical connector, and observe the programmer movement through the slot at the bottom of the programmer cover. If the programmer remains in the maximum air conditioner position, remove the multiple vacuum connector and check for supply vacuum at the black hose. If no (or low) vacuum supply, check for leaks or disconnects in vacuum hose assembly. If vacuum supply is okay, programmer is malfunctioning. Remove programmer cover and inspect for obvious disconnects. If no programmer defect is obvious, use tester J-23678 and adapter harness J-24774 to analyze and correct problem.

If the programmer moved to the maximum heater position when the electrical connector was removed, the defect is *external* to the programmer. Check the following items:

1. Shorted in-car sensor or ambient sensor.
2. Shorted or miscalibrated temperature dial.
3. A short in the sensor circuit of the wiring harness.

SYSTEM OPERATES ONLY AT MAXIMUM HEATING

This is usually an electrical problem either internal or external to the programmer.

1. Disconnected or defective in-car sensor.
2. Disconnected or defective ambient sensor.
3. Open circuit or backed-out terminal in the wiring harness sensor string circuit.
4. Disconnected or defective temperature dial.
5. Disconnect or open in ground circuit (black wire) between control head and programmer.
6. Defect within programmer assembly.

Use Tester, J-23678 and adapter harness J-24774, to analyze and correct the above problems.

SYSTEM FLUCTUATES BLOWER SPEEDS and/or MODE SHIFTS DURING ACCELERATION

1. Defective vacuum checking relay (inside programmer).
2. Leaking programmer vacuum motor.

It is possible to distinguish between the two above items. With the system operating and the programmer cover removed, reinstall the vacuum and electrical connectors, and perform the following steps:

a. Remove the programmer electrical connector to force the programmer to maximum heating (full vacuum).

b. Remove the vacuum hose assembly connector. The programmer should remain in the maximum heat position. If it does not, repeat Step a, and then pinch the programmer vacuum motor supply hose with a pair of needle-nose pliers. If the programmer still moves, the vacuum motor is leaking. If the programmer does not move, the checking relay is defective.

c. If the original complaint was mode shifts without blower change, the check valve portion of the checking relay is probably defective.

DIAL SETTING DOES NOT PROVIDE COMFORT

The best approach to solving problems of the "off calibration" variety, is to use Tester, J-23678 and adapter harness J-24774 to check and reset calibration on *all* of the following parts:

1. The temperature dial.
2. The feedback potentiometer in the programmer.
3. The temperature door link adjustment.
4. The sensor string.

(NOTE: Check to assure that in-car sensor aspirator hose is attached at both the in-car sensor and the aspirator and not kinked in routing.)

Refer to the instruction sheet included with the Tester or component adjustments on page 1-197 for procedures on checking and calibrating the above items.

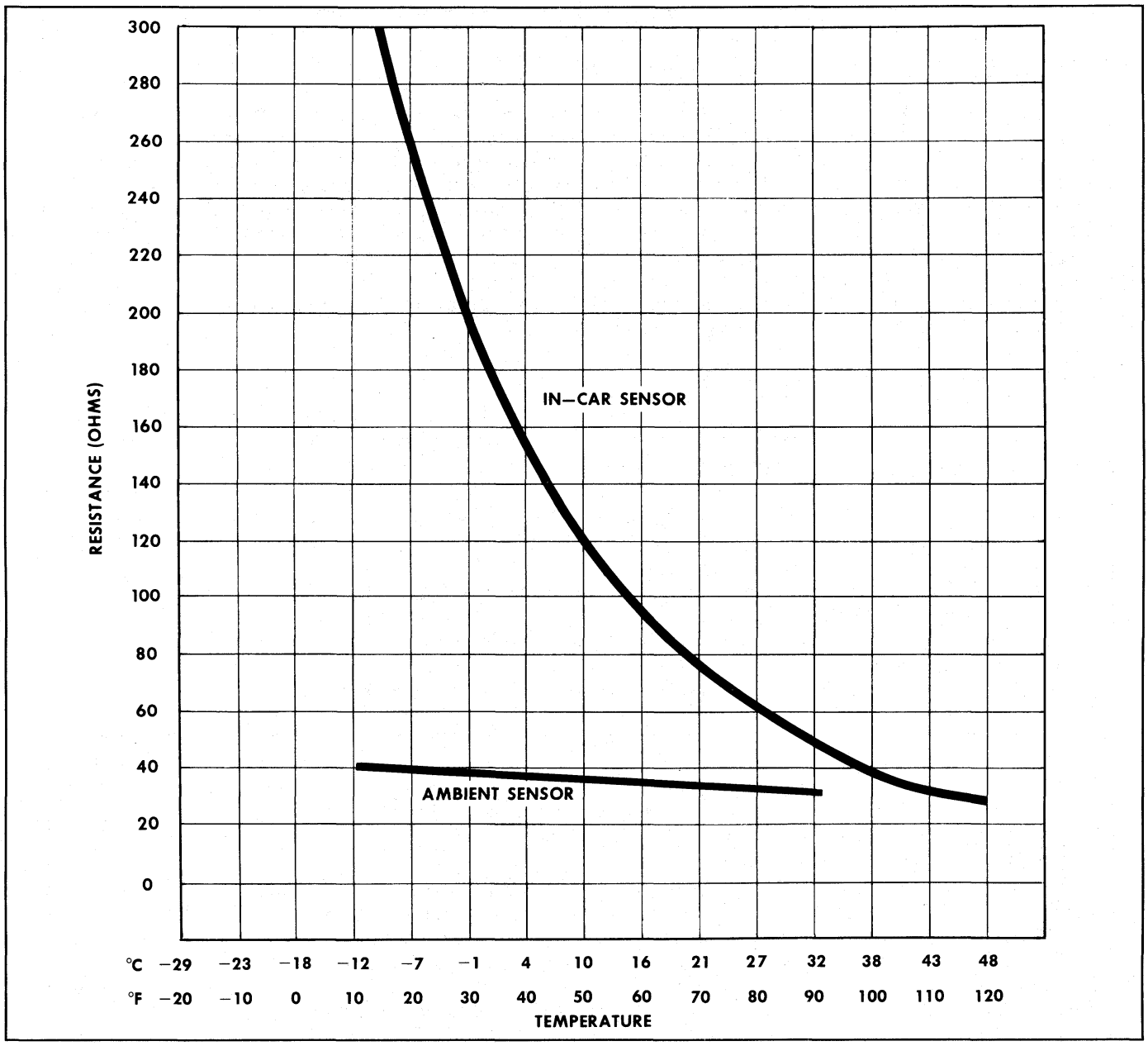


Fig. 1-217 Resistance Graph of Sensors

BLOWER CYCLING AND MODE CYCLING

Erratic system performance may be caused by poor electrical connections, "cold" solder joints, or a defective sensor or amplifier. The problem may be intermittent and occur from the shock of going over road bumps. Such a problem may be accompanied by a clicking or buzzing of the transducer. To isolate the problem area, "rap" the areas around the sensors, control head, and programmer, and shake the wires attached to those areas. Listen for buzzing or clicking of the transducer. If the problem cannot be pinpointed by transducer buzzing, remove the programmer cover, (reinstall the vacuum and electrical connectors) and attach a *good* voltmeter to the transducer output terminal (grey wire). Repeat the rapping and wire shaking, and observe the voltmeter for violent, erratic voltage fluctuations. Replacement of parts or resoldering of terminals may be necessary. The sensors may be individually checked to the sensor resistance curve, Fig. 217.

(NOTE: Some system cycling may also occur and is normal if the temperature dial is moved in large increments. Instruct owner of this, and explain system operation.)

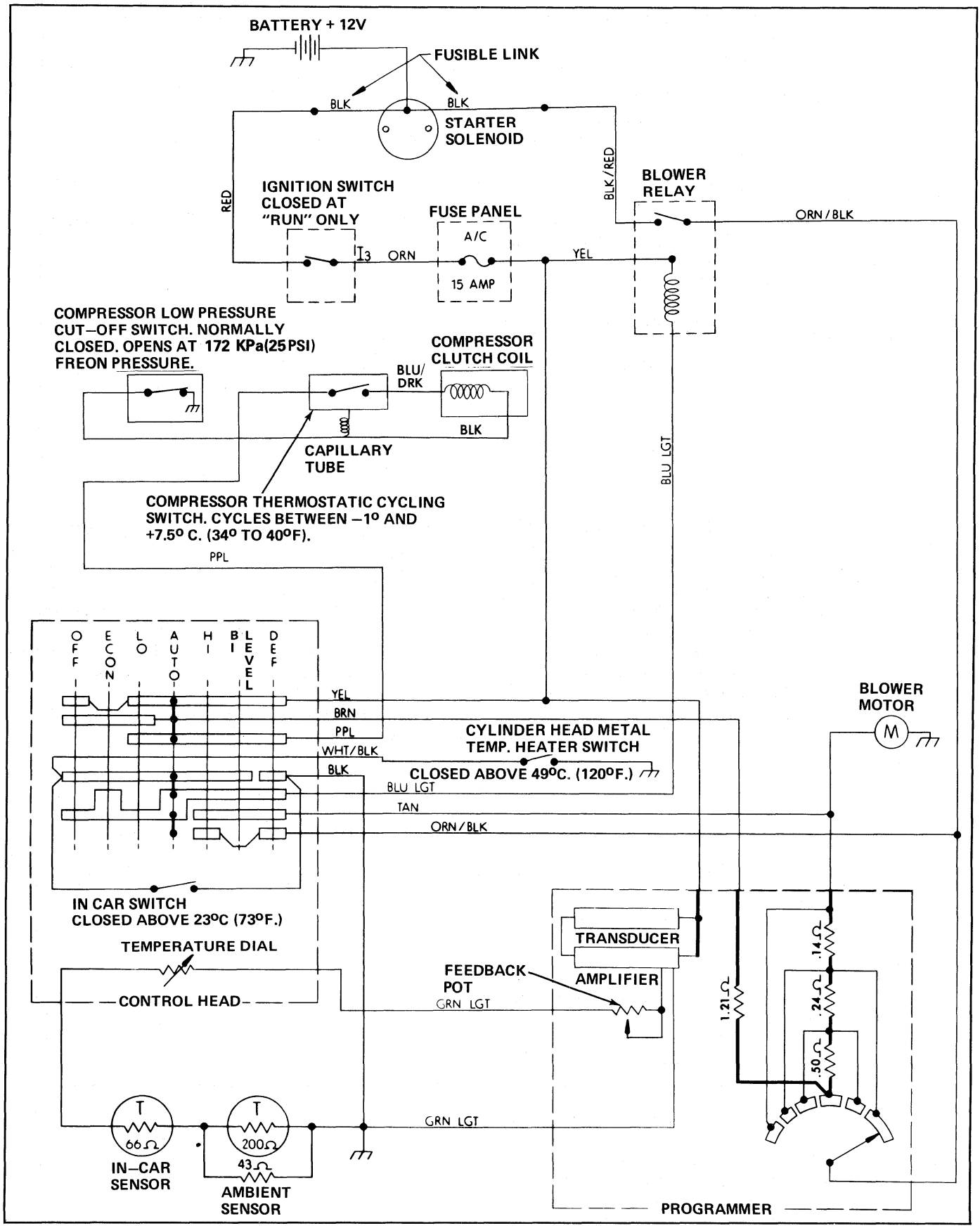


Fig. 1-218 Blower Control Circuit

INSUFFICIENT HEATING OR COOLING

This problem may be caused by a control system malfunction or by the refrigerant or heater systems. Determine first which area to pursue:

1. Check for compressor clutch actuation (no cooling). If not operating, refer to Note 6 for diagnosis of low refrigerant detection system.
2. Check for cold suction line (no cooling).
3. Check engine coolant level (no heating).
4. Check temperature of heater hoses by feel with engine hot to see if hot water is entering the heater core (no heating).
5. Check for proper air flow at the "Auto" and "Hi" lever settings. (Improper air flow may be a blower relay problem, a blocked air passage, or a disconnected air hose.)

If a refrigeration problem exists, refer to the refrigeration diagnosis section on page 1-197. If the problem appears to be caused by the temperature control system, locate problem area using Tester, J-23678,or as specified elsewhere in this section. Also check air mix door link adjustments.

BLOWER SPEEDS AND MODE SHIFT OCCURS WITHOUT TEMPERATURE CHANGE

Check connection of air mix door link to programmer shaft and to air door crankarm.

Blower Control Circuit Problem Diagnosis

The components and electrical circuits that make up the blower control circuit are shown in Fig. 1-218. Blower control can be divided into two separate categories, blower turn-on and blower speed control. Blower turn-on is accomplished when a ground path is completed for the blower relay coil. Relay coil grounds are completed by (a) the heater turn-on switch which provides dealy for heater water warm-up in winter operation, (b) the in-car switch which provides immediate turn-on in summer operation, or (c) manual override in the "Vent" and "Def" settings. Blower speed control is accomplished by circuit board lever connections in the "Off" and "Lo" positions by selective use of the resistors on the blower circuit board in the "Auto", "Economy" or "Bi-Level" lever settings, or by a high blower override circuit in the "Hi" and "Def" lever positions. It should be noted that the system air doors are always positioned to allow delivery of air into the passenger compartment. Particulars of the blower control circuit are explained in more detail beginning on page 1-175. Problem descriptions and probably causes are listed in the following diagnosis chart:

SYSTEM OPERATES ONLY AT LOW BLOWER

1. Electrical disconnect at blower relay.
2. Failed blower relay.
3. Backed-out terminal or poor connection at programmer, or at control head. Trace blower circuit using electrical wiring diagram, Fig. 1-218.
4. Open in blower circuit wiring.

Refer to wiring diagram, Fig. 1-218.

NO BLOWER OPERATION IN ANY LEVER SETTING

1. Electrical disconnect at blower motor or at radio capacitor in series with blower feed.
2. Blown or defective 15 amp. A/C-heater fuse.
3. Stalled blower motor.
4. Open circuit in wiring harness to blower motor.

NO BLOWER IN OFF OR LO SETTINGS

1. Open low speed resistor on programmer.
2. Backed-out terminal or poor connection at programmer.
3. Open in low blower circuit wiring. Refer to wiring diagram, Fig. 1-218.

OPERATES AT LOW BLOWER ONLY EXCEPT IN "HI" AND "DEF"

1. Defect in programmer wiper contacts or board.
2. Backed-out terminal or disconnect at programmer electrical connector.
3. Open in programmer internal wiring.

BLOWER OPERATION ONLY IN "HI" OR "DEF"

1. Electrical disconnect at programmer (system will also operate only at maximum heat).

BLOWER SPEED VARIES IN "HI" AND "DEF"

1. Defective wipers or board in control head circuit board switch.
2. Open in control head wiring harness.
3. Open in by-pass circuit in wiring harness (refer to electrical circuit diagram, Fig. 1-228).

BLOWER OPERATES WITH IGNITION OFF

1. Defective blower relay (closed contacts).

BLOWER SPEEDS SKIPPED IN "AUTO" SETTING

1. Open resistor on programmer blower circuit board.

NO HEATER TURN-ON IN COLD WEATHER EXCEPT IN "DEF", "OFF" AND "LO".

1. Electrical disconnect at heater turn-on switch (located at front of intake manifold).
2. Defective heater turn-on switch (will not close). Check by grounding switch feed wire.
3. If problem persists, refer to electrical circuit diagrams for wiring discontinuity.

NOTE: If problem does *not* occur in shop, it is probable that the system is turned on by the in-car sensor. Disconnect control head electrical connectors to disarm the in-car switch. If the blower turns off (with the engine warmed up), ground the heater turn-on switch feed wire. If the blower now turns on (in low blower speed), the heater switch is probably defective.

IMMEDIATE HEATER TURN-ON IN COLD WEATHER

1. Defective (closed) heater turn-on switch (remove and check cold).
2. Defective (closed) in-car switch.
3. If problem persists, refer to electrical circuit diagram, and trace wiring continuity.

A/C DELAYED IN HOT WEATHER UNTIL ENGINE WARMS UP (UNLESS CONTROL LEVER IS IN "VENT" OR "DEF")

1. Defective (open in-car switch).
2. Open in control head wiring harness (in-car switch circuit).
3. If problem persists, check wiring continuity in the in-car switch circuit. Refer to the wiring diagram, Fig. 1-218.

Auxiliary Vacuum Problem Diagnosis

Auxiliary vacuum functions are defined as those vacuum circuits in the automatic temperature control system which do not affect the temperature of discharge air. Specifically that would include all vacuum functions except the transducer, relay portion of the vacuum checking relay, and the programmer vacuum motor. Included in this section is one auxiliary electrical circuit, and the compressor actuation circuit. A list of the auxiliary circuits is as follows:

1. A/C mode door vacuum circuit.
2. Heater mode door vacuum circuit.
3. Defroster bleed vacuum circuit.
4. Defroster door vacuum circuit.
5. Recirc and outside air door vacuum circuit.
6. Heater water valve vacuum circuit.
7. Auxiliary vacuum circuit check valve.
8. Compressor electrical circuit.

Refer to the controls portion beginning on page 1-159 for a brief explanation of each function and separate circuit diagrams.

Because of the relative simplicity of each of the auxiliary vacuum circuits, the best diagnostic aid will be a clear understanding of the type of problem or complaint which would result from a malfunction in any of the individual circuits. Once the problem has been isolated to a specific circuit, diagnosis will generally consist of checking vacuum connections at one or two points. The following chart presents the types of problems most likely to be encountered in each of the auxiliary circuits.

It should be noted that because of the interrelationship of the vacuum circuits, a leak in one circuit may reduce the vacuum supply to another circuit sufficiently to cause a malfunction of the second circuit. For example, a water valve vacuum hose disconnected may cause malfunction of the mode door circuit.

A/C AND HEATER MODE DOOR ACTUATION PROBLEMS

The most likely malfunction would be bi-level air delivery only. Vacuum is required to get either air conditioner or heater mode. *Check the hose connections at the mode door vacuum actuator.*

DEFROSTER BLEED PROBLEMS

Actuation of the side (bleed) port of the defroster diaphragm is delayed by a porous flow plug inserted in the yellow-coded vacuum hose. Complaints relating to defroster bleed operation will generally be of two types:

1. No defroster bleed. Check hose connection at defroster bleed nipple of defroster vacuum actuator. If connections are satisfactory, porous plug is probably too restrictive. Replace plug. (Before installing new plug, check for vacuum in yellow line; and apply hose to nipple, without the plug, to check bleed door operation.)
2. Rapid fogging of windshield when heater turns on. Either there is no porous flow plug or installation of the plug is incorrect.

DEFROSTER DOOR ACTUATION PROBLEMS

The most common problem to be expected in this circuit would be "no air out of defroster outlets in "Def" setting". Vacuum to the defroster actuator is required for defroster operation.

1. Check hose connection (blue) at defroster actuator.
2. Check for vacuum at the control head purple hose.
3. If system stays in A/C mode at "Def", check vacuum circuit to determine why mode override did not occur.

RECIRC AND OUTSIDE AIR DOOR ACTUATION PROBLEMS

The most likely problem to be encountered will be "no recirc air at "auto" or "hi" lever setting". Vacuum is required to obtain recirc air. *Check hose connections at recirc air door, outside air door and within hose assembly.*

HEATER WATER VALVE CONTROL PROBLEMS

The water valve is a normally open valve requiring vacuum to close off water flow. It would be very difficult for a customer to recognize a problem in the water valve circuit by "no heater water shut-off"; however, a leak in that circuit may manifest itself by reduced vacuum levels available in other vacuum functions.

AUXILIARY VACUUM CIRCUIT CHECK VALVE PROBLEMS

The check valve for the auxiliary vacuum circuit is located in the programmer checking relay assembly. A malfunction of this check valve will probably result in complaints of loss of a specific function such as "A/C shuts off" during accelerations or mountain driving. The check valve may be checked with the system operating by disconnecting and plugging the black hose feeding the programmer checking relay. The vacuum functions (a vacuum gage in the purple hose or the system in A/C mode) should hold. If they do not hold, reinstall the black hose, and pinch the purple hose. If the functions now hold, the check valve is bad. If the functions continue to leak down, there is a circuit leak further upstream.

COMPRESSOR ELECTRICAL PROBLEMS

Malfunctions in the compressor electrical circuit would result in complaints of "no cooling", or "insufficient cooling". Perform the following checks:

1. Blown 20 amp fuse in fuse block.
2. Electrical disconnect at compressor clutch coil.
3. Electrical disconnect at compressor low pressure switch.
4. Backed-out terminal or disconnect at the control head electrical connectors.
5. Defective compressor low pressure switch.
6. Open in wiring harness. Refer to electrical circuit diagram, Fig. 1-218.

Refrigeration Problem Diagnosis

Refer to page 1-43 for this information.

NOTE: Tester J-23678 is designed for on-car diagnosis of control problems using the cars electrical and vacuum supplies.

Instructions for using the tester are provided with the tester however instruction card J-23468-50A must be used. Adapter harness J-24774 is also required to allow the tester to be connected to the car's electrical system.

ON-CAR SERVICE

Refer to page 1-49 for procedures on "Handling Refrigerant and Refrigeration Components."

Control System Functional Test

The following procedure is used to assure correct functional operation and requires approximately two minutes to perform. The system is to be tested at room temperature with the hood down, the doors and windows closed and the engine operating. Engine coolant must be warm. Proceed as follows:

1. Operate car at 1000 RPM or better.
2. Place A/C outlets in wide-open position.
3. Install thermometer in center A/C outlet.
4. Set control lever at "DEF" and temperature dial at 85°.
   a. Air should be delivered out of the defroster outlets.
   b. Blower should operate at high speed.
   c. Some air should come out heater outlet.
5. Set lever at "BI-LEVEL" and temperature dial at 75°.
   a. Air should be delivered from *both* the A/C and heater outlets.
   b. Blower should operate at a lower speed.
   c. Small airflow should come from defroster outlets.
6. Set lever at "HI" and temperature dial at 65°.
   a. Cool to cold air should be delivered from A/C outlets.
   b. Blower should operate at high speed.
   c. Recirc air door should open (will be slightly noisy).
7. Set lever at "AUTO" and temperature dial at 65°.

After 45 seconds, discharge air temperature should be 10°C (50°F) or lower (may be slightly higher in 32°C (90°F) or above ambient).

8. Set lever at "AUTO" and temperature dial at 85°.
   a. Recirc door should close - noise level will drop.
   b. Blower speeds should drop (Hi - M3 - M2 - M1 - etc.).
   c. Discharge air temperature should increase.
   d. Air delivery may change from A/C outlets to bi-level to heater outlet - depending upon ambient temperature.
9. Set lever at "LO" and temperature dial at 85°. Air should be delivered at fixed low blower.
10. Set lever at "ECONOMY" and temperature dial at 85°.
    a. Air delivery may be from A/C outlets, heater outlet or both (bi-level) depending upon ambient temperature.
    b. Blower speed may vary as at "AUTO".
    c. A/C compressor should not operate.
11. Set lever at "OFF" and temperature dial at 65°.
    a. Air discharge should be from heatr outlet.
    b. Blower should operate at fixed Lo speed.
    c. A/C compressor should not operate.

Component Adjustments

Be sure to allow sufficient time for the car engine to "warm up" and for the system to "turn-on" before attempting calibration. Do not skip any steps in the Calibration Procedure.

a. Temperature Dial Calibration

1. Disconnect electrical connector from programmer and connect appropriate end of harness adapter J-24774 to the programmer and car harness.
2. Connect the ATC Tester J-23678 into the opposite end of Adapter Harness J-24774.

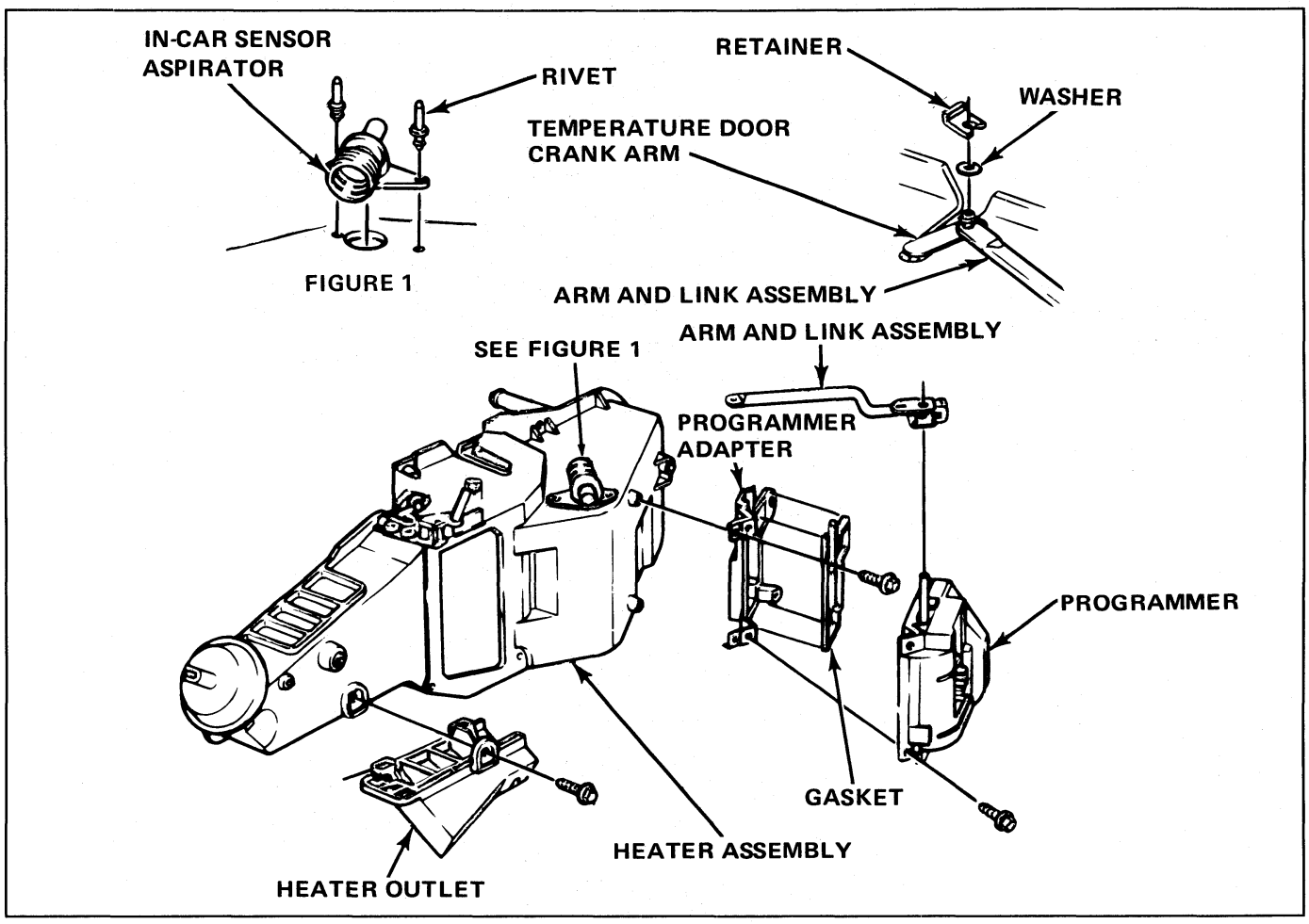


Fig. 1-219 Heater Case Components

3. Disconnect in-car sensor electrical connector and connect harness to double connector (black wires) coming out of Adapter Harness J-24774.

4. Place the "MANUAL-AUTOMATIC" switch on the tester in the "MANUAL" position.

5. Place the "TEMPERATURE DIAL CALIBRATOR" switch on the tester in the "CALIBRATE" position.

6. Note the voltmeter reading.

7. Press the "CALIBRATE" button and note the voltmeter reading.

8. With the "CALIBRATE" button pressed in, rotate the temperature dial on the control head until the voltmeter reading is the same as it was in Step 5 (when the button is not pressed in).

9. The temperature dial should be set at 75°. If it is not, use tool #J-21530 to hold the gear on the top of the temperature dial and slip the temperature dial to the correct setting. If the temperature dial cannot be calibrated using this procedure, it is defective.

10. Remove test equipment and make all normal connections. Make sure in-car sensor aspirator hose is properly attached, Fig. 1-219.

b. Mix Door Link Adjustment

1. Loosen the hex screw of the door link at the output shaft of the programmer (Fig. 1-219).

2. Place the control head selector lever in the "DEF" position.

3. Remove the elctrical connector from the ambient sensor. This results in the proper position of the output shaft of the programmer (full heat position).

4. Check to make sure that air mix door is in the full heat position. The blower air flow will now hold the mix door in the proper position.

5. Without disturbing the door link or the output shaft position, tighten the hex screw on the door link, (Fig. 1-219).

6. To check the Mix Door Link Adjustment, proceed as follows.

a. Connect Tester J-23678 into the wiring harness and the programmer using Harness Adapter J-24774. Place the control head in "AUTO". Place the "MANUAL-AUTOMATIC" switch in the "MANUAL" position. Using the "MANUAL CONTROL", swing the programmer to "Max. Heat" then to "Max. Cold". Hi blower should be obtained in both positions.

b. Check for recirculation operation. Operate the system with "MANUAL CONTROL" on "150" so the vacuum line can move the recirc and outside air doors to outside air position. With the control head in "HI", move the "MANUAL CONTROL" to "Max. Cold". *With all the car doors and windows closed,* the blower noise level should increase when recirculation occurs.

TORQUE SPECIFICATIONS
METAL TUBING

Metal Tube O.D. (Inch Lbs.)	Steel Tubing Torque (Ft. Lbs.)	Alum. Tubing Torque (Ft. Lbs.*)
1/4"	15	7
3/8"	35	13
1/2"	35	13
5/8"	35	21
3/4"	35	28

*Torque taken with crow foot attachment at 90° angle on torque wrench.

c. Programmer Amplifier Calibration (Feedback "Pot" Adjustment)

1. Remove the plastic cover from the programmer while it is still mounted in the car.
2. Connect the Tester J-23678 into the wiring harness and the programmer using Harness Adapter J-24774.
3. Place the control head selector lever in the "AUTO" position.
4. Place the "MANUAL-AUTOMATIC" switch on the tester in the "MANUAL" position.
5. Place the "TEMPERATURE DIAL CALIBRATOR" switch of the tester in the "OFF" position.
6. Rotate the "MANUAL CONTROL" knob on the tester to the "Max. Heat" position. The programmer should move to the full heat position.
7. Rotate the "MANUAL CONTROL" knob to 180 and STOP. *DO NOT OVER-TRAVEL!*
8. Using a blade type screwdriver, slip the shaft of the feedback potentiometer fully counterclockwise to its stop (see Fig. 1-191) for location of the feedback potentiometer in the programmer). The vacuum motor mechanism will be "in" the vacuum motor indicating full heat operation.
9. Using the screwdriver, very slowly slip the feedback potentiometer clockwise until the *first movement andof the vacuum motor mechanism can be seen. Stop the adjustment when the movement first occurs. (Do not watch the programmer output shaft.)*
10. To check the adjustment, rotate the "MANUAL CONTROL" knob to the "Max. Heat" position. Then slowly rotate the "MANUAL CONTROL" knob counterclockwise and the vacuum motor mechanism should first start to move when the "MANUAL CONTROL" knob is exactly at 180 ± 1. Touch up the feedback potentiometer adjustment in the programmer so that the mechanism movement occurs exactly 180. If this adjustment cannot be made, the programmer is malfunctioning.

Compressor Removal and Installation (Complete)

a. Removal

1. Remove air cleaner.
2. Purge system as described on page 1-51.
3. Remove right hand wheel house tiestrut.
4. Remove screw securing plate retaining high and low pressure connectors to compressor rear head, and remove plate.
5. Remove high and low pressure connectors from rear head of compressor and cap connectors.
6. Cover compressor openings with Test Plate, J-9625, to prevent dirt from entering compressor.
7. Disconnect electrical connector from clutch coil terminals.
8. Disconnect low pressure switch, if compressor mounted type.
9. Remove screw from adjuster link under pulley, Fig. 1-220.
10. Remove screw from rear adjuster link, Fig. 1-220.
11. Move compressor inward and disengage drive belt.
12. Remove three screws securing compressor to mounting bracket and remove compressor, Fig. 1-220.

b. Installation

NOTE: Before installing a replacement compressor, make certain the numerals 3-1/2 are stamped 1/8 inch high on blank space provided in lower right hand corner of compressor name plate. If numerals are not evident, then stamp numeral as indicated. This numeral indicates the refrigerant capacity and must be shown on all compressors as required by law in some states.

1. Position compressor to mounting bracket and loosely install three screws, Fig. 1-220.
2. Loosely install two screws, securing compressor adjusting links at front and rear of compressor, Fig. 1-220.
3. Install compressor drive belts on compressor and adjust belts as described on page 6B-18.
4. Torque three mounting screws to 30 ft-lbs.
5. Connect electrical connector to clutch coil terminals.
6. Connect low pressure switch if compressor mounted type.
7. Remove Test Plate J-9527, and using new O-rings, position high and low pressure connectors to rear head and position retaining plate to connectors. (Refer to Fig. 1-229).

NOTE: The O-rings in the compressor head should be oiled prior to placement in the cavity. Care should be taken not to damage these O-rings when installing the connectors.

8. Install screw and washer securing retaining plate and pressure connectors to rear head of compressor.
9. Evacuate system as described on page 1-51.
10. Charge system as described on page 1-52. Leak test all compressor connections.

CAUTION: *All leaks must be repaired. Under no circumstances should a compressor be operated when a leak exists, as complete loss of refrigerant prevents oil return to the compressor.*

11. Install right hand wheelhouse tiestrut.
12. Install air cleaner.

Compressor Removal and Installation (Partial)

In order to perform certain engine operations it is necessary to move the compressor out of the way. This can be done without disconnecting any lines as follows:

a. Removal

1. Remove one nut from stud headed cylinder head bolt beneath compressor bracket, Fig. 1-220. *Do not loose spacer.*
2. Remove one screw securing compressor to front bracket, Fig. 1-220.
3. Loosen adjusting screws at front and rear adjuster links and at rear pivot bolt, Fig. 1-220.

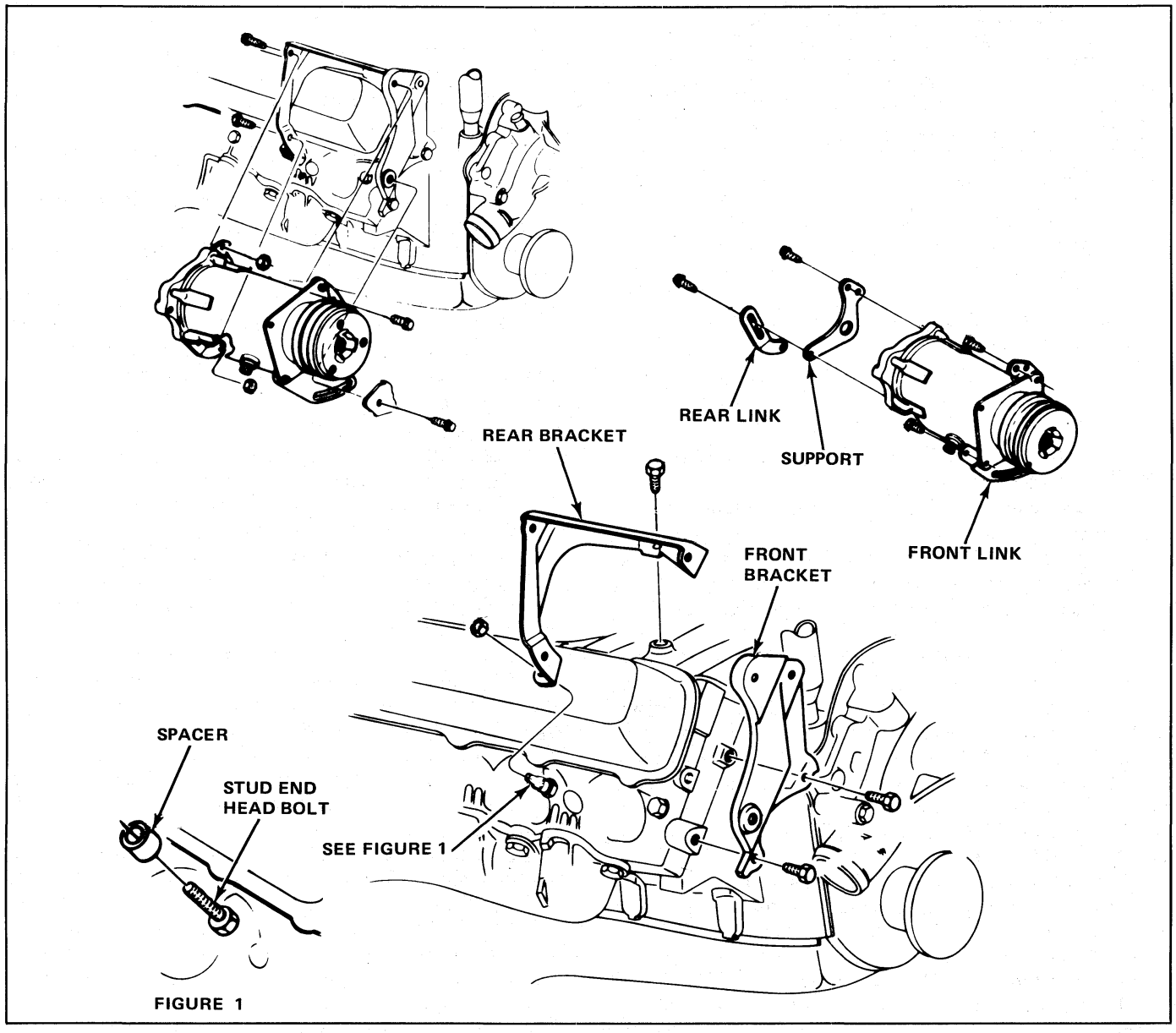


Fig. 1-220 Compressor Mounting

4. Pivot compressor inward and remove drive belt.

5. Disconnect clutch coil connector and remove two ground wires from compressor bracket. Disconnect connector on low pressure switch if compressor mounted type switch.

6. Remove one screw securing compressor bracket to intake manifold.

7. Move complete assembly clear of working area being careful not to kink hoses. Use rope or wire to hold compressor out of way.

b. Installation

1. Position compressor-bracket assembly to engine and install nut over cylinder head bolt and spacer, Fig. 1-220. Torque nut to 45 ft.-lbs.

2. Secure bracket to intake manifold with one screw and torque to 30 ft.-lbs.

3. Loosely install front pivot bolt.

4. Tension drive belt as described on page 6B-18.

5. Torque pivot bolts to 30 ft.-lbs.

6. Connect clutch coil connector and attach two ground wires to compressor bracket. Install connector on low pressure switch if compressor mounted type switch.

Condenser Removal and Installation (Complete)

a. Removal

1. Purge system as described on page 1-51.

2. Remove radiator as described on page 6B-9.

3. Remove high pressure vapor line.

4. Remove liquid line from condenser outlet pipe.

5. Remove four screws, 2 each side, securing condenser to radiator cradle and remove condenser, Fig. 1-221.

b. Installation

1. Add refrigeration oil as described on page 1-52.

2. Position condenser to radiator cradle and secure with four screws, Fig. 1-221.

3. Connect high pressure vapor line to condenser using

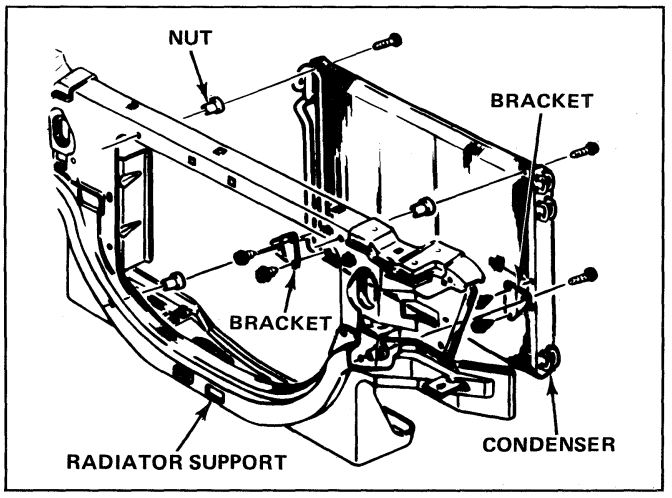


Fig. 1-221 Condenser

a new O-ring.

4. Connect liquid line to condenser outlet fitting using a new O-ring.

5. Install radiator as described on page 6B-9.

6. Charge system with refrigerant as described on page 1-51 and leak test condenser fittings.

Condenser Removal and Installation (Partial)

In order to perform certain engine operations it is necessary to move the condenser out of the way. This can be done without disconnecting any lines as follows:

a. Removal

1. Remove radiator as described on page 6B-9.
2. Remove four condenser mounting screws, Fig. 1-221.
3. Swing condenser out of position in radiator.
4. Position condenser out of way and secure in this position.

b. Installation

1. Position condenser to radiator craddle and secure with four screws, Fig. 1-221.
2. Install radiator as described on page 6B-9.

Evaporator Case

a. Removal

1. Discharge system as described on page 1-51.
2. Drain radiator and remove right hand wheelhouse strut.
3. Support front of hood and tape a pad to the right hand rear corner.
4. Remove right hand hood hinge.
5. Remove electrical connections from electrical components mounted on evaporator assembly, including blower motor, and position harness out of way.
6. Remove thermostatic cycling switch as described on page 1-57.
7. Remove heater hose at heater core side of hot water valve. Remove two screws securing hot water valve to evaporator case and poisition valve out of way.
8. Remove right wheelhouse as described on page 2C-16.
9. Remove heater hoses from heater core nipples.

CAUTION: *The heater core nipples are very long and damage to the heater core could result if handled roughly.*

10. Disconnect refrigeration lines at accumulator assembly and plug both hoses andfittings on accumulator.
11. Remove screws and nuts at locations shown in Fig. 1-222 and remove evaporator case.

b. Installation

1. Position evaporator case to cowl and secure with screws and nuts as shown in Figs. 1-222 and 1-223.
2. Connect heater hoses to heater core nipples. Refer to Fig. 1-229 for proper hose routing.
3. Install right wheelhouse as described on page 2C-16.
4. Connect refrigeration lines to accumulator assembly using new O-rings. Refer to Fig. 1-229 for proper hose routing.
5. Position hot water valve to evaporator case and secure with two screws.
6. Connect heater hose to hot water valve.
7. Install thermostatic cycling switch as described on page 1-57.
8. Connect electrical connectors to evaporator as shown in Fig. 1-223.
9. Install right hood hinge.
10. Install right wheelhouse strut.
11. Refill cooling system.
12. Evacuate and charge refrigeration system as described on page 1-51 and leak test all connections.

Evaporator Core

a. Removal

1. Remove evaporator case as described above.
2. Remove six screws securing evaporator case halves together.
3. Remove case half and remove core from case. Case to cowl gasket must be cut where halves separate.

b. Installation

1. Install evaporator core in position in case. Install evaporator case half and secure with six screws.
2. Seal the junction where the case halves were split with sealer and position evaporator to cowl.
3. Proceed with evaporator case installation as described above.

Accumulator

Refer to page 1-58 for removal and installation procedure.

Programmer

a. Removal

1. Remove litter recepticle.
2. Remove screw which secure recirc. air door actuator chroud to right kick panel assembly.
3. Disconnect vacuum and electrical connectors from programmer.
4. Remove 3 screws which attach programmer to heater assembly.
5. Lower programmer to gain access to air mix door link.
6. Loosen air mix door link set screw and disconnect link.
7. Remove programmer.

b. Installation

1. Position programmer under instrument panel and secure to heater assembly with 3 screws.
2. Connect vacuum and electrical connectors to programmer. Secure vacuum harness with clips on pins of

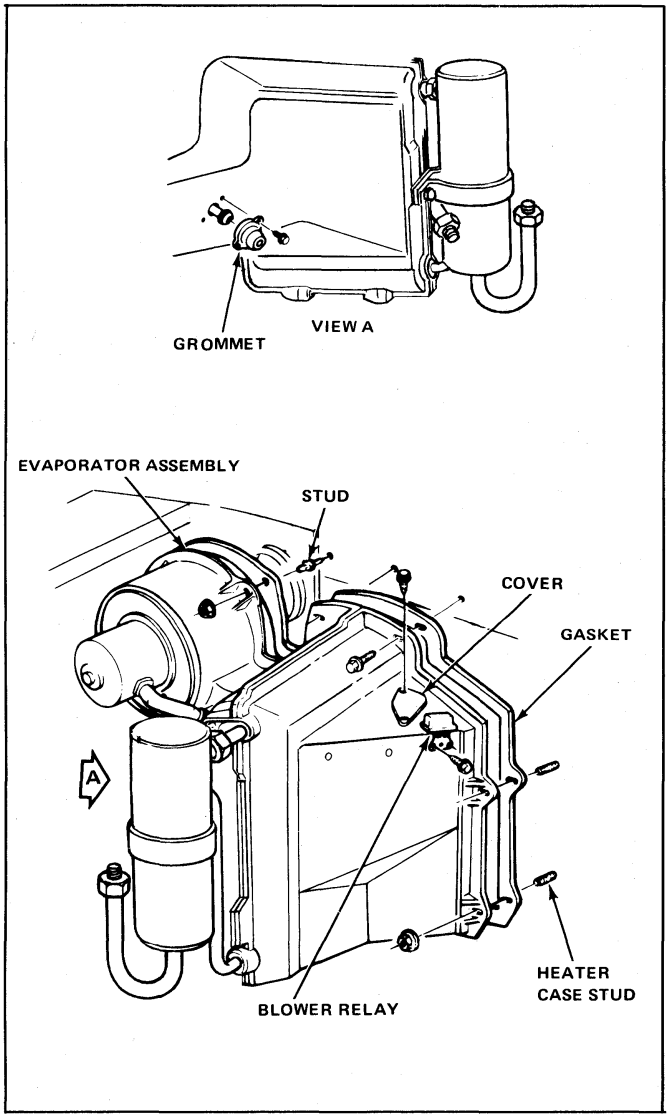


Fig. 1-222 Evaporator Mounting Screws

valve.

3. Install air mix door link to programmer and adjust link as described on page 1-198.

4. Position recirculation air door actuator shroud to right kick panel assembly. Secure with screws.

5. Install litter recepticle.

Blower Motor

a. Removal

1. Disconnect negative battery cable.

2. Remove rubber cooling hose from nipple and blower motor.

3. Disconnect electrical connector at lead to motor.

4. Remove six screws securing blower to case and remove blower.

b. Installation

1. Install ground wire to blower flange screw at 5 o'clock position.

2. Secure capacitor to blower flange screw at 5 o'clock position.

3. Place a bead of sealer around opening where blower will contact case.

4. Guide blower motor against cowl and place on locating dowel.

5. Install five screws securing blower to case.

6. Connect electrical connector at lead to motor.

7. Install cooling hose on motor and nipple.

Water Control Valve

a. Removal

1. Clamp off valve inlet and outlet water hoses.

2. Remove vacuum hose from water control valve.

3. Remove clamps securing hoses to valve, and remove valve from hoses.

4. Remove one screw securing water valve to evaporator case.

b. Installation

1. Secure water valve to condenser with one screw.

2. Install water valve on inlet and outlet hoses and install clamps.

3. Remove clamps from hoses.

4. Install vacuum hose at water control valve.

5. Replace any coolant lost.

Thermostatic Cycling Switch

The procedure for removing and installing the thermostatic cycling switch is described on page 1-57.

Low Pressure Switch

The procedure for removing and installing the low pressure switch is described on page 1-57.

Expansion Tube

The procedure for removing and installing the expansion tube is described on page 1-59.

Air Conditioning Outlets

The procedures for removing and installing the outlets are described on page 8-41.

In-Car Sensor

The procedure for removing and installing the in-car sensor is described on page 8-47.

Automatic Climate Control Air Conditioner Control Panel

The procedure for removing and installing the control panel is described on page 8-51.

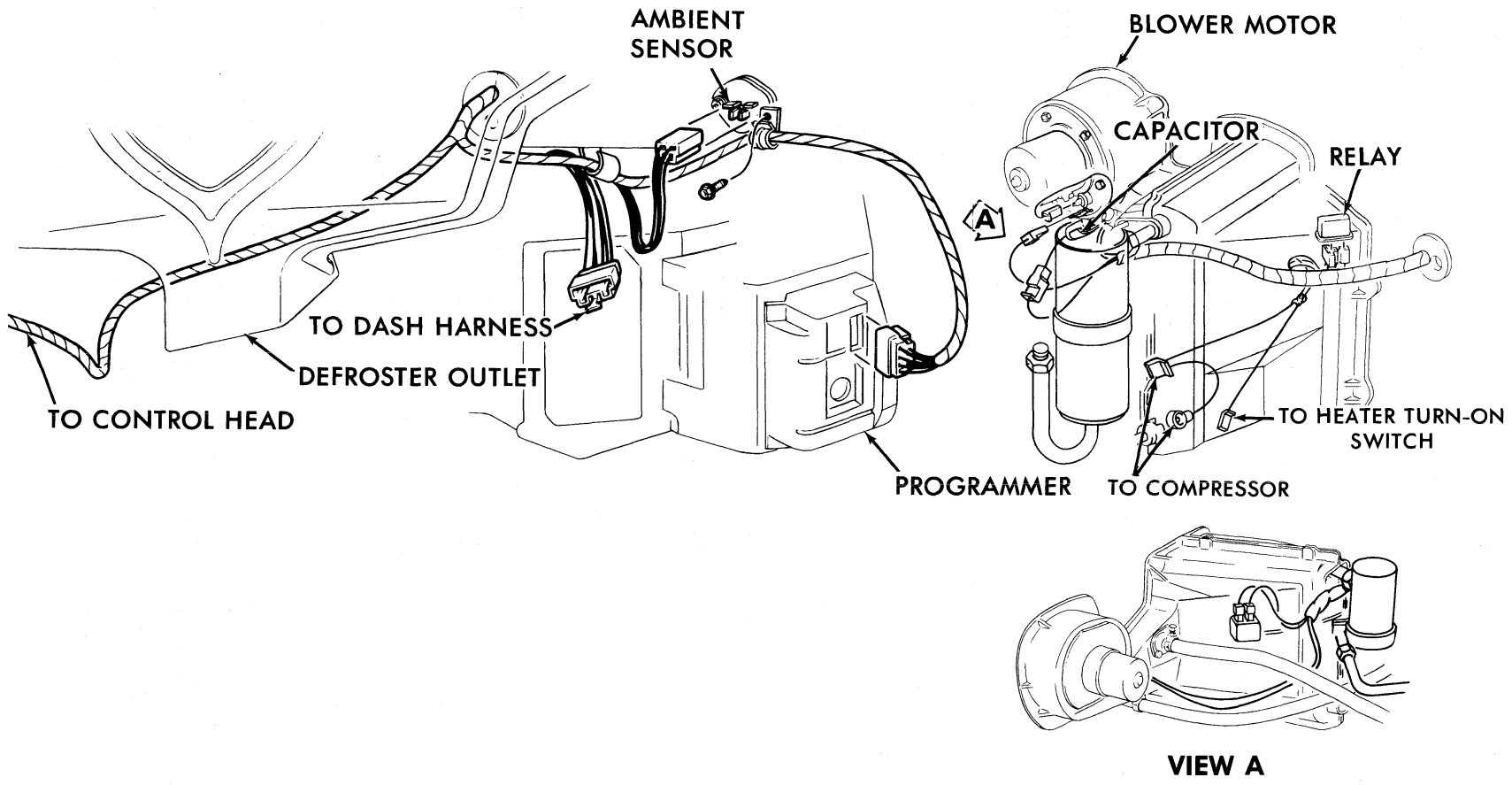


Fig. 1-223 Evaporator Wiring Harness

UNIT REPAIR

Air Conditioning Control Panel Disassembly and Assembly

The control panel must be removed as described on page 8-51 to perform any of the following procedures.

a. Circuit Board Removal

1. Remove one screw securing wire harness clip to control head base plate.
2. Remove two green wires from temperature dial rheostat.
3. Remove three screws on bottom of base plate securing circuit board to base plate.
4. Move control lever to "OFF" position and remove circuit board by sliding out from under control lever.

b. Circuit Board Installation

1. Move control lever to "DEF" position and feed circuit board connector and wires through base plate from bottom.

CAUTION: *This procedure is important to avoid damage to the wiper contacts on bottom of control lever.*

2. Work circuit board into position and secure to base plate with three screws.
3. Working on top side of control head, connect two green wires to temperature dial rheostat.
4. Secure harness clip to base plate with one screw.

c. Temperature Dial Rheostat Removal

1. Disconnect two green leads from rheostat terminals.
2. Remove two screws securing rheostat bracket to mounting plate and remove rheostat.

d. Temperature Dial Rheostat Installation

1. Position rheostat to control panel and install two screws securing rheostat bracket to mounting plate.
2. Connect two green wires to rheostat terminal.
3. After installing control panel on car, adjust temperature dial as described on page 1-197.

e. Control Head Vacuum Valve Removal

Loosen two screws securing control vacuum valve to control head and remove valve.

f. Control Vacuum Valve Installation

1. Position control vacuum valve on control head so that pin engages lever arm.
2. Secure with two screws.

Compressor Overhaul

Refer to page 1-67 for compressor service procedures.

Programmer Overhaul

Refer to page 1-155.

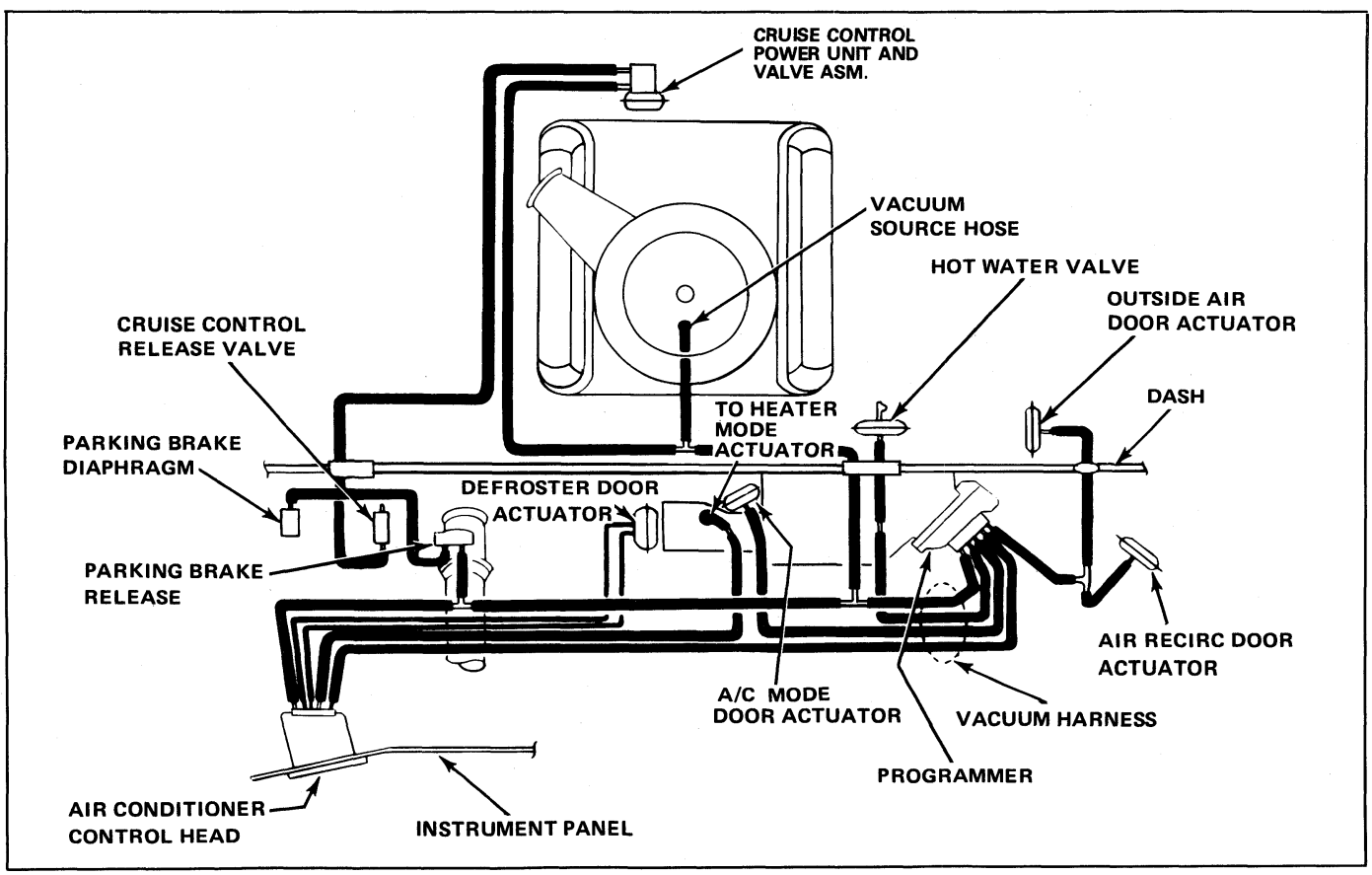


Fig. 1-224 Vacuum Hose Schematic

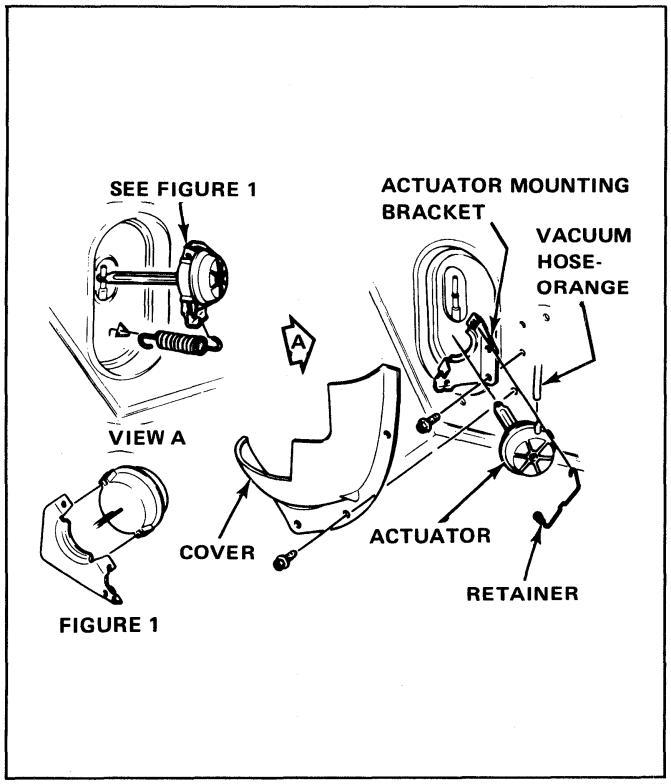


Fig. 1-225 Recirc Air Door Connections

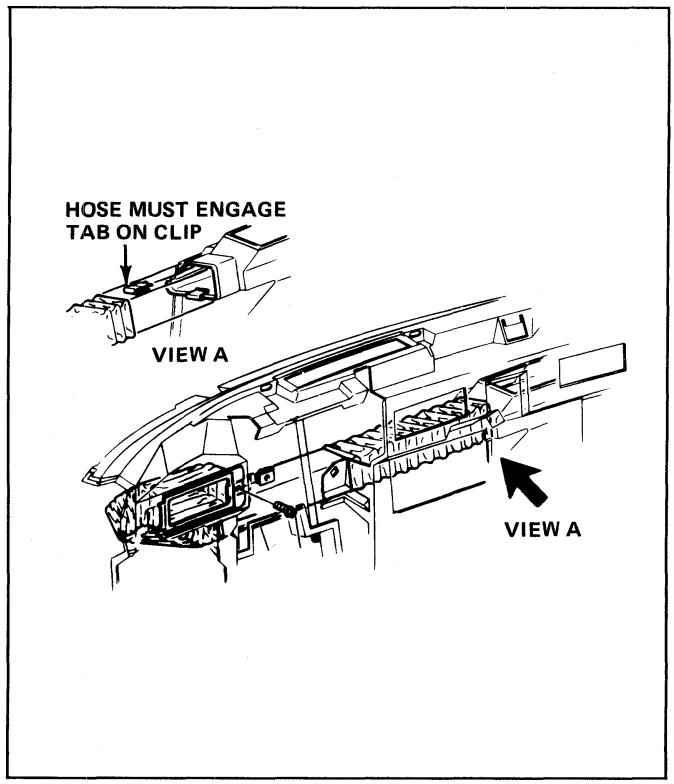
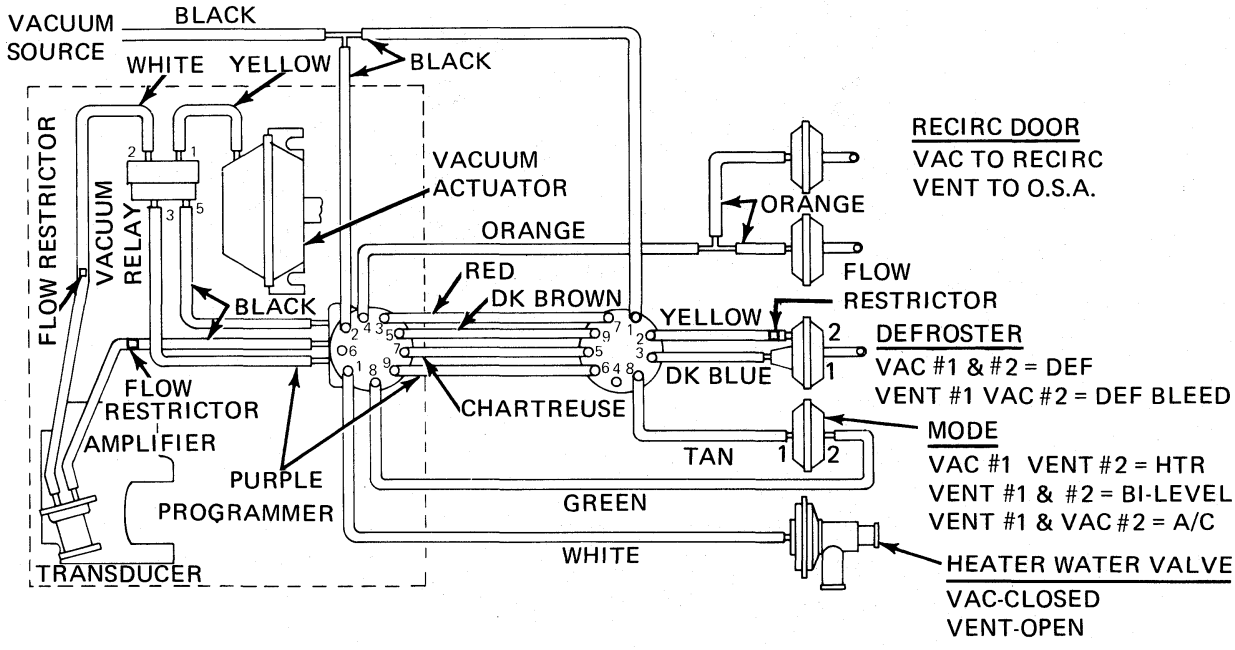
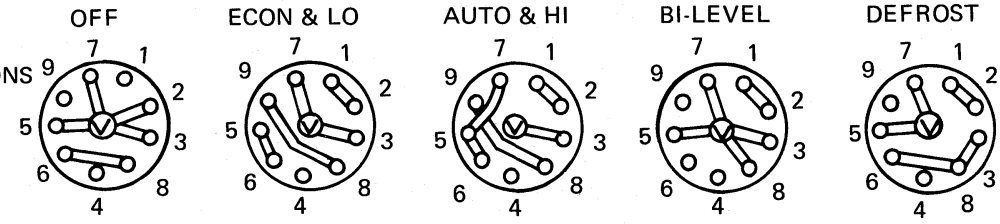


Fig. 1-226 A/C Duct Routing

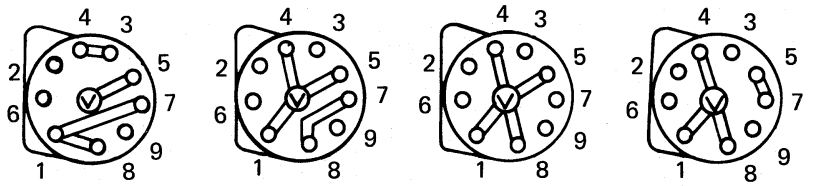


VALVE CONNECTIONS FOR VARIOUS CONTROL HEAD LEVER SETTINGS



VALVE CONNECTIONS FOR VARIOUS PROGRAMMER POSITIONS

NOTE V = VENTED TO ATMOSPHERE



RECIRC AIR HWV CLOSED A/C MODE

OUTSIDE AR HWV OPEN A/C MODE

OUTSIDE AIR HWV OPEN BI-LEVEL MODE

OUTSIDE AIR HWV HEATER MODE

Fig. 1-227 Complete Vacuum Circuit

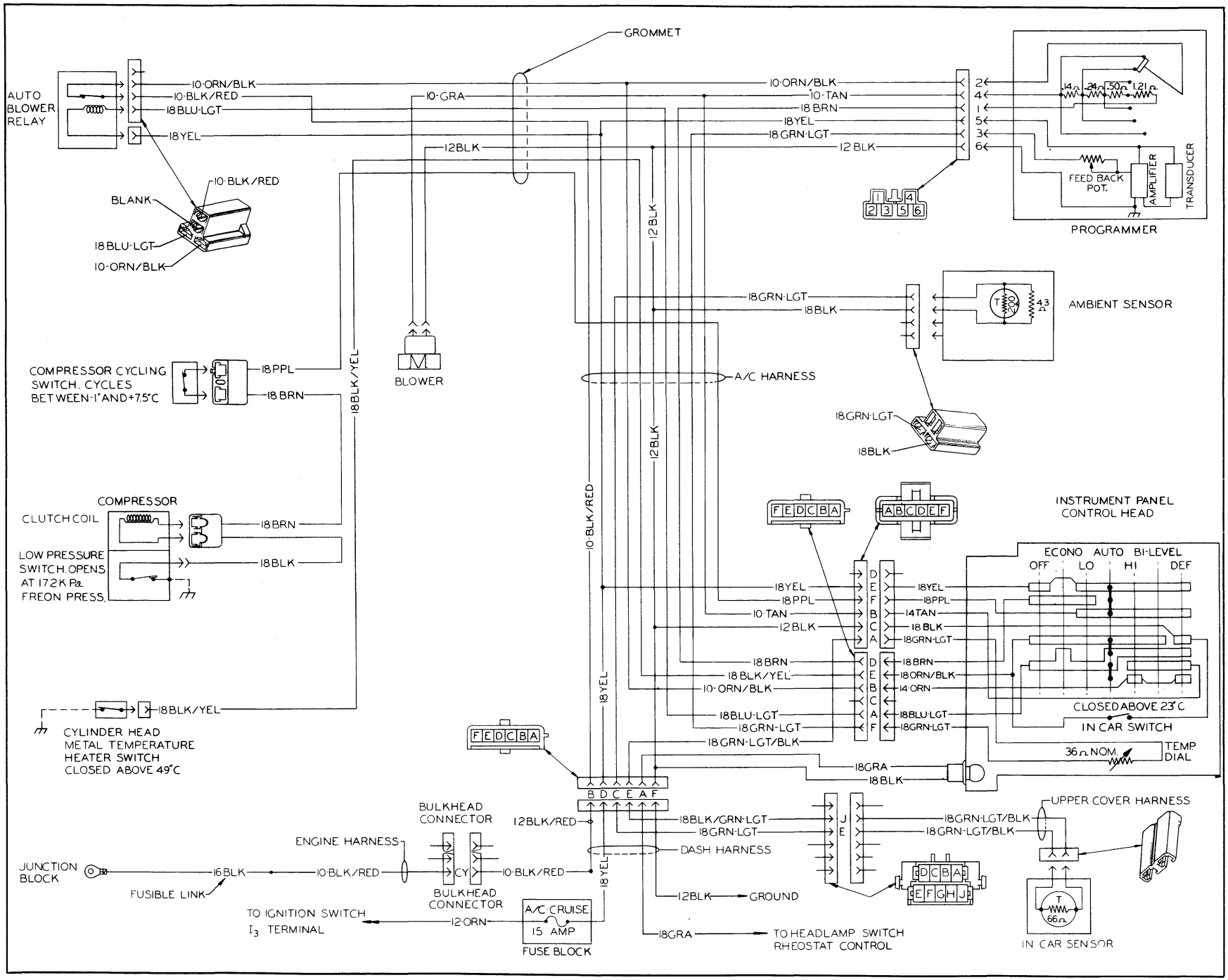


Fig. 1-228 Complete Electrical Circuit-Seville

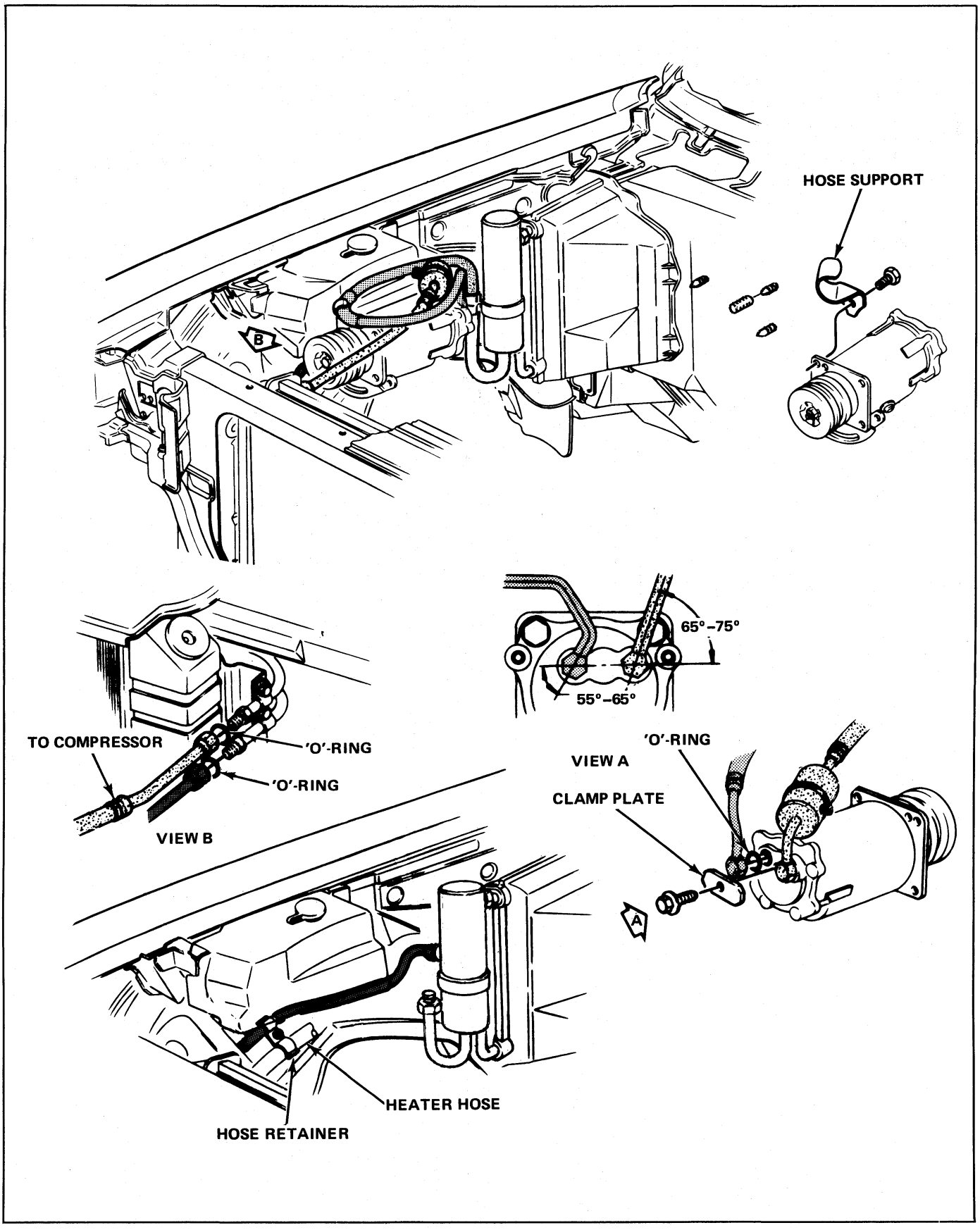


Fig. 1-229 Refrigerant Hose Routing

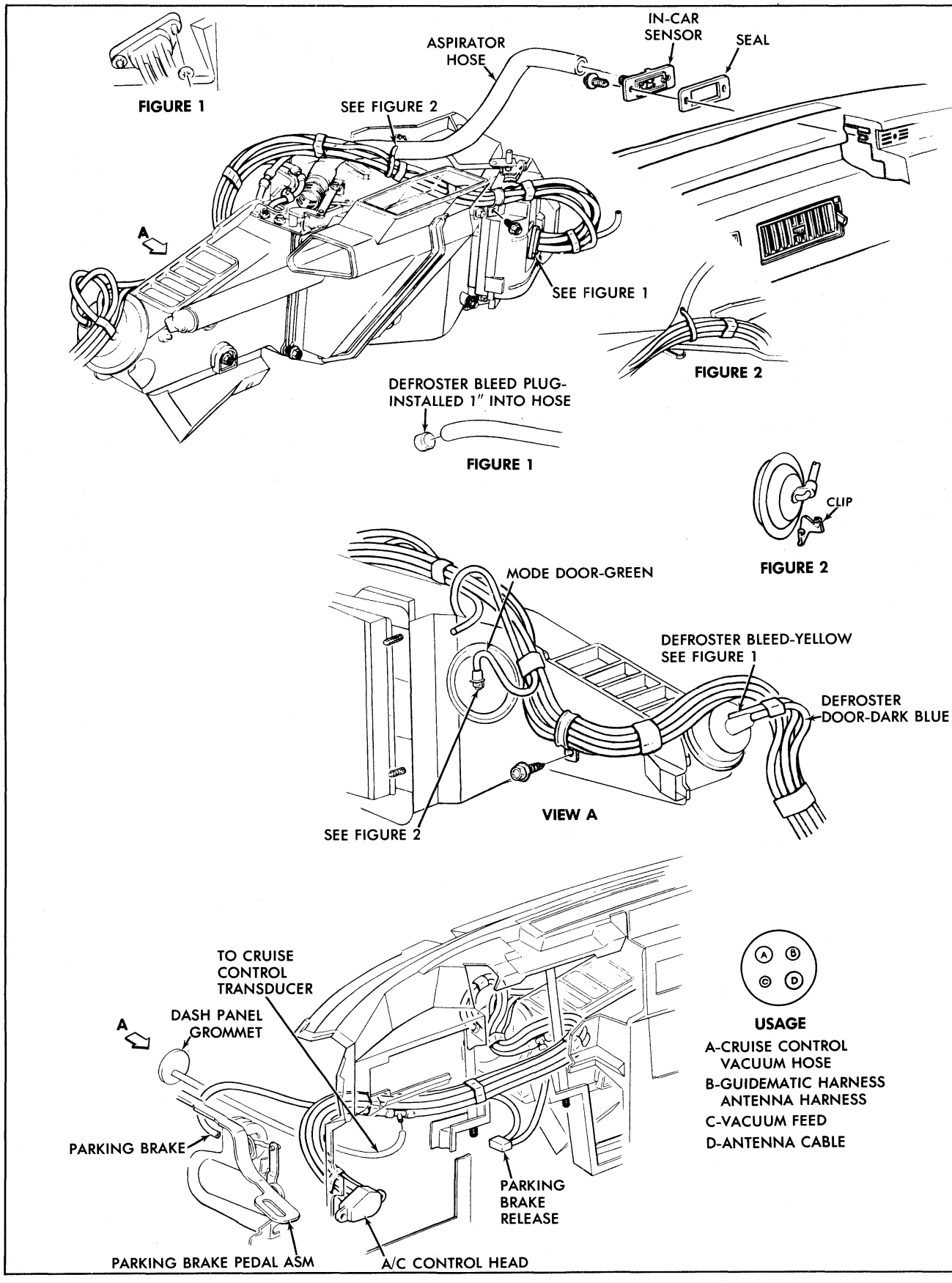
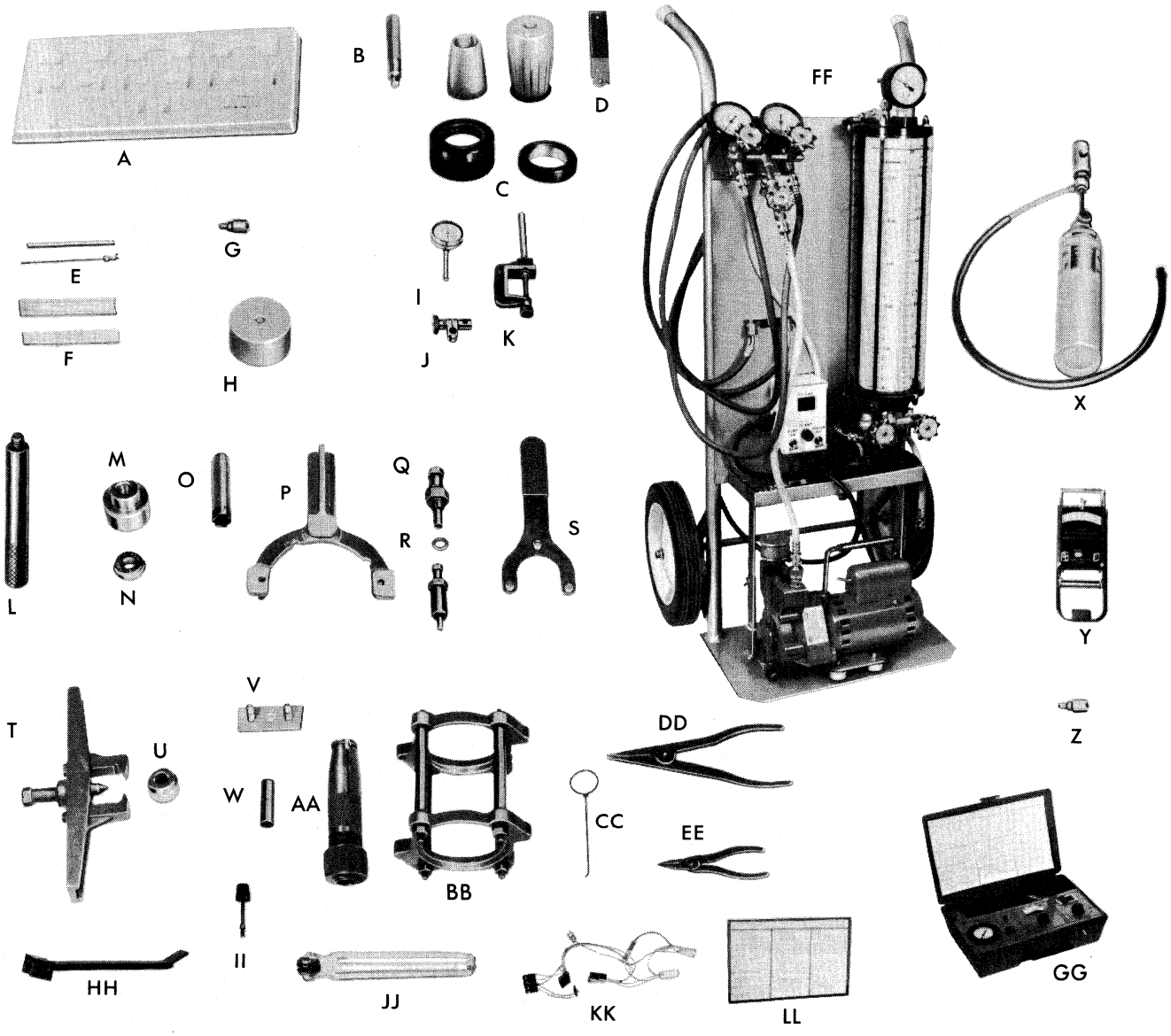


Fig. 1-230 Vacuum Hose Routing

TORQUE SPECIFICATIONS
SEVILLE

Material	Application	Size	Inch Pounds
286M	Compressor Rear Mounting Bracket Stud Nut	7/16-20	45*
280M	Compressor Rear Mounting Bracket Attach. Bolt	3/8-16	30*
280M	Compressor Front Mounting Bracket Attach. Bolt	3/8-16	30*
280M	Compressor to Mounting Bracket Bolt	5/16-24	33*
286M	Compressor Rear Strut to Exhaust Manifold Stud Nut	3/8-16	33*
1008N	Condenser to Radiator Support Screw	1/4-20	8
1022N	Control Head Attach. Screw	10-16	20
6010M	Distributor Attach. Screw	10-16	15
6010M	Distributor Extention Attach. Screw	10-16	15
6010M	Defroster Nozzle Attach. Screw (Top)	10-16	25
6010M	Defroster Nozzle Attach. Screw (Bottom)	10-16	25
6010M	Evaporator Case to Cowl Screw	1/4-14	60
284M	Evaporator Case to Cowl Stud Nut	1/4-20	60
6010M	Heater Outlet to Heater — Air Cond. Assy. Screw	10-16	15
1022N	In-Car Sensor Attach. Screw	10-16	20
1022N	Outlet Housing Inst. Panel Screw	10-16	20
6010M	Programmer Attach. Screw	10-24	15
6010M	Programmer Adapter Attach. Screw	10-16	15
6010M	Plenum Duct Attach. Screw	8-18	15
6010M	Relay to Evaporator Case Screw	10-16	15

*Foot Pounds TS-Self Tapping



Key	Tool No.	Name	Key	Tool No.	Name	Key	Tool No.	Name
A	J-9402	Parts Tray	P	J-9396	Holding Fixture	FF	J-23500	Charging Station
B	J-9432	Needle Bearing Installer	Q	J-9480	Clutch Plate and Hub Installer	GG	J-23678	A/C Tester
C	J-24608	Teflon Piston Ring Tools	R	J-9401	Clutch Plate and Hub Remover	HH	J-24182-1	Valve Capsule Remover
D	J-21530	Temperature Dial Adjuster	S	J-9403	Clutch Hub Holding Tool	II	J-24182-2	Valve Core Remover
E	J-22555	Thermometer	T	J-8433	Pulley Puller	JJ	J-24182-3	Pick-Up Tube Installer
F	J-6076	Humidicator	U	J-9395	Puller Pilot	KK	J-23678-77	Harness Adapter
G	J-5420	Gage Adapter — Low — 7/16-20	V	J-9625	Test Plate		(Exc. Eldorado	
	J-25498	Gage Adapter — High — 3/8-24	W	J-9399	9/16" Thin Wall Socket		& Seville)	
H	J-21352	Internal Assembly Support	X	J-6084	Leak Deterctor Torch		J-24774	Harness Adapter
	J-9521(Seville)	Internal Assembly Support	Y	J-23600	Tension Gage		(Eldorado and	
I	J-8001-3	Dial Indicator	Z	J-25498	Gage Adapter		Seville)	
J	J-8001-2	Sleeve	AA	J-23128	Seal Seat Remover/Installer	LL	J-23678-51	Instruction Card
K	J-8001-1	Clamp		J-9393 Seville	Seal Seat Remover/Installer		(Exc. Eldorado	
L	J-8092	Universal Handle	BB	J-9397	Compressor Fixture		& Seville)	
M	J-9398	Pulley Bearing Remover	CC	J-5139	Oil Pick-up Tube Remover		J-23468-50A	Instruction Card
N	J-9481	Pulley and Bearing Installer	DD	J-6435	Snap Ring Pliers (#26)		(Eldorado and	
O	J-9392	Seal Remover and Installer	EE	J-5403	Snap Ring Pliers (#21)		Seville)	

Fig. 1-231 Special Tools

FRAME AND BODY MOUNTS
TABLE OF CONTENTS

Body Cross Rod (Eldorado) 2A-3
Body Mount Removal (C-Car) 2A-3
Body Mount Removal (Eldorado) 2A-7
Body Mount Removal (Seville) 2A-11
Frame Repair 2A-3
General Description
Frame (C-Car) 2A-1
Frame (Eldorado) 2A-3
Frame (Seville) 2A-3
Torque Specifications 2A-12

GENERAL DESCRIPTION

Service information pertaining to Seville is covered at the back of the section, beginning on page 2A-10.

Frames used on "C", "D", and "E" series are full frames and are basically the same, consisting of full length right and left side members joined laterally by crossmembers. The frame used on the "K" series is of half frame and half unibody construction.

Frame - "C" and "D" Series

A swept torque-box, ladder-type perimeter frame, Fig. 2A-1, is used on "C" and "D" series 1977 model Cadillac cars. The frame side rails are joined by a welded-in front suspension crossmember, a welded-in rear suspension crossmember, a welded-in crossmember at the rear of the frame, and a bolted in transmission support crossmember. The frame encircles the passenger compartment, permitting a low front floor with adequate seat height. This frame design also allows a small floor tunnel, and simplifies drive shaft arrangement.

The forward portion of the front side rails and the aft end of the rear side rails provide a rigid mounting for the front and rear bumpers and the Energy Absorbing devices to withstand loads resulting from a 8km/h (5 mph) impact.

An additional welded-in crossmember is provided in the Limousine and Commercial Chassis frames to support the center bearing of the two-piece drive shaft used on these models. This crossmember is located between the No. 3 and No. 4 body mounting locations.

A center side rail boxing has been added to the frame on the Limousine and Commercial Chassis.

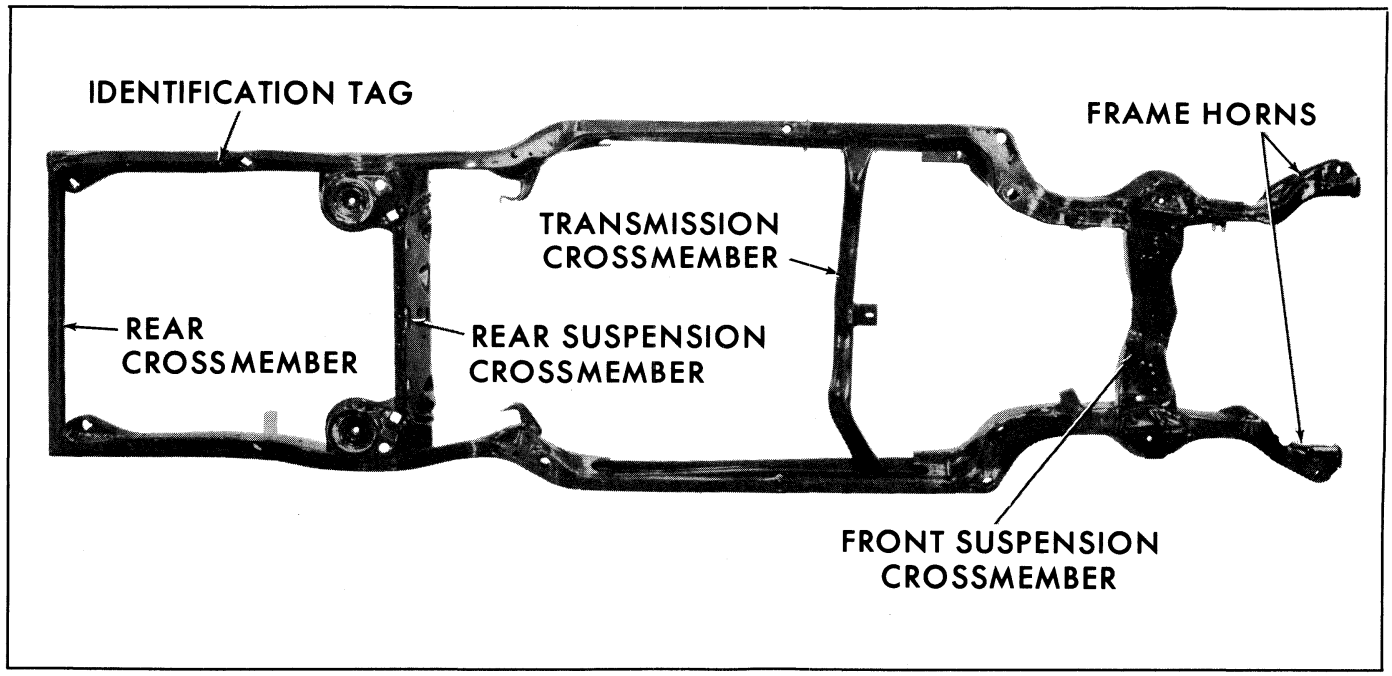


Fig. 2A-1 Frame (C-Car)

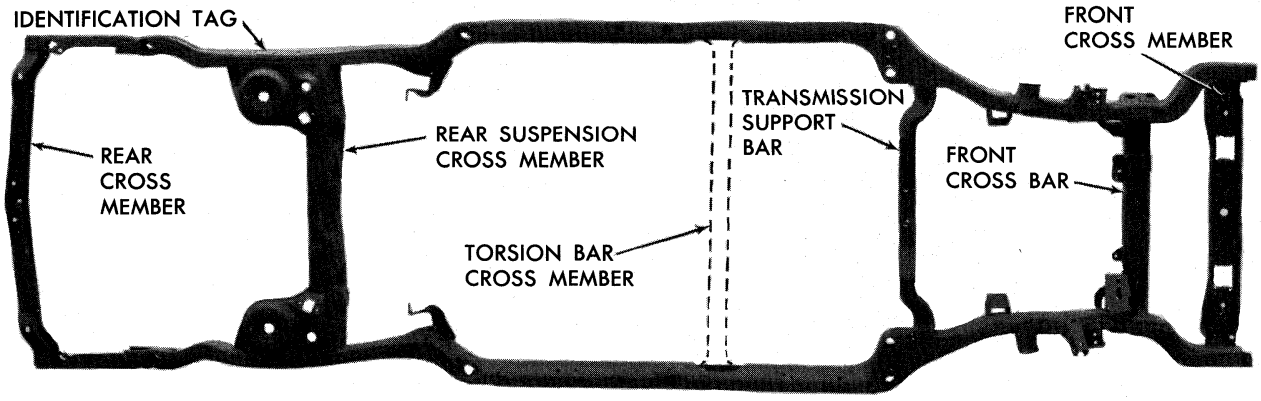


Fig. 2A-2 Frame (Eldorado)

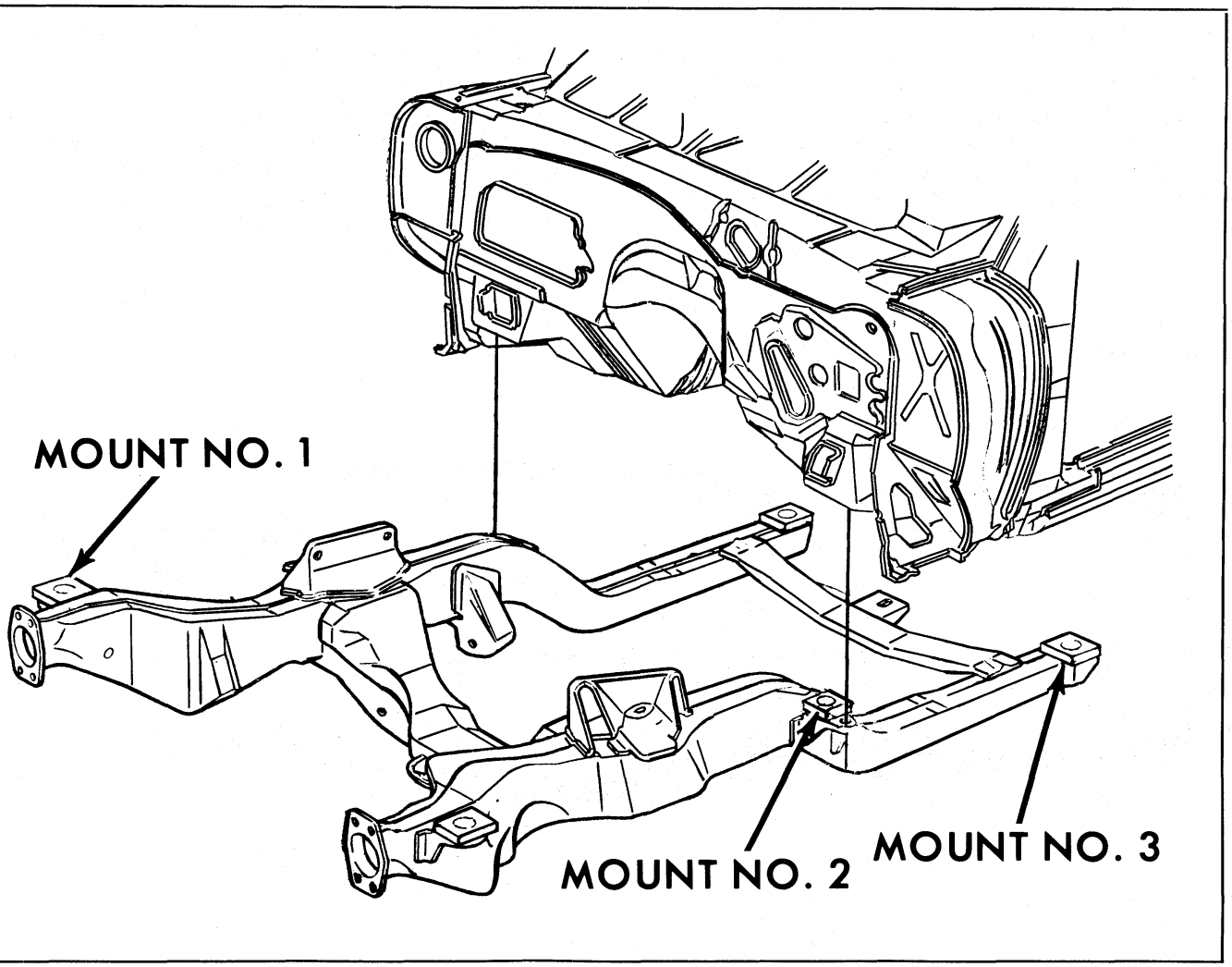


Fig. 2A-3 Frame and Unibody Construction (Seville)

Frame - Eldorado

A swept torque-box perimeter type frame, Fig. 2A-2, is used on "E" series Cadillac automobiles. The frame side rails are joined by a weld-in radiator crossmember, a weld-in front suspension crossmember, a weld-in transmission crossmember, a weld-in rear suspension crossmember and a weld-in crossmember at the rear of the frame.

A detachable crossmember is located behind the engine and transmission assembly to mount the torsion bars for the front suspension.

Body to frame cross rods are used in the rear axle area on Eldorados to restrain relative lateral motion. This restraint system contributes to rolling smoothness, Fig. 2A-10.

The slide-in body castings are connected to stamped brackets at the upper shock absorber mounts with cross rods. It is important that the rubber insulators are properly positioned for fuel line protection, Fig. 2A-10.

Installation of the cross rods is described below.

Frame - Seville

The "K" body series is of unitized construction with a stub frame supporting the front end sheet metal, radiator cradle, front suspension, engine, and steering components. The frame, Fig. 2A-3, has short side members bolted to the underbody which extend from behind the front door to the front of the vehicle. The side members are joined together by crossmembers.

The rear section of the frame is an integral part of the body and is covered in the Body Service Manual.

ON CAR SERVICE

The following caution applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology:

CAUTION: *See "CAUTION" on page 2A-3 of this section.*

CAUTION: *This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.*

Frame Repair

Vehicles involved in an accident of any nature which might result in a "bent" or "sprung" frame should always be checked for proper frame alignment in addition to steering geometry and wheel alignment. The illustrations shown in Figs. 2A-4, 2A-5, and 2A-6 can be used to check the alignment of a frame that has been distorted. The car should be on a flat, level floor to assure accurate measurements when either of the following methods are used.

The easiest and most accurate method of checking the reference points indicated is by use of tram gauges. When using tram gauges, be sure to keep the gauge cross bar level to insure accuracy in all measurements.

If a tram gauge is not available, the "plumb bob" method of checking may be used. By using this method, it is only necessary to have a piece of cord attached to an ordinary surveyor's plumb bob. When measuring the distance between two points, the free end of the cord should be placed on the reference point allowing the plumb bob to hang to the floor. A mark should be made on the floor just under the tip of the plumb bob. This operation should be repeated at all reference points. With these points located on the floor, they may be easily measured.

If a damaged frame crossmember is to be replaced, use the same method of attachment as on the original frame crossmember, Fig. 2A-7, 2A-8, and 2A-9. New nuts and bolts should be of the same specifications as the original bolts.

Body Cross Rod Installation - Eldorado

With rod ball seated in underbody retainer, place .150" shim (5/32") between frame bracket face and tension gaging nut, Fig. 2A-10. Finger tighten gaging nut. Remove shim and tighten rod end nut to 20-25 foot-pounds until jammed. This results in a 800-1,000 pound tension load on the rods.

Body Mount Locations (Except Seville)

Locations and assembly of body mounts are shown in Fig. 2A-11.

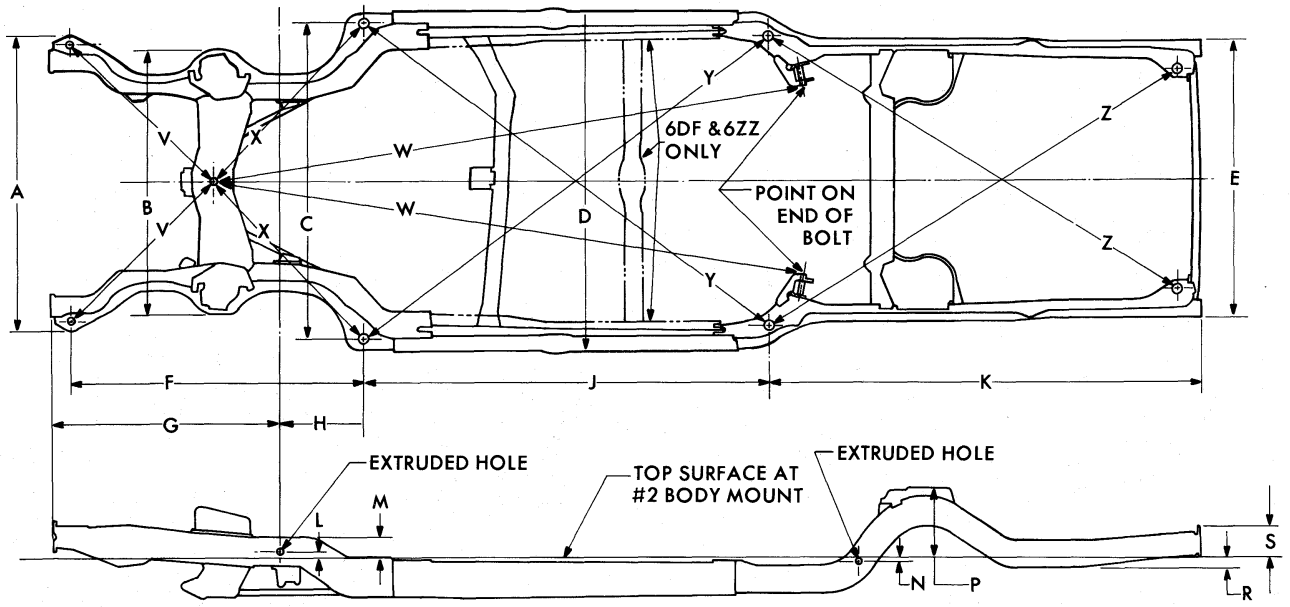
A cross sectional view of the parts required for installation of body mounts showing the order of assembly and a charted list of cushion and pad applications also appear in Fig. 2A-11.

C-Car Body Mounts - No. 1 through No. 3 Left or Right

CAUTION: *Perform procedure exactly as specified regardless of whether all or only one of these mounts is to be replaced, as damage to sheet metal or other components could result.*

a. Removal

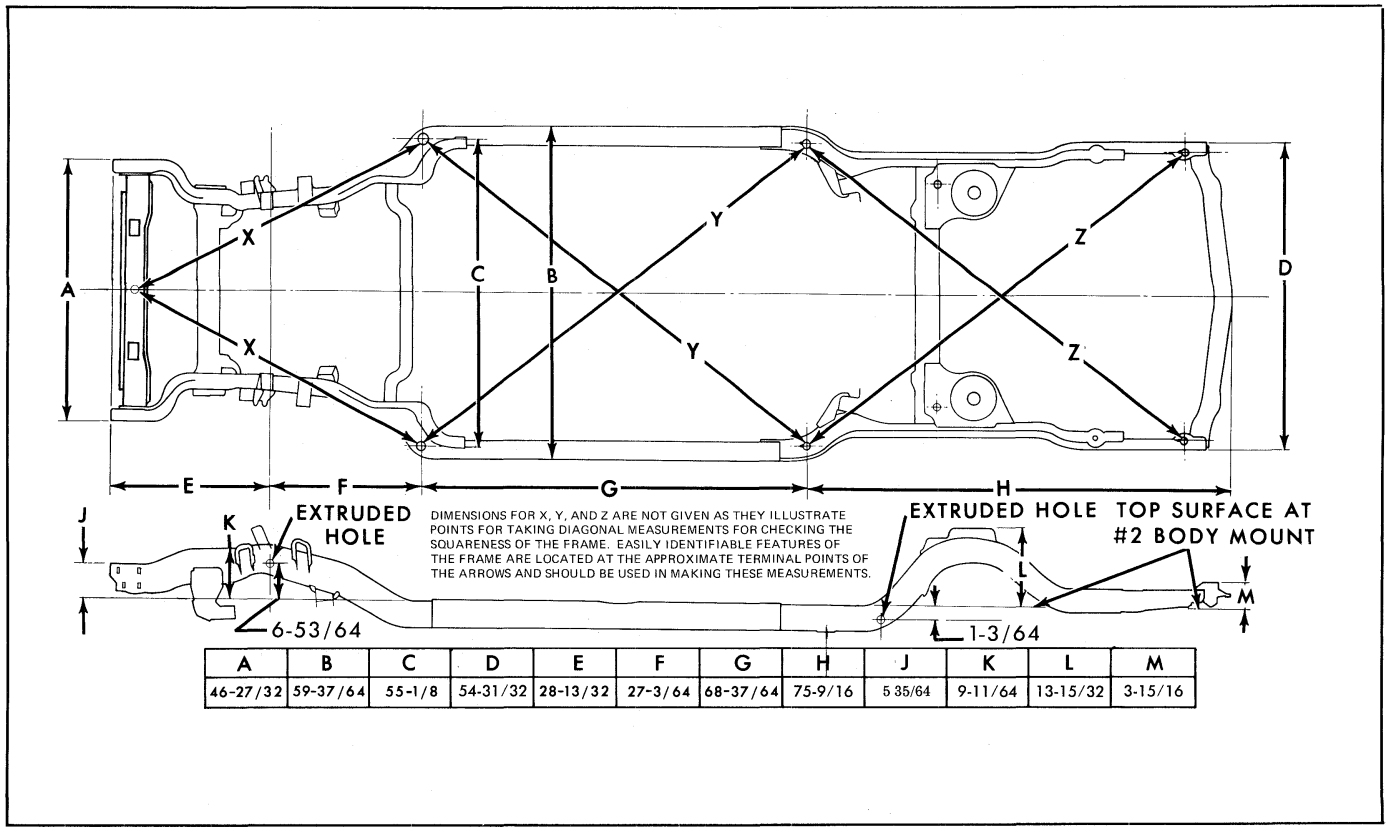
1. Disconnect negative battery cable.
2. Raise car.
3. Remove plastic retainers securing wheelhousing splash shields on each side of car.
4. Remove nuts, retainers, and cushions securing radiator support cross rods to EA frame bracket and make sure rods are out of way.
5. Remove two screws securing power steering gear to frame and loosen third screw. Loosen pinch bolt at upper coupling.
6. Remove two mounting bolts (and pads if necessary) from radiator support mounts.
7. Remove mounting bolts and lower pads from all No. 1 through No. 5 body mount locations. Store pads and bolts so they can be identified for reinstallation in the same locations.
8. Place jack stands under body side rails near the No. 4 body mount locations.



DIMENSIONS FOR V,W,X,Y, & Z ARE NOT GIVEN AS THEY ILLUSTRATE POINTS FOR TAKING DIAGONAL MEASUREMENTS FOR CHECKING THE SQUARENESS OF THE FRAME. EASILY IDENTIFIABLE FEATURES OF THE FRAME ARE LOCATED AT THE APPROXIMATE TERMINAL POINTS OF THE ARROWS AND SHOULD BE USED IN MAKING THESE MEASUREMENTS

SERIES	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S
DEVILLE (INCH)	50.0	45 7/64	5345/64	57 31/64	47¼	49 59/64	38¾	14 21/64	68 55/64	73 15/32	1 47/64	4 3/32	5/16	12 1/8	1 5/16	5 3/8
DEVILLE (MM)	1270.0	1145.7	1364.0	1460.0	1200.0	1268.0	984.0	364.0	1749.0	1866.0	44.0	104.2	8.0	308.0	33.34	136.5
FLEETWOOD 6DF & 6ZZ (INCH)	50.0	45 7/64	53 45/64	57 31/64	47¼	49 59/64	38¾	14 21/64	91 51/64	73 15/32	1 47/64	4 3/32	5/16	12 1/8	1 5/16	5 3/8
FLEETWOOD 6DF & 6ZZ (MM)	1270.0	1145.7	1364.0	1460.0	1200.0	1268.0	984.0	364.0	2331.64	1866.0	44.0	104.2	8.0	308.0	33.34	136.5

Fig. 2A-4 Frame Checking Points (C-Car)



A	B	C	D	E	F	G	H	J	K	L	M
46-27/32	59-37/64	55-1/8	54-31/32	28-13/32	27-3/64	68-37/64	75-9/16	5 35/64	9-11/64	13-15/32	3-15/16

Fig. 2A-5 Frame Checking Points (Eldorado)

9. Lower chassis until separation between body and frame is barely sufficient to slip out upper pads to be replaced.

CAUTION: *Do not separate body and frame more than necessary as damage to sheet metal and other components could result.*

10. Remove all upper pads that require replacement.

b. Installation

1. Install new upper pads as required. Use shims (if any) found on disassembly.

2. Raise chassis until body is lifted from jack stands. Attempt to rotate upper pads with fingers. If any pad can be moved, separate frame and body and add shims as required.

3. Remove jack stands.

4. Install mounting bolts and lower pads at all applicable locations from front of car through No. 5 mount. Tighten all bolts uniformly to 75 N·m (55 foot-pounds).

CAUTION: *See "CAUTION" on page 2A-3 of this section.*

5. Position steering gear and secure to frame with three screws, tightening to 55 foot-pounds. Tighten pinch bolt at upper coupling assembly to 35 foot-pounds.

CAUTION: *See "CAUTION" on page 2A-3 of this section.*

6. Install two radiator support mounts.
7. Secure radiator support rods to EA frame bracket.
8. Secure wheelhouse splash shield to frame.
9. Lower car.
10. Install negative battery cable.

C-Car Body Mounts - No. 3 Through No. 7, (Left or Right)

CAUTION: *Use the identical procedure described below, including loosening and removal of all fasteners regardless of whether all or only one of these body mounts is to be replaced. Otherwise, damage to sheet metal or other components could result.*

a. Removal

1. Raise car.

2. Remove mounting studs and lower pads from all No. 3 through No. 7 body mounts using access holes in underside of frame. Store bolts and pads so that they can be reinstalled at same locations.

3. Loosen but do not remove mounting bolts at both No. 1 locations and No. 2 locations.

4. Place jack stands under reinforced portion of underbody near No. 4 mount locations.

5. Lower chassis until separation between body and frame is barely sufficient to slip out all upper pads to be replaced.

CAUTION: *If frame and body are separated more than necessary, risk of visible sheet metl damage is greatly increased.*

6. Remove any upper pads requiring replacement.

b. Installation

1. Position new upper pads at all locations requiring pad replacement. Install same shims (if any) found on disassembly between pad and frame.

2. Raise chassis until body is lifted from jack stands.

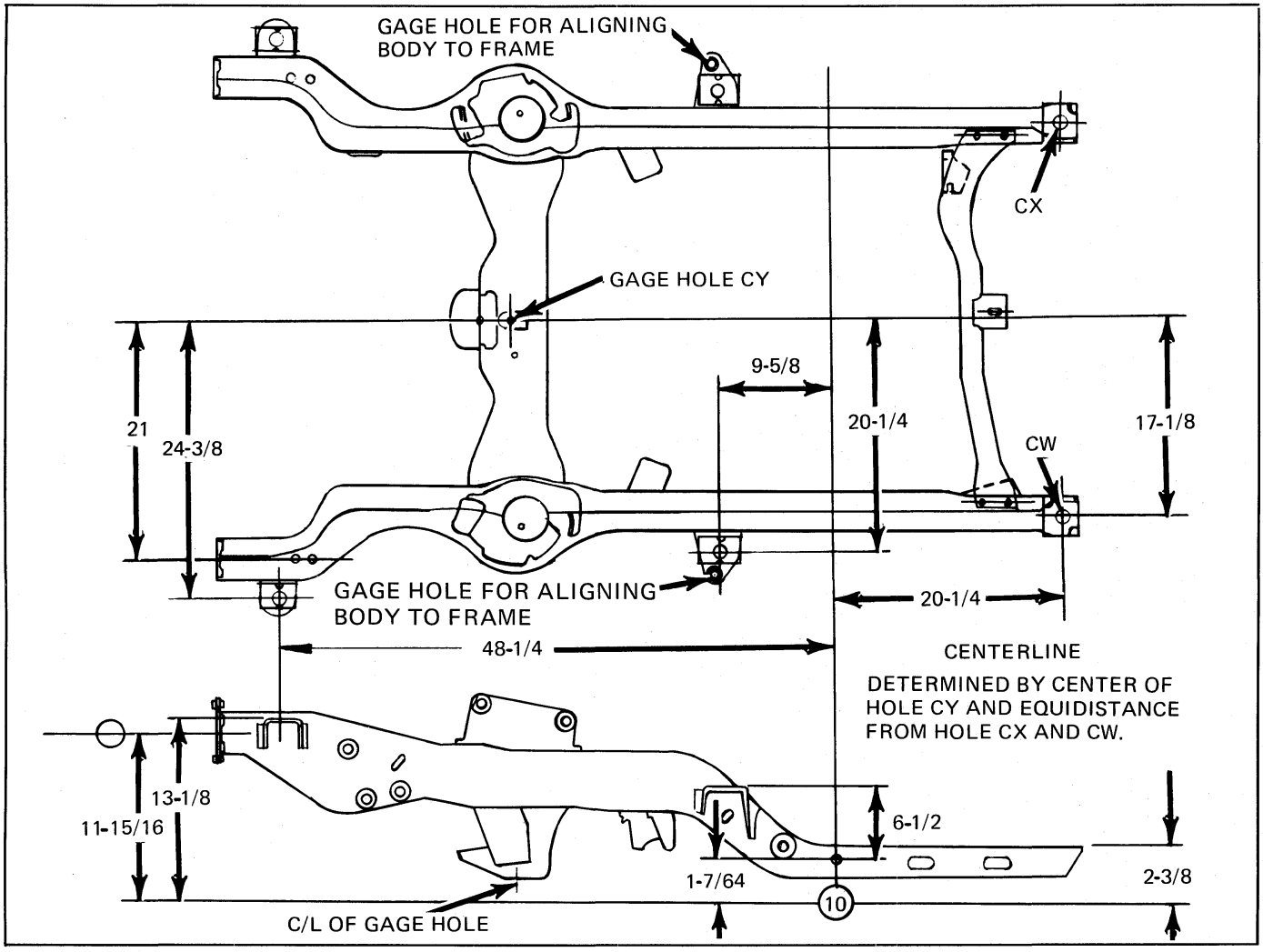


Fig. 2A-6 Frame Checking Points (Seville)

Attempt to rotate all upper pads with fingers. If any pads can be moved, lower chassis and install shims between pad(s) and frame.

3. Remove jack stands.

4. Tighten bolts at No. 1 and No. 2 locations to 75 N·m (55 foot-pounds).

CAUTION: *See "CAUTION" on page 2A-3 of this section.*

5. Install lower pads and mounting bolts at same locations as found on disassembly, using new pads and bolts as necessary. Tighten mounting bolts to 75 N·m (55 foot-pounds).

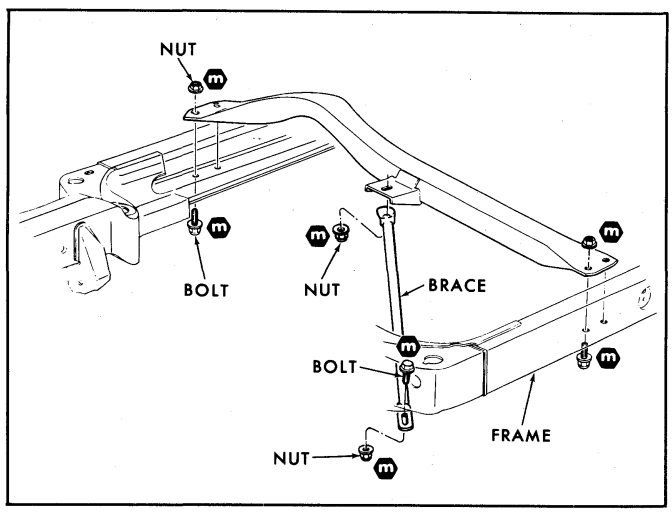


Fig. 2A-7 Crossmember and Brace (C-Car)

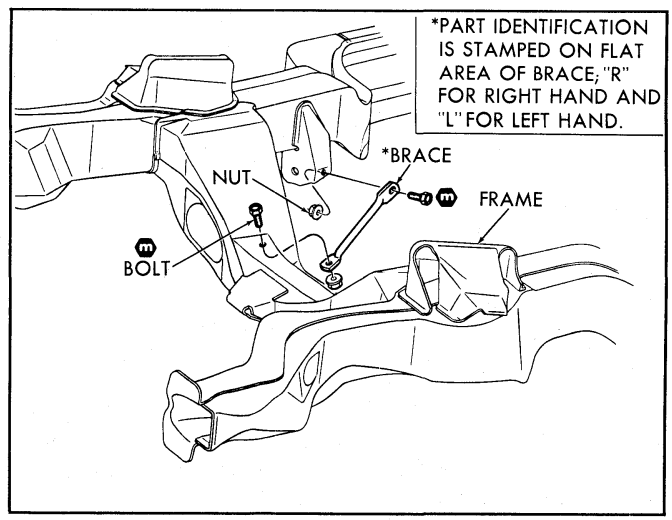


Fig. 2A-8 Frame Brace (C-Car)

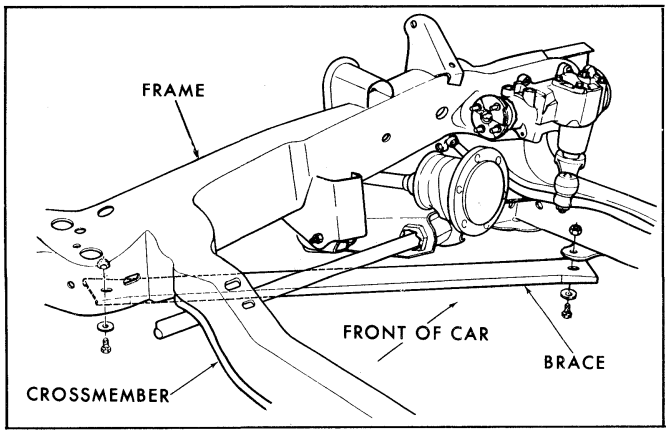


Fig. 2A-9 Frame Brace (Eldorado)

CAUTION: *See "CAUTION" on page 2A-3 of this section.*

CAUTION: *Make sure torques on all mounting bolts are even, or ride could be affected.*

6. Lower car.

Eldorado Body Mounts - No. 1 or No. 2 Locations (Left or Right)

CAUTION: *Perform procedure exactly as specified regardless of whether all or only one of these mounts is to be replaced, as damage to sheet metal or other components could result.*

a. Removal

1. Disconnect negative battery cable and raise car.

2. Remove radiator support mounts from frame front crossmember.

3. Remove nut, two grommets, spacer, and two retainers securing each support rod to front bumper outer end support brackets.

4. Remove screw and washer securing each wheelhousing splash shield to frame.

5. Remove bolts and body mount lower pads from No. 1 and No. 2 locations on each side of car.

6. Place jack stands under body side rails approximately midway between No. 1 body mount and torsion bar crossmember.

7. Lower frame carefully until separation between frame and body is barely sufficient to slip out all upper pads to be removed.

CAUTION: *Do not separate body and frame more than necessary as damage to sheet metal and other components could result.*

b. Installation

1. Install new upper pads in all No. 1 and No. 2 locations requiring mount replacement. Install same shims (if any) found on disassembly.

NOTE: When installed, upper pad must be rotated so that two crescent-shaped slits in undersides of No. 1 and No. 2 mounts near spacer tube are in a "fore and aft" orientation. See Fig. 2A-11.

2. Raise frame until it is supporting body. Recheck all No. 1 and No. 2 upper pads to make sure holes line up with mounting holes in frame. Attempt to rotate pads. If any pads can be moved, lower frame and install additional shims.

3. Install lower pad and mounting bolt assemblies at both No. 1 and No. 2 locations. Tighten mounting bolts to 75 N·m (55 foot-pounds). Make sure torques are even or rough ride could result.

CAUTION: *See "CAUTION" on page 2A-3 of this section.*

4. Tighten mounting bolts at No. 4 locations to 75 N·m (55 foot-pounds).

CAUTION: *See "CAUTION" on page 2A-3 of this section.*

5. Secure wheelhousing splash shields to their respective frame rails with one screw and washer each.

6. Install radiator support mounts.

7. Install support rods in mounting brackets at outer ends of front bumper.

8. Lower car.

9. Install negative battery cable, tightening to 70 inch-pounds.

Eldorado Body Mounts - No. 4, 6, or 7 Locations (Left or Right)

CAUTION: *Perform procedure exactly as specified regardless of whether all or only one of these mounts is to be replaced as damage to sheet metal or other components could result.*

a. Removal

1. Disconnect negative battery cable and raise car.

2. Remove mounting studs and lower pads from No. 4, No. 6, and No. 7 body mounts, both sides of car (six total), using access holes in underside of frame. Store bolts and pads so that they can be reinstalled at same location.

3. Loosen but do not remove mounting bolts at both No. 1 locations and both No. 2 locations.

4. Place jack stands under reinforced portion of underbody forward of each rear lower control arm bracket and inboard of frame side rails.

5. Lower chassis until separation between body and frame is barely sufficient to slip out all upper pads to be replaced.

CAUTION: *Do not separate body and frame more than necessary as damage to sheet metal and other components could result.*

6. Remove any upper pads requiring replacement.

b. Installation

1. Position new upper pads at all locations requiring pad replacement. Install same shims (if any) found on disassembly between pad and frame.

NOTE: If replacing pads at either No. 4 locations or either No. 7 locations, pads require specific orientation. Two crescent-shaped slots appear on underside of pad near spacer tube. At No. 4 locations, pads must be installed so that slots are in "fore and aft" position. At No. 7 locations, slots must be in lateral, i.e., cross-car, position. See Fig. 2A-11.

2. Raise chassis until body is lifted from jack stands. Attempt to rotate all upper pads with fingers. If any pads can be moved, lower chassis and install shims between pad(s) and frame.

3. Remove jack stands.

4. Tighten mounting bolts at No. 1 and No. 2 locations to 75 N·m (55 foot-pounds).

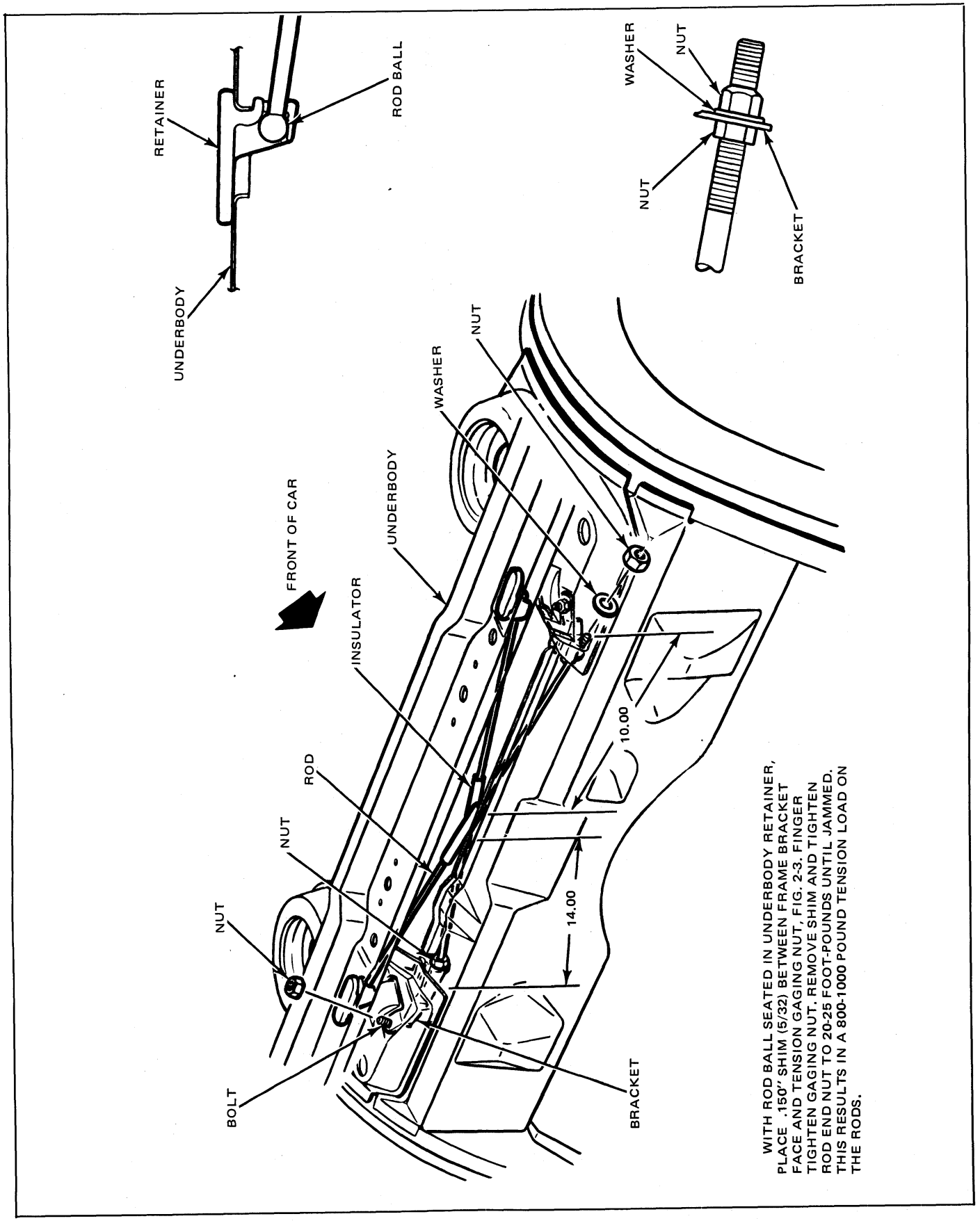
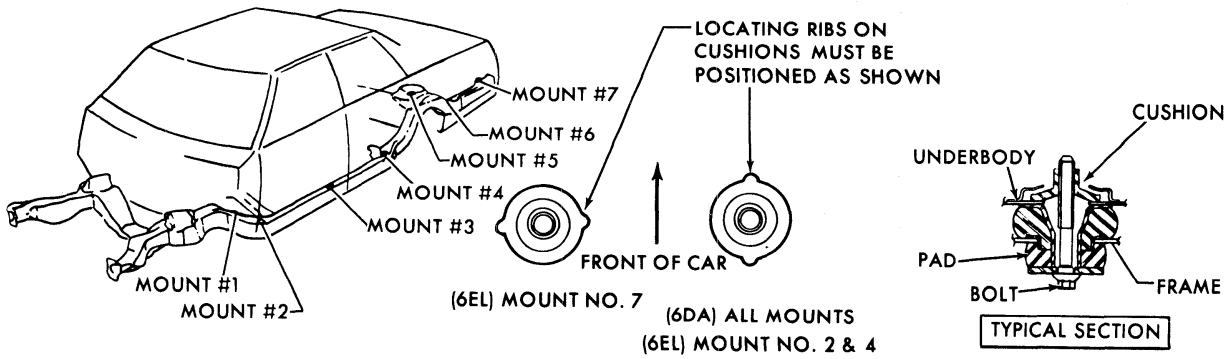
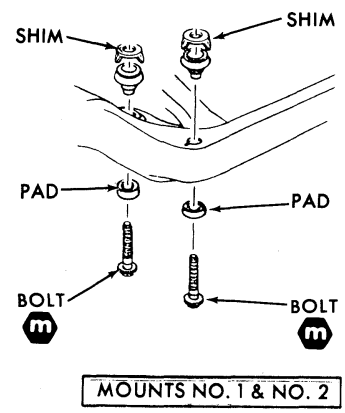
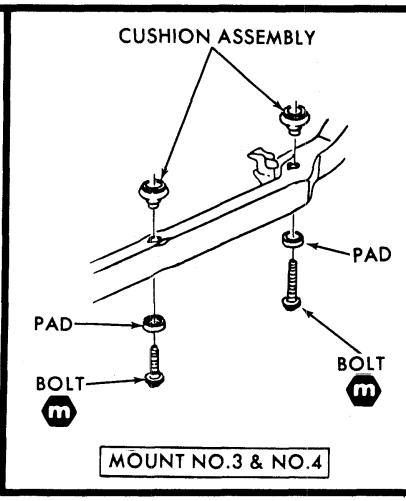
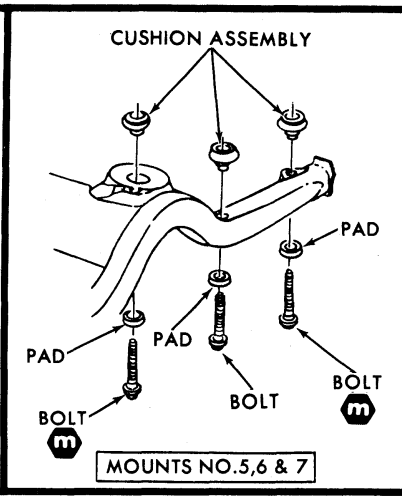


Fig. 2A-10 Body to Frame Crossrods (Eldorado)









CUSHION & PAD APPLICATIONS

BODY MOUNTS	PAD	CUSHION
NO.1	(ALL EXC. 6EL & 6DA) GREEN (6EL) NONE (6DA) GOLD	(ALL EXC. 6EL & 6DA) RED (6EL) PINK (6DA) VIOLET
NO. 2	(ALL EXC. 6EL) BLACK (6EL) GREEN	(ALL EXC. 6EL) BLACK (6EL) LIGHT GREEN
NO. 3	(ALL EXC.6EL) BLACK (6EL) NO BODY MOUNT	(ALL EXC. 6EL & 6DA) ORANGE (6EL) NO BODY MOUNT (6DA) YELLOW
NO. 4	(ALL EXC. 6EL) BLACK (6EL) GREEN	(ALL EXC. 6EL & 6CD47) RED (6EL) LIGHT GREEN (6CD47) BROWN
NO. 5	(ALL EXC. 6EL) BLACK (6EL) NO BODY MOUNT	(ALL EXC. 6EL) GREEN (6EL) NO BODY MOUNT
NO. 6	(ALL EXC. 6DA) BLACK (6DA) BLUE	(ALL EXC. 6EL, 6CD69 & 6DA) ORANGE (6EL& 6CD69) BLACK (6DA) GREEN
NO. 7	(ALL) BLACK	(ALL EXC.6EL, 6CD69 & 6DA) ORANGE (6EL) GOLD (6CD69) BLACK (6DA) GREEN

Fig. 2A-11 Body Mount and Locations (C-Car and Eldorado)

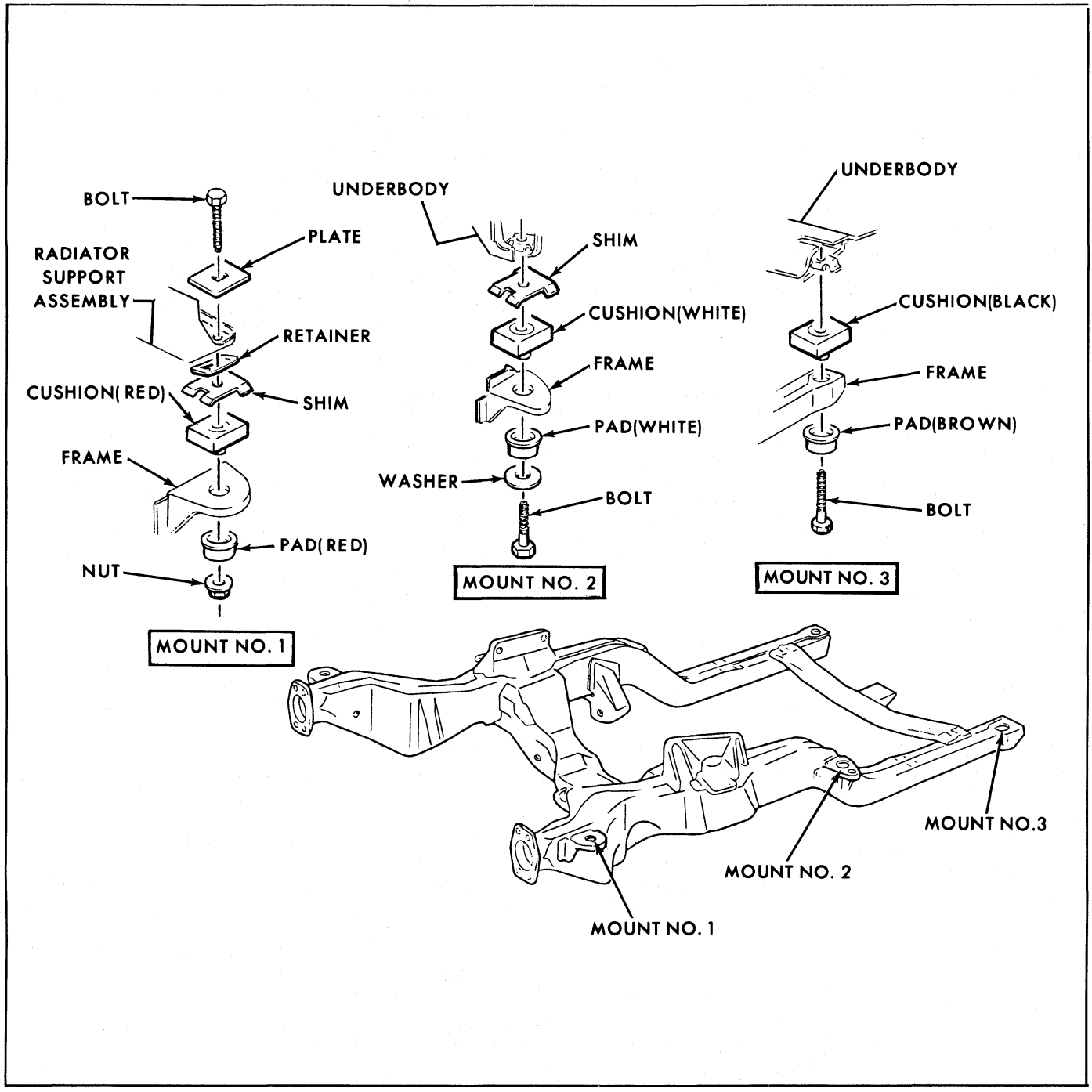


Fig. 2A-12 Body Mount and Locations (Seville)

CAUTION: *See "CAUTION" on page 2A-3 of this section.*

5. Install lower pads and mounting bolts at No. 4, No. 6 and No. 7 locations as found on disassembly, using new pads and bolts as necessary. Tighten mounting bolts to 75 N·m (55 foot-pounds).

CAUTION: *See "CAUTION" on page 2A-3 of this section.*

NOTE: Make sure torques on all mounting bolts are even or rough ride could result.

6. Lower car and connect negative battery cable, tightening to 70 inch-pounds.

Body Mount Locations - Seville

There are six "Isoflex" cushion type body mounts, Fig. 2A-12, in the frontal area. Four are used at the body-to-frame attaching and two at the radiator support-to-frame. The correct color cushion must be installed on each side, Fig. 2A-12.

The body mounts are retained with special microencapsulated, epoxy coated bolts. The coating is applied to the threaded area of the bolt, and prevents premature loosening. The bolts can be loosened and reused.

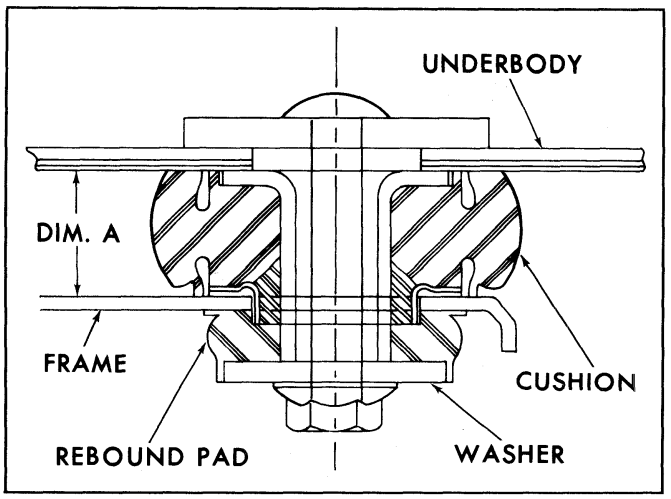


Fig. 2A-13 Measuring Body Mount Height

Inspection Procedure

Upper Isoflex Cushion

The upper cushion should be replaced if:

1. The height of the cushion is less than specified below, as measured across the upper cushion (Dim. A), Fig. 2A-13, at curb load: refer to cushion location in Fig. 2A-12.

Mount No. 1 - 1.06″
Mount No. 2 - 1.06″
Mount No. 3 - .82″

2. Splitting has occurred on rubber surfaces.

Lower Rebound Pad

The lower rebound pad should be replaced if it is broken, torn or deformed excessively.

Body Mount Investigation

Look for the following items if the body mounts are thought to be the cause of a complaint:

1. Heat shield for No. 3 right hand mount loose or rattling. Shield is attached between transmission crossmember and frame.
2. Loosen body bolts and nuts.
3. Bent or missing washers.

Body Mounts - Seville

a. Removal

NOTE: Perform procedure exactly as specified or damage to sheet metal or other components could result. Mounts must be changed only on one side of the car at a time, never both sides together.

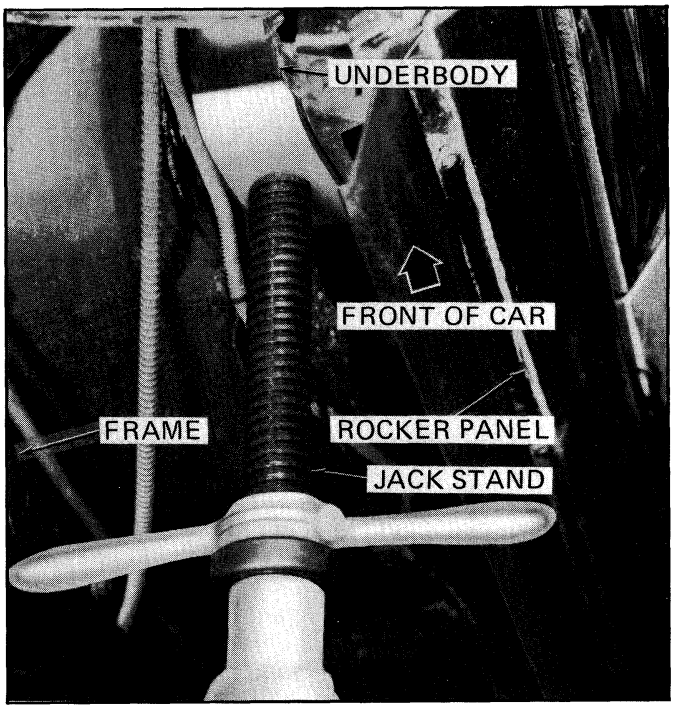


Fig. 2A-14 Jack Stand Support

1. Raise car on twin post hoist.
2. Remove all mount bolts and rebound pads and washer from one side of car only.
3. Support that side of car with jack stands at cowl. See Fig. 2A-14.
4. Remove fastener securing front ackromat seal to frame.
5. Remove transmission shift rod from lever assembly.
6. Carefully lower front hoist just enough to allow cushion to be removed, (approximately one inch).
7. Remove cushions as required.

b. Installation

NOTE: The correct color must be installed on all body mount positions, each side of car. See Fig. 2A-12.

1. Position cushions on frame and, using a drift pin in gage hole (Fig. 2A-6) for alignment, slowly raise front hoist until cushions contact body.
2. Install rebound pads, washers and body bolts. Torque nuts at No. 1 position to 50 foot-pounds and bolts at No. 2 and No. 3 positions to 90 foot-pounds and remove drift pin.
3. Position transmission shift rod to lever assembly and secure with screw. Tighten to 20 foot-pounds.
4. Position front ackromat seal to frame and secure with fastener.
5. Raise car, remove jack stand and lower car to ground.

TORQUE SPECIFICATIONS

Material No.	Application	Size	Newton Metres	Foot-Pounds
280M	Body to Frame Bolt No. 2 and No. 3 Positions	5/8-11	120	90
500M	Body Mounts (Exc. Seville)	12 x 1.75	75	55
510M	Brace to Frame (C-Car)	10 x 1.5	60	45
300M	Brace to Frame (Eldorado)	.438 x 14	70	50
301M	Brace to Frame Transmission (C-Car)	.438 x 14	70	50
280M	Cradle to Frame Nut No. 1 Position	7/16-14	70	50
510M	Crossmember to Frame (C-Car)	10 x 1.5	55	40
286M	Transmission Crossmember to Frame Bolt, Nut	3/8-16	40	30
300M	Transmission Shift Rod to Lever Screw	5/16-18	30	20

FRONT AND REAR BUMPERS

TABLE OF CONTENTS

General Description 2B-1
Energy Absorber Diagnosis 2B-4
On Car Service
C-Car 2B-5
Eldorado 2B-11
Seville 2B-17
Torque Specifications 2B-20

GENERAL DESCRIPTION

NOTE: For additional information pertaining to Eldorado and Seville bumpers, refer to the latter portion of this section.

C-Car

The front bumper assembly, Fig. 2B-1, consists of the upper center bar, lower center bar, outer ends on each side, license guard, outer guards on each side and a main reinforcement. Impact strips on the center bar bumper guards, and outer ends protect the assembly.

Eldorado

The Eldorado front bumper, Fig. 2B-2, consists of an upper center bar, two bumper guards, a lower center bar, a lower intermediate bar on each side, and one-piece outer ends.

Seville

The front bumper assembly consists of a lower impact bar, upper impact bar, outer guards on each side, two license

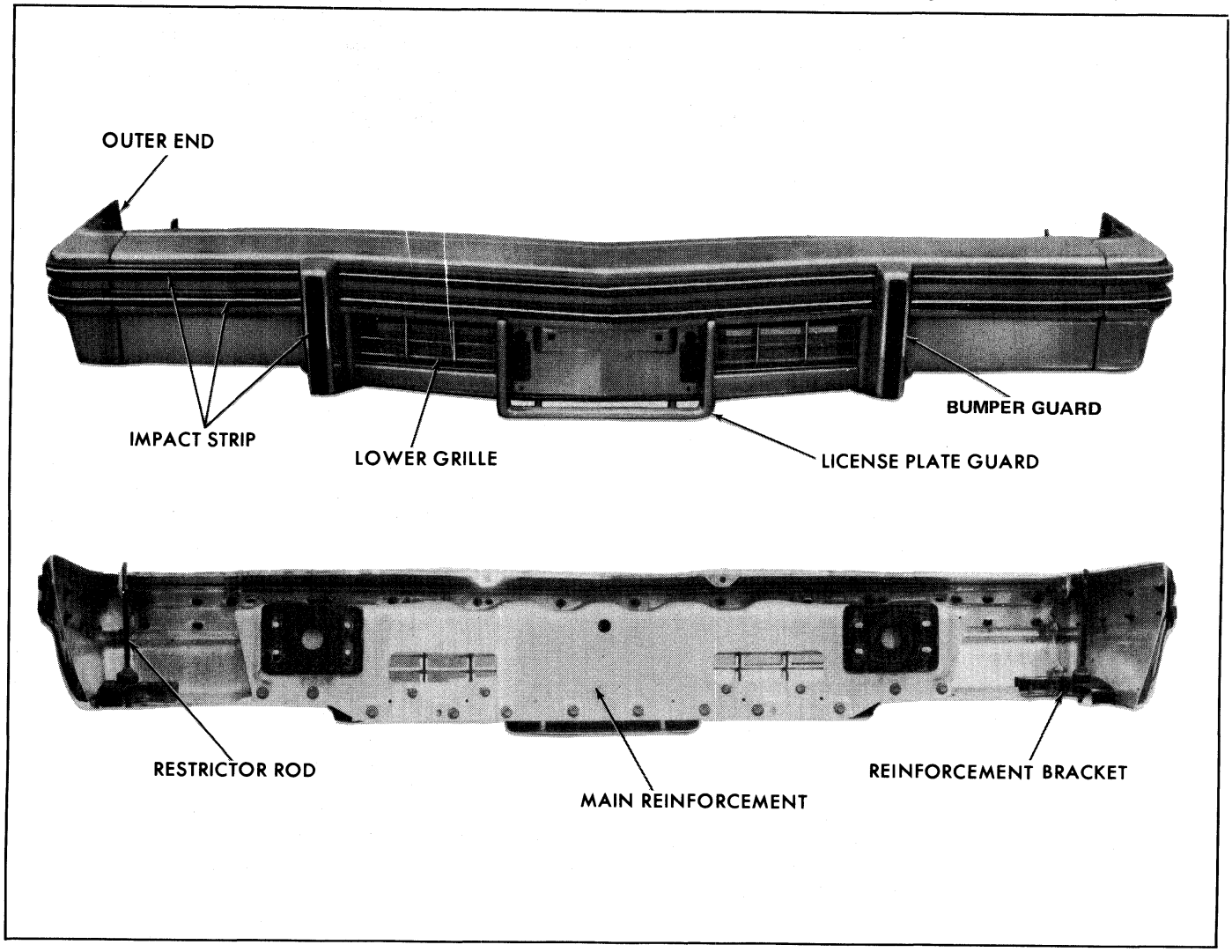


Fig. 2B-1 Front Bumper Assembly (C-Car)

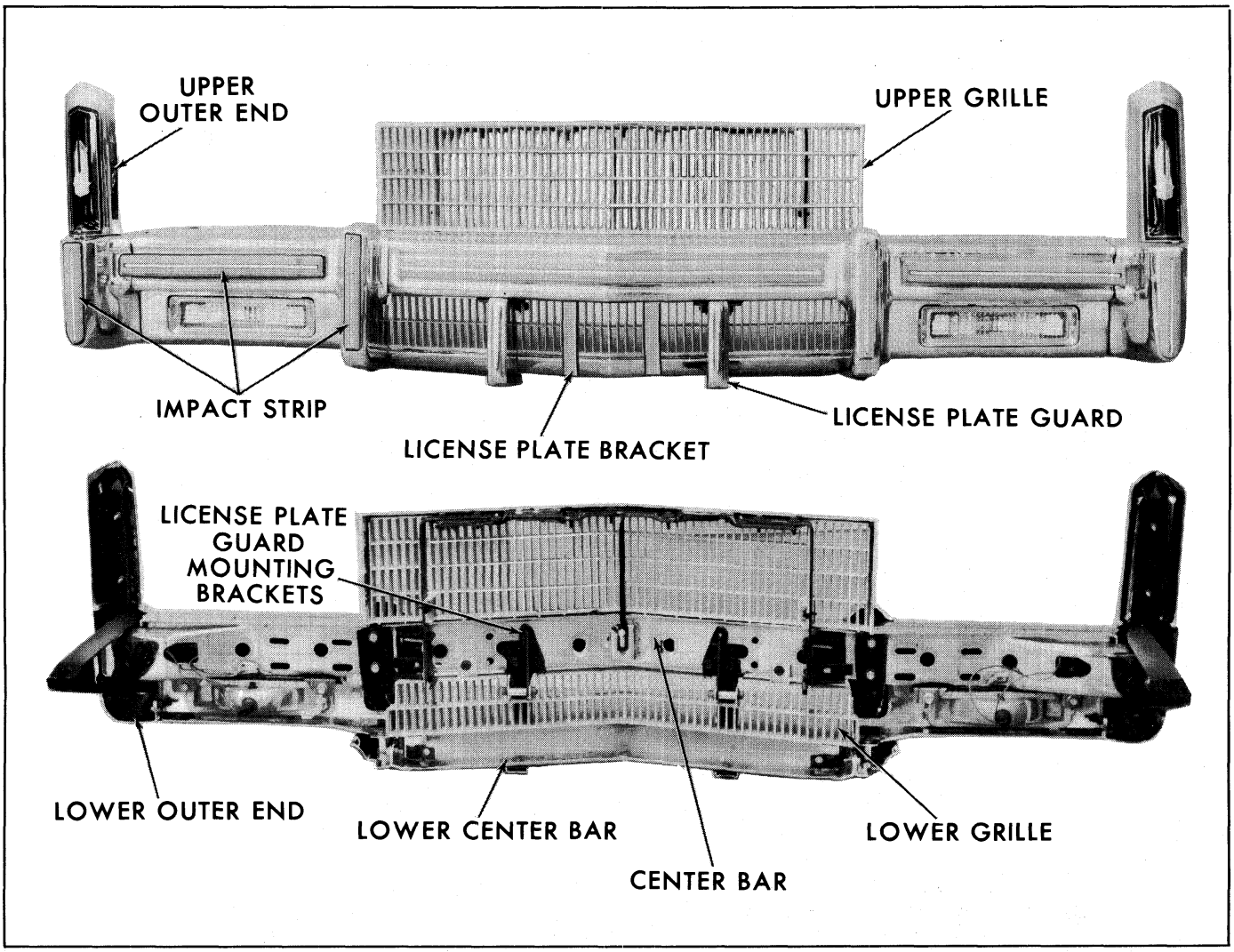


Fig. 2B-2 Front Bumper Assembly (Eldorado)

guards, license bracket, and a main reinforcement. Impacts strips on the upper impact bar, outer guards and license guards protect the assembly.

The rear bumper for all cars consists of one main bar. All but Seville have detachable outer ends. Impact strips protect the assembly through virtually the entire width.

Cadillac passenger car bumpers are designed so that the vehicle can withstand a collision into a fixed barrier at 8 km/h (5 mph) without damage. After absorbing the energy of the collision, the bumpers restore themselves to their original position.

The absorbing capability for both front and rear bumper systems is achieved through two energy absorbing devices in each bumper. These units convert the energy of an impact into heat and restoration.

The Energy Absorbing Device consists of two main sub-assemblies; the piston tube assembly and the cylinder tube assembly, Fig. 2B-3. The piston tube assembly is filled with an inert gas under pressure and consists of a bumper bracket, piston tube, orifice, seal, piston seal, piston, and stop-ring. The cylinder tube assembly is filled with a hydraulic fluid and consists of a frame bracket, cylinder tube, mounting stud, and metering pin.

The piston tube assembly is inserted in the cylinder tube assembly and the cylinder tube is crimped. This crimp mates with the stop-ring to hold the unit together. The recess in the stop-ring area is filled with grease to prevent the entrance of water and other contaminating materials.

The gas pressure in the piston tube assembly maintains the unit in an extended position. Extension is limited by the stop-ring on the outside of the piston tube engaging the matching contour of the crimp on the cylinder tube as shown in Fig. 2B-4. This engagement is also intended to provide extra rigidity to withstand jacking and towing stresses.

Upon impact, as the energy absorber is collapsed, the hydraulic fluid in the cylinder tube is forced into the piston tube through the orifice, Fig. 2B-3. The metering pin controls the rate at which this fluid passes from the cylinder tube through the orifice and into the piston tube. This controlled passage of the fluid provides the energy absorbing action.

The hydraulic fluid that is forced from the cylinder tube into the piston tube displaces the floating piston, compressing the gas behind the floating piston. After impact, the pressure of the compressed gas behind the floating piston forces the hydraulic fluid back into the cylinder tube assembly extending the unit to its normal position.

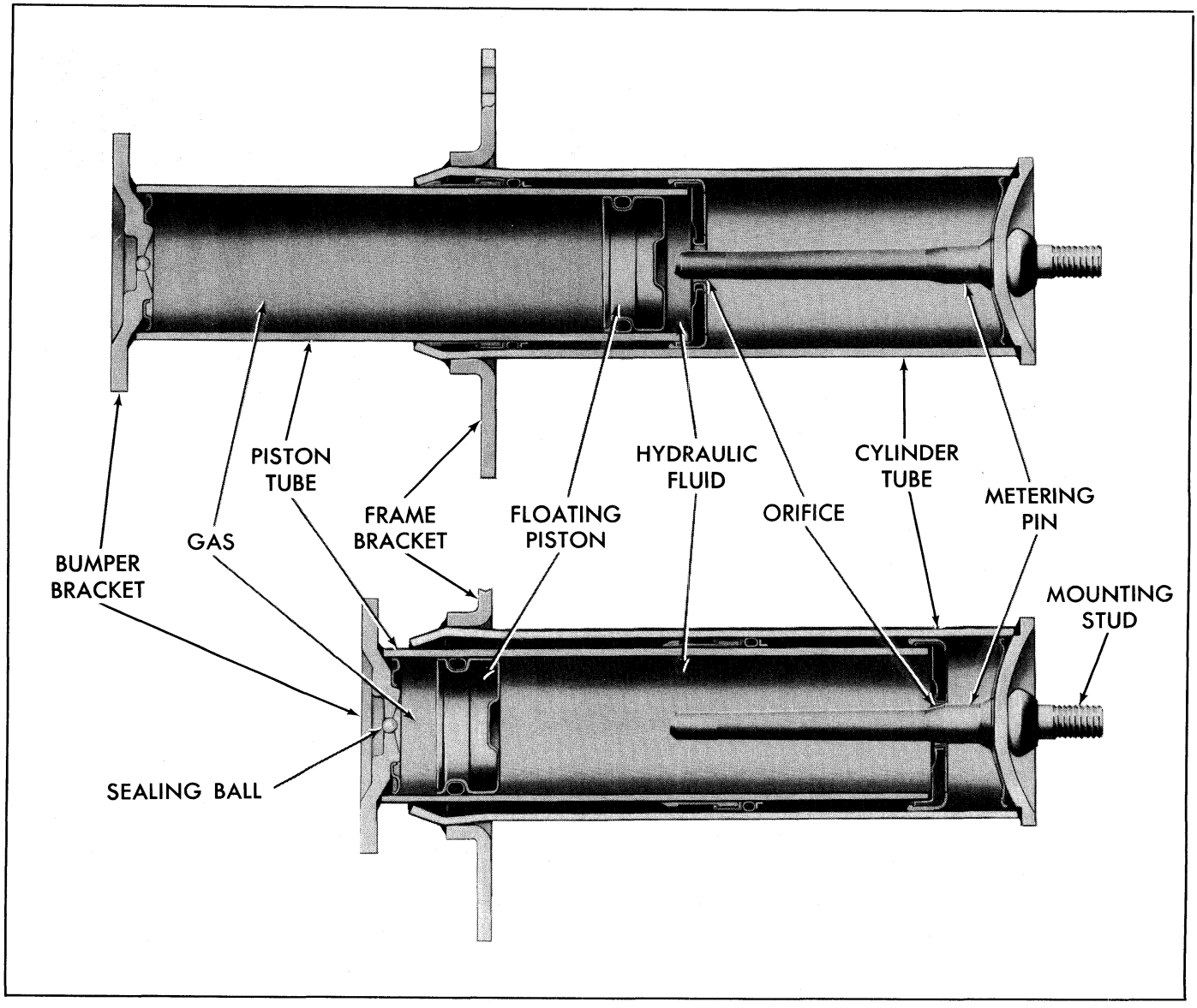


Fig. 2B-3 Energy Device Extended and Collapsed

A thin film of fluid on the energy absorber piston tube is a normal condition and does not require replacement of the unit.

Also attached to the bumper is a two piece grille that travels with the bumper when it absorbs an impact. Attachment to the frame is made by means of the Energy Absorbing Devices and their mounting brackets.

On all cars except Eldorado and Seville, two rubber mounted support rods extend upward from the bumper outer end to the radiator support.

On Eldorado, two rubber mounted support rods extend downward from the fender catwalk reinforcement to support brackets that attach to the front bumper upper outer ends.

Radiator Grille Lower Air Deflector

The radiator grille lower air deflector is attached to the front side of the radiator support with push-on plastic retainers. The front of the air deflector is attached to front bumper after bumper installation with push-on plastic retainers. The plastic retainers come pre-assembled in the deflector.

NOTE: Plastic retainers are not to be reused.

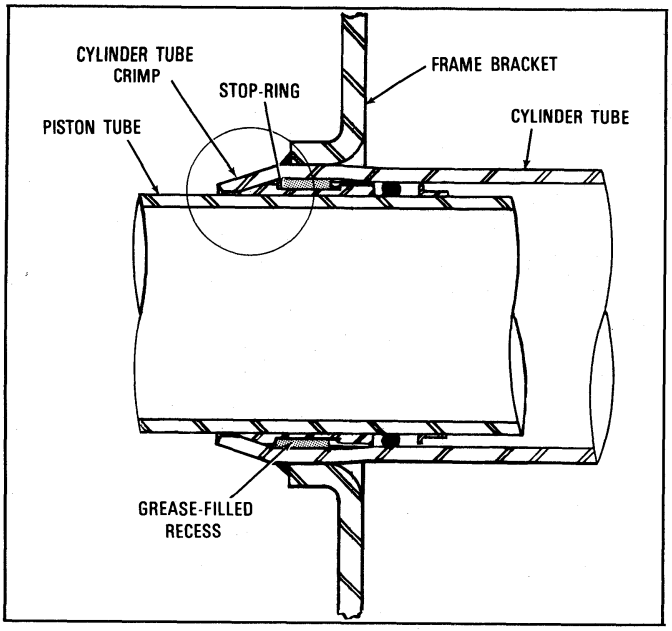


Fig. 2B-4 Energy Absorber Crimp Area

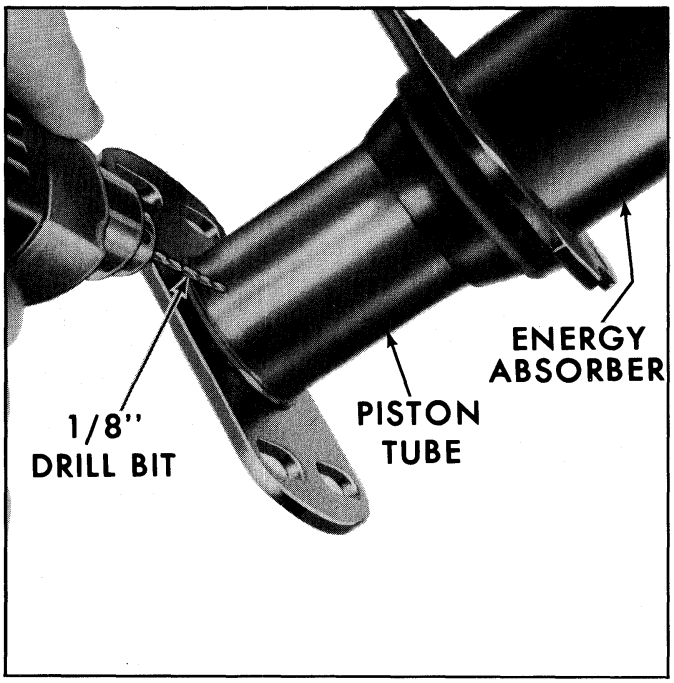


Fig. 2B-5 Scrapping Energy Absorber

DIAGNOSIS

WARNING: HEED THE FOLLOWING WHEN HANDLING ENERGY ABSORBING DEVICES OR PERSONAL INJURY MAY RESULT:

1. DO NOT APPLY HEAT TO A UNIT.

2. DO NOT WELD IN THE AREA OF A UNIT.

3. DO NOT ATTEMPT TO REPAIR A DAMAGED UNIT. ALWAYS REPLACE WITH A NEW UNIT.

4. IF UNIT IS BOUND-UP AS A RESULT OF A COLLISION SUCH THAT IT CANNOT EXTEND, TAKE PRECAUTIONS TO AVOID SPRING-BACK WHEN BENDING SHEET METAL. SEE PAGE 2B-5.

5. IF UNIT IS TO BE SCRAPPED, RELIEVE THE GAS PRESSURE PRIOR TO DISPOSAL OF A UNIT, MAKE AN INDENTATION WITH A CENTER PUNCH IN THE SMALL CYLINDER SECTION OF THE ENERGY ABSORBER, FIG. 2B-5.

USE A 1/8 INCH DRILL TO PENETRATE THE SMALL CYLINDER WALL.

BE SAFE. PROTECT YOUR EYES. WEAR APPROVED SAFETY GLASSES.

Testing Front or Rear Energy Absorber Operation

The right and left Energy Absorbing Devices are to be diagnosed separately. The following checks and separate judgments are to be made on each unit:

a. Leakage

Some oil wetting may be visible due to the grease packed in the crimp recess. Therefore, a stain or trace of oil on the piston tube near the crimp is normal. However, if oil is dripping continuously from the crimp or the stud end of the unit, a leak is indicated and the unit should be replaced.

b. Damage

Observe the bumper bracket, piston tube, frame bracket and cylinder tube for evidence of visible distortion. Scuffing of the piston tube will occur when the unit is stroked and is to be considered normal.

If there is obvious damage to the unit, it should be replaced.

c. On Car

1. Position car in front of a suitable fixed barrier such as a pillar, wall, post, or other anchorable fixture.

2. Turn ignition to Off, place selector lever in Park, set parking brake, and apply service brake.

3. Position a hydraulic or mechanical jack between bumper and barrier such that jack is positioned squarely with bumper directly in line with Energy Abosrber to be checked, Fig. 2B-6.

4. Apply pressure to compress Energy Absorber at least 3/8" using an indicator to detect exact amount of travel.

5. Release pressure and check indicator to determine whether Energy Absorber returned to its original position. If not, replace Energy Absorber.

6. Repeat Steps 3, 4, and 5 for second Energy Absorber.

WARNING: DRIVING INTO POSTS, WALLS, OR BARRIERS TO PERFORM THIS TEST IS NOT RECOMMENDED BECAUSE PERSONAL INJURY OR PROPERTY DAMAGE COULD RESULT.

d. On Bench

1. Position Energy Absorber lengthwise in arbor press.

2. Using a suitable measuring device, note original position of unit then use press to compress unit at least 3/8".

3. Release pressure and determine whether unit has returned to original position. If not, discard unit.

Inspection After Collision

If the collision was so severe that the bumper did not return to its original position, the energy absorber(s) will require replacing.

1. Stand clear of the bumper.

2. Provide a positive restraint, such as a chain or cable to hold the bumper in the position it is in.

3. Wear safety glasses and drill a small hole in the piston tube near the bumper bracket, Fig. 2B-5, to relieve gas pressure.

4. Remove the energy absorber(s) after gas pressure has been relieved.

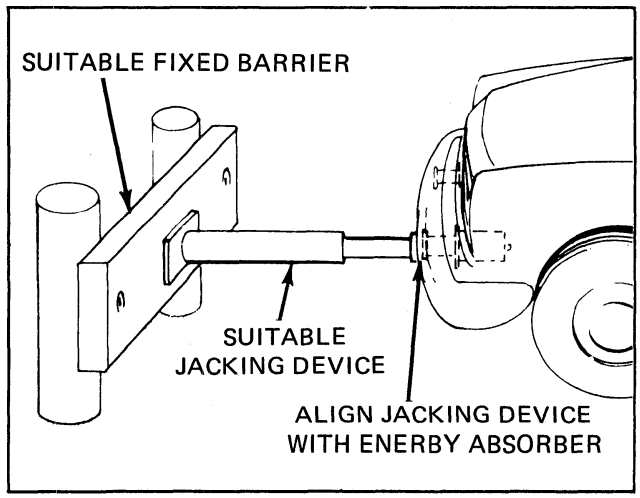


Fig. 2B-6 Fixed Barrier Test

ON-CAR SERVICE–"C" CAR

Front Bumper

a. Removal

1. Support bumper at center with hydraulic jack.

2. Disconnect retainers securing air deflector to lower main reinforcement.

3. Loosen nut below and above reinforcement bracket to relieve tension.

4. Remove one bolt, washer, grommet and sleeve securing restrictor rod to radiator support, Fig. 2B-7.

NOTE: Count number of shims at each location so that the same number are installed during installation.

5. Remove four nuts securing front bumper to each EA unit.

6. Repeat steps 3 and 4 on other side of car and remove bumper.

b. Installation

1. Raise bumper into position. Make sure filler strips at headlamp housings are underneath rear edge of bumper.

2. Insert shims between bumper bracket and bumper. Install four nuts finger tight, securing each EA unit to bumper.

3. Loosely install one bolt, washer, grommet and sleeve securing restrictor rod to radiator support.

4. Before tightening bumper, check to assure proper alignment. Vertical and side-to-side adjustments can be made using slotted holes in EA unit and bumper.

5. Tighten four nuts each side of car to 55 N·m (40 foot-pounds).

6. Tighten nuts above and below reinforcement bracket to 16 N·m (12 foot-pounds).

7. Tighten bolt at restrictor rod to 10 N·m (75 inch-pounds).

8. Secure air deflector to lower main reinforcement.

9. Remove hydraulic jack.

Front Energy Absorbing Unit (Fig. 2B-8)

a. Removal

1. Remove front bumper as described.

2. Remove two bolts and nuts securing radiator support cross rod bracket to EA frame bracket, Fig. 2C-5.

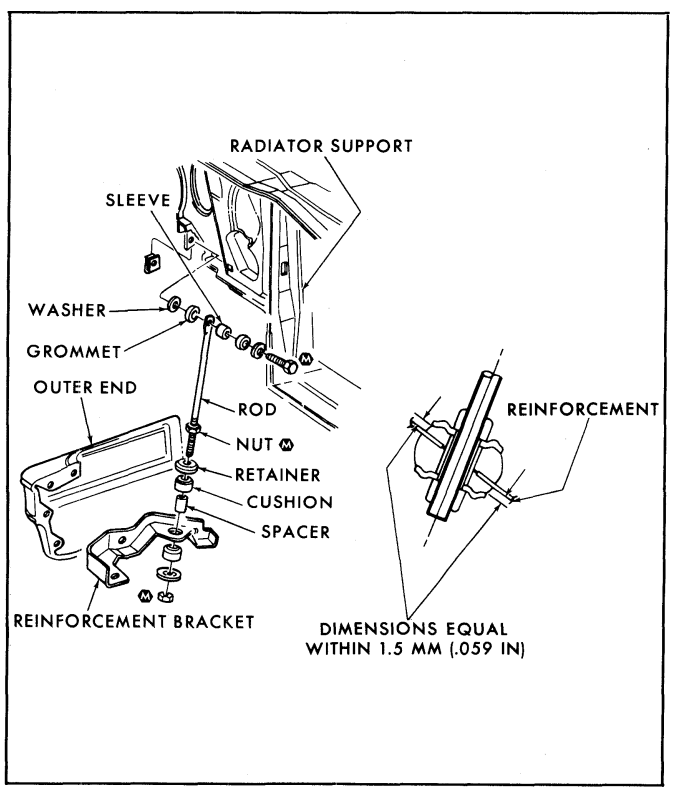


Fig. 2B-7 Restrictor Rod

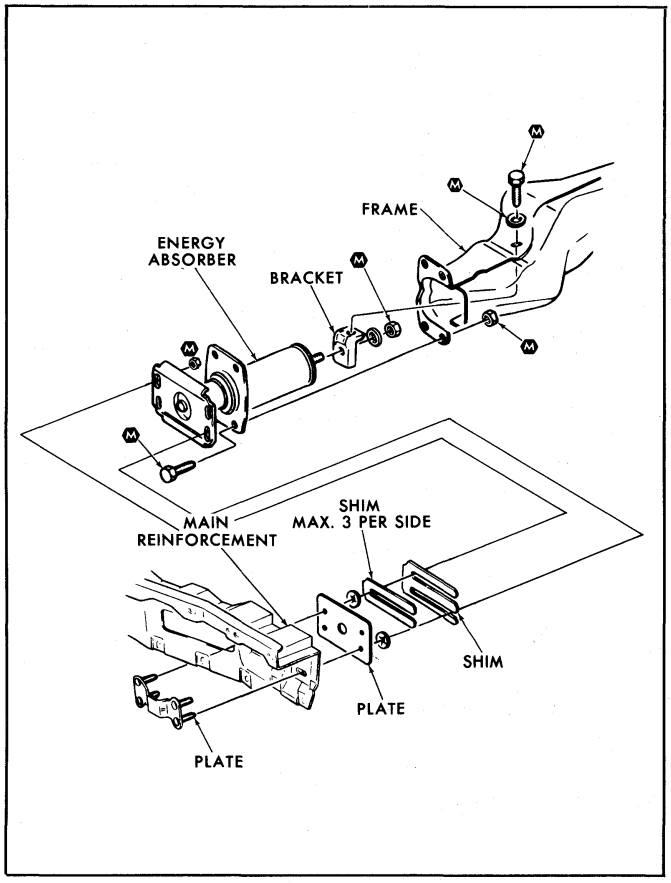


Fig. 2B-8 Front Energy Absorber Attachment

3. Remove remaining two bolts and nuts securing EA frame bracket to frame horn.

4. Remove one bolt and washer located at top of frame rail securing rear of EA unit to frame. Turn unit to maneuver pass strut rod and slide out of frame rail.

5. Remove bracket from EA unit.

b. Installation

1. Install bracket on new EA unit with weld nut facing up.

2. Position EA unit inside frame rail. Align rear EA bracket with hole in frame. Install one bolt and washer finger tight.

3. Install four bolts and nuts securing EA frame bracket to frame horn. Make sure the strut rod bracket is connected to the lower EA frame bracket and tighten all bolts to 55 N·m (40 foot-pounds).

4. Tighten rear EA bracket to frame bolt to 55 N·m (40 foot-pounds).

5. Install bumper as described.

Front Bumper Main Reinforcement (Fig. 2B-9)

a. Removal

1. Remove front bumper as described on page 2B-5.
2. Remove lower grilles as described on page 2C-6.

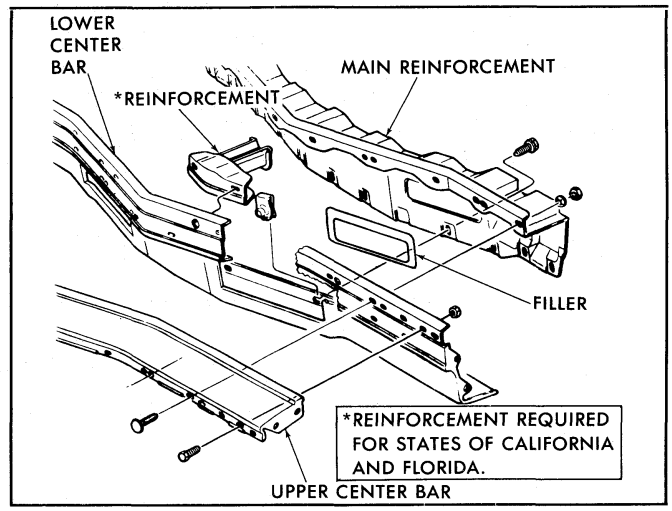


Fig. 2B-9 Main Reinforcement

3. Remove 14 nuts securing main reinforcement to upper center bar.

NOTE: The two out-board studs securing main reinforcement to upper center bar are independent studs and are not part of the outer impact strips.

4. Remove 10 bolts securing main reinforcement to lower center bar and remove reinforcement.

b. Installation

1. Position main reinforcement to bumper.
2. Install 10 bolts securing main reinforcement to lower center bar. Tighten to 30 N·m (22 foot-pounds).
3. Install 14 nuts securing main reinforcement to upper center bar. Tighten to 30 N·m (20 foot-pounds). Do not over torque or impact strip may become distorted.
4. Install lower grilles as described on page 2C-6.
5. Install front bumper as described on page 2B-5.

Front Bumper Center Impact Strip (Fig. 2B-10)

a. Removal

1. Remove bumper as described on page 2B-5.

NOTE: Use care when removing impact strips as the ends are located just under the bumper guards.

2. Remove lower grilles as described on page 2C-6.
3. Remove 14 nuts securing main reinforcement to upper center bar and remove upper impact strip.
4. Remove 10 bolts securing reinforcement to lower center bar and remove main reinforcement to gain access to lower impact strip.
5. Remove 6 nuts securing lower impact strip to center bar and remove strip.

b. Installation

NOTE: When installing the center impact strips, make sure the ends are placed under the bumper guards.

1. Position lower impact strip on center bar with locator properly in place. Install 6 nuts and tighten to 20 N·m (14 foot-pounds).
2. Install main reinforcement as described, securing upper impact strip.
3. Install lower grilles as described on page 2C-6.
4. Install front bumper as described on page 2B-5.

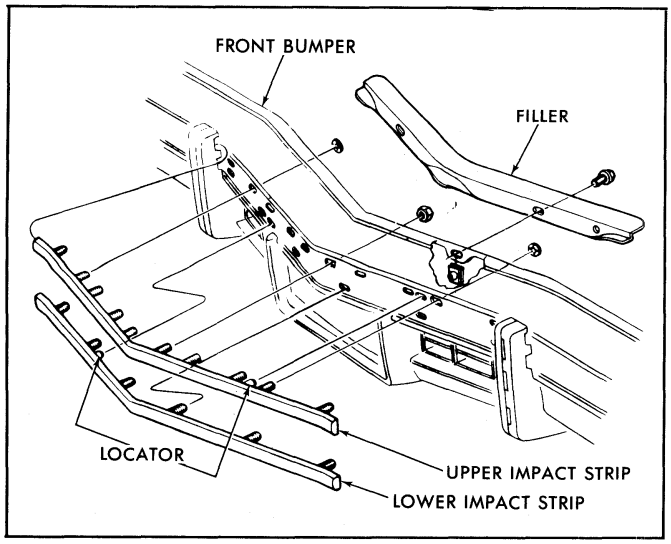


Fig. 2B-10 Front Bumper Center Impact Strip

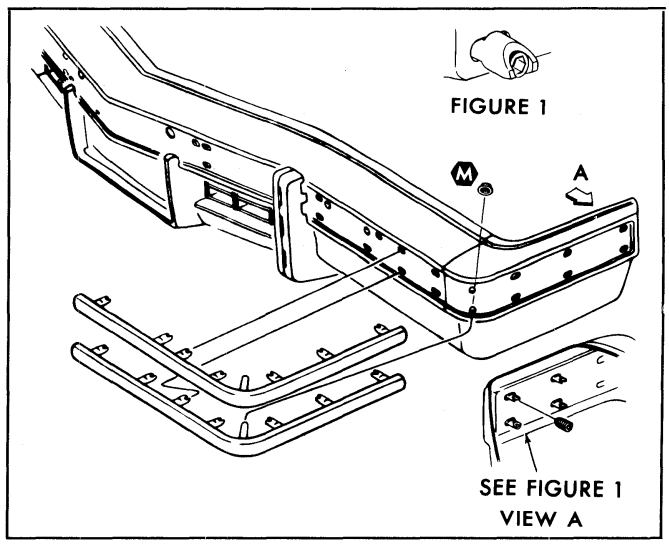


Fig. 2B-12 Front Bumper Outer Impact Strip

Front Bumper Guards and Bumper Guard Impact Strips (Fig. 2B-11)

a. Removal

1. Remove front bumper as described on page 2B-5.
2. Remove lower grilles as described on page 2C-6.
3. Remove main reinforcement as described on page 2B-6.
4. Remove two bolts securing bumper guard to center bar and remove bumper guard.
5. Remove three nuts securing impact strip to bumper guard and remove impact strip.

b. Installation

1. Install impact strip on bumper guard, securing with three nuts. Tighten to 5 N·m (25 inch-pounds). Do not over torque or strip may become distorted.
2. Position bumper guard on bumper. Install two bolts and tighten to 30 N·m (22 foot-pounds).
3. Install main reinforcement as described on page 2B-6.
4. Install lower grilles as described on page 2C-6.
5. Install front bumper as described on page 2B-5.

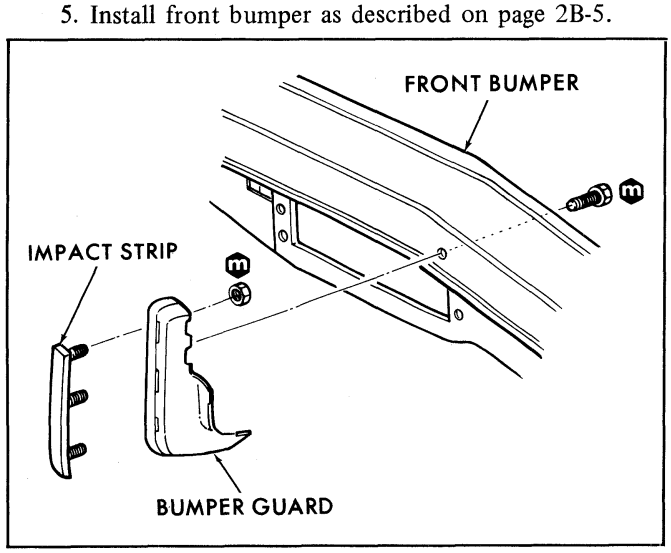


Fig. 2B-11 Front Bumper Guards and Bumper Guard Impact Strips

Front Bumper Outer Impact Strip (Fig. 2B-12)

a. Removal

NOTE: For outer impact strip replacement where strip is not reused, strip may be removed without removing bumper by removing set screws and chiseling tabs using a plastic paddle or an equivalent tool, taking care not to damage bumper. However, this impact strip can be removed without damage, using the following procedure:

CAUTION: *Be extremely careful not to damage bumper finish when removing outer impact strips.*

1. To gain access to tabs of upper and lower impact strips, remove front bumper as described on page 2B-5, remove lower grilles as described on page 2C-6, and remove main reinforcement as described on page 2B-6.
2. Remove two set screws secured in impact tabs, one upper, one lower, located at ends of impact strip. Use pliers or equivalent and squeeze tabs to remove upper and lower impact strips.

NOTE: Be careful not to lose the two independent studs located under impact strip.

3. Remove one nut each securing corner of upper and lower impact strip to outer end.

b. Installation

NOTE: Be sure independent studs are under impact strips when installing.

1. To install impact strips, align tabs with holes on outer bumper and, after making sure end of strip is under bumper guard, use a plastic-tip hammer forcing tabs in holes.
2. Install one nut per impact strip securing corner of impact strip to outer end and tighten to 5 N·m (30 inch-pounds).
3. Install set screws in impact strip tabs, one upper, one lower, located at ends of impact strip.
4. Install main reinforcement as described on page 2B-6, install lower grilles as described on page 2C-6, and install front bumper as described on page 2B-5.

Front Bumper Outer End (Fig. 2B-13)

a. Removal

1. Remove upper and lower impact strips from outer end as described above.

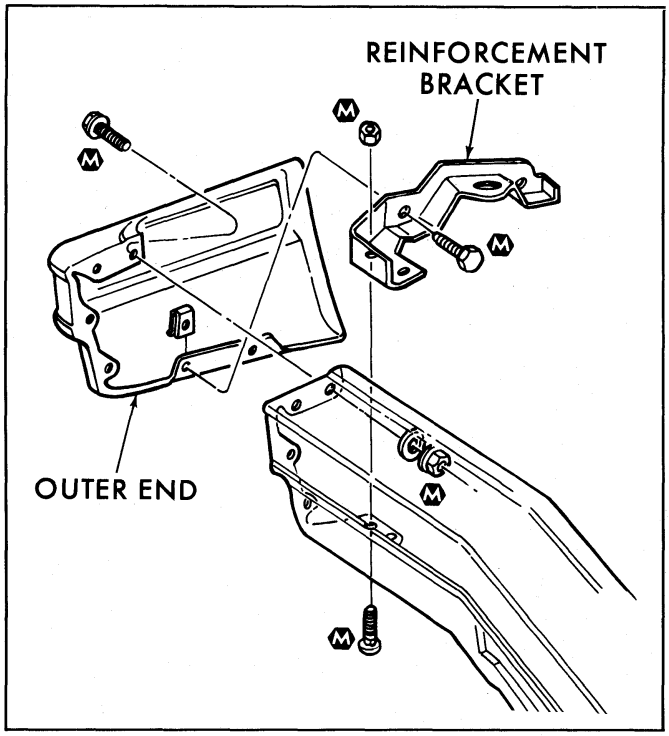


Fig. 2B-13 Front Bumper Outer End

2. Remove two bolts securing outer end to reinforcement bracket.

3. Remove four screws, nuts and washers securing outer end to center bar and remove.

b. Installation

1. Install four screws, nuts and washers securing outer end to bumper. Tighten to 30 N·m (22 foot-pounds).

2. Install two bolts securing reinforcement bracket to outer end.
Tighten to 30 N·m (22 foot-pounds).

3. Install upper and lower impact strips to outer end as described on page 2B-7.

Front Bumper Filler - On Car (Fig. 2B-10)

a. Removal

Remove two bolts securing filler to upper center bar and remove filler.

b. Installation

Position filler to bumper and install two bolts securing filler to center bar and tighten to 20 N·m (13 foot-pounds).

License Guard (Fig. 2B-14)

a. Removal

1. Remove front bumper as described on page 2B-5.

2. Remove lower grilles as described on page 2C-6.

3. Remove main reinforcement as described on page 2B-6.

4. Remove two nuts and bolts on each side of license guard, securing top of guard to center bar.

5. Remove two nuts, bolts, and spacers securing bottom of license guard to lower center bar and remove guard.

b. Installation

1. Position license guard on bumper and install two nuts, bolts, and spacers, securing guard to lower center bar. Tighten to 30 N·m (22 foot-pounds).

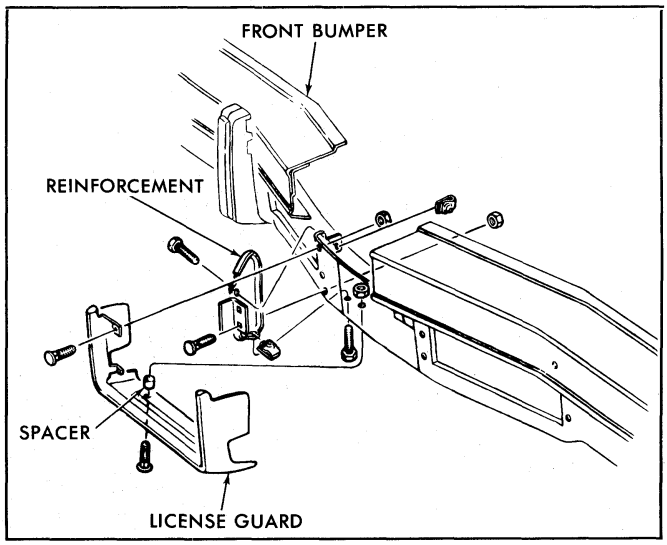


Fig. 2B-14 License Guard

2. Install two nuts and bolts, one each side of guard, securing guard to center bar. Tighten to 10 N·m (75 inch-pounds).

3. Install main reinforcement as described on page 2B-6.

4. Install lower grilles as described on page 2C-6.

5. Install front bumper as described on page 2B-5.

Rear Bumper (Fig. 2B-15)

a. Removal

1. Scribe alignment marks on bumper at EA unit for proper orientation on assembly.

2. Support bumper at center with hydraulic jack.
NOTE: Count number of shims at each location so that the same number are installed during installation.

3. Remove four nuts securing bumper to EA unit.

4. Repeat Step 3 on other side of car.

5. Disconnect tail lamp connectors and remove bumper.

b. Installation

1. Align bumper on car and connect tail lamp connectors.

2. Install four nuts securing bumper to EA unit.

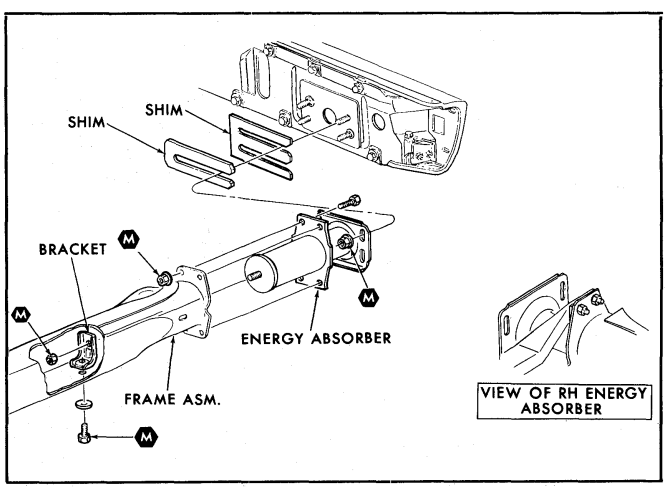


Fig. 2B-15 Rear Energy Absorber Attachment

3. Repeat Step 2 on other side of car and tighten to 55 N·m (40 foot-pounds).

4. Remove hydraulic jack.

Rear EA Unit (Fig. 2B-15)

a. Removal

1. Remove bumper as described.

2. Remove four bolts and nuts securing EA frame bracket to frame horn. If working on right side of car, remove the resonator support bracket secured to the upper EA frame bracket.

3. Remove one bolt and washer securing rear EA bracket to frame located under frame rail.

4. Remove EA unit by sliding out of frame rail. If working on right side of car, maneuver unit around resonator bracket and remove.

b. Installation

1. Position EA unit in frame rail. Align rear EA bracket with hole in frame. Install one bolt and washer finger tight.

2. Install four bolts and nuts securing EA frame bracket to frame horn. If working on right side of car, secure resonator bracket to upper EA frame bracket and tighten all bolts to 55 N·m (40 foot-pounds).

3. Tighten rear EA bracket to 55 N·m (40 foot-pounds).

4. Install bumper as described.

Rear Bumper Main Reinforcement (Fig. 2B-16)

a. Removal

1. Remove bumper assembly as described.

2. Remove 22 screws securing main reinforcement and outer ends to center bar and remove main reinforcement.

b. Installation

1. Position outer ends and main reinforcement to center bar. Install 22 screws securing main reinforcement and outer ends to center bar. Tighten to 30 N·m (22 foot-pounds).

2. Install bumper assembly as described.

Rear Bumper Outer End and Impact Pad (Fig. 2B-17)

a. Removal

1. Raise car.

2. Remove two screws securing bumper outer end to bumper.

3. Remove outer end from filler and disconnect electrical connections.

4. Remove outer end.

5. Remove three nuts securing impact pad to outer end.

b. Installation

1. Install impact pad to outer end and secure with three nuts. Tighten to 5 N·m (25 inch-pounds). Do not over torque as impact pad may become distorted.

2. Position outer end on bumper and connect electrical connections.

3. Install two screws securing outer end to bumper. Tighten to 30 N·m (22 foot-pounds).

4. Lower car.

Rear Bumper Impact Strips (Fig. 2B-18)

a. Removal

NOTE: For rear impact strip replacement where strip is not reused, strip may be removed without removing bumper by chiseling tabs using a plastic paddle or an equipment tool, taking care not to damage bumper. However, this strip can be removed without damage, using the following procedure:

1. Remove bumper assembly as described on page 2B-8.

2. Remove main reinforcement as described in column 1 on this page.

CAUTION: *Be extremely careful not to damage bumper finish when removing impact strips.*

3. Use pliers or equivalent to squeeze tabs and remove upper and lower impact strips.

b. Installation

1. To intall impact strips, align tabs with holes on outer bumper and, with a plastic-tip hammer, force tabs in holes, properly seating impact strips.

2. Install main reinforcement as described in column 1 on this page.

3. Install bumper assembly as described on page 2B-8.

Rear Bumper License Plate Filler (Fig. 2B-19)

a. Removal

1. Remove rear bumper assembly as described on page 2B-8.

2. Remove main reinforcement as described in column 1 on this page to gain access to filter fasteners.

3. Remove six nuts securing ends of filler escutcheon to upper center bar and remove escutcheon and filler.

4. Remove filler gasket from bumper and discard.

b. Installation

1. Install a new filler gasket taking care that adhesive side of gasket adheres to bumper.

2. Position filler and filler escutcheon on bumper and install six nuts securing escutcheon to upper center bar, tightening to 20 N·m (15 inch-pounds).

3. Install main reinforcement as described in column 1 on this page.

4. Install rear bumper as described on page 2B-8.

Rear Bumper Quarter Filler

a. Removal

1. Remove rear bumper outer end as described on page 2B-8.

2. Open trunk and pull out side panel to remove six screws inside and one screw outside on bottom of filler securing filler to body and remove filler.

b. Installation

1. Position filler to body and secure with six screws inside trunk and one screw outside on bottom of filler.

2. Install rear bumper outer end as described on page 2B-8.

Fuel Filler Door (Fig. 2B-20)

a. Removal and Installation

To remove, open door and remove two screws securing backing plate to body and remove assembly.

To install, position door assembly and secure with two screws. Tighten to 15 N·m (10 foot-pounds).

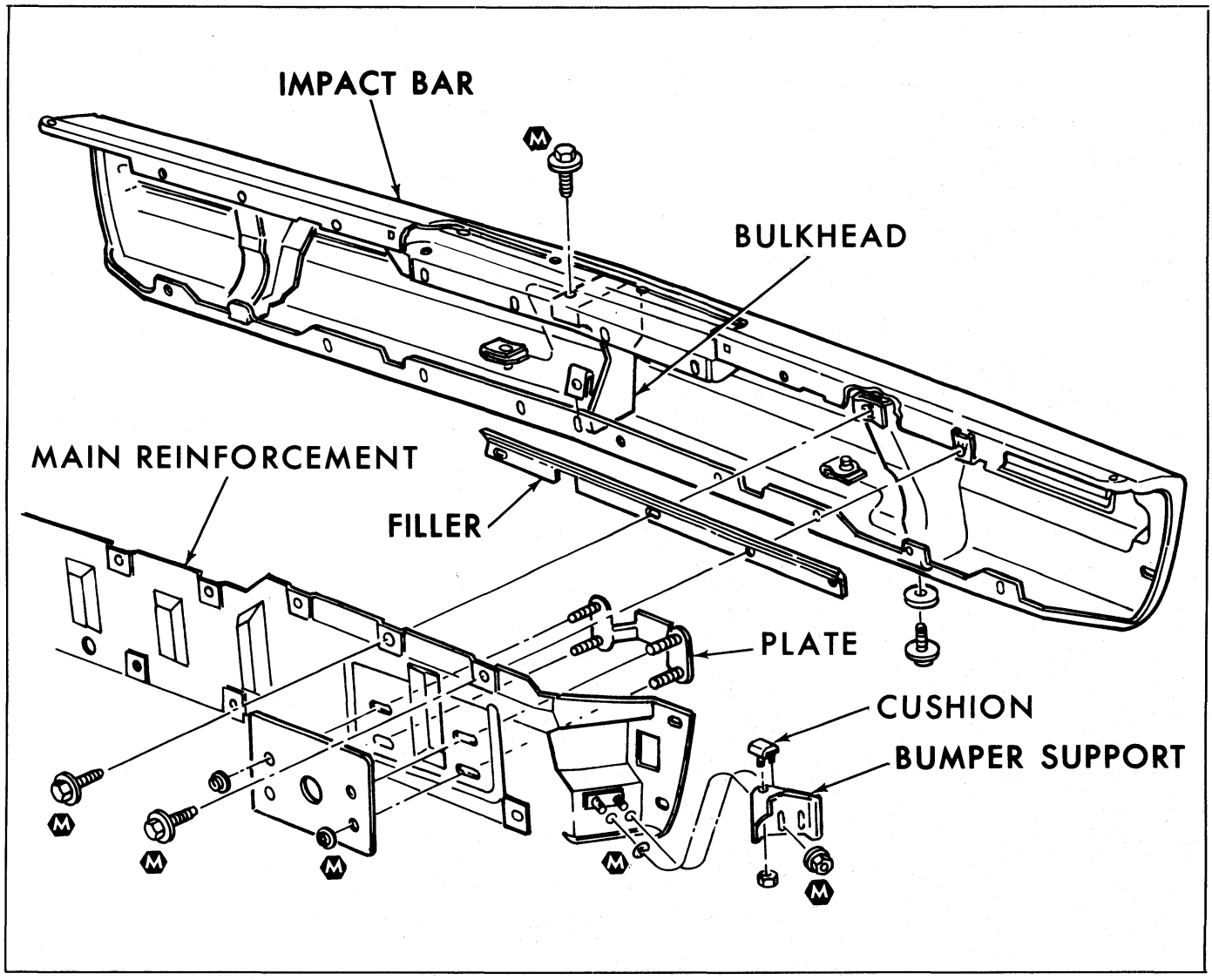


Fig. 2B-16 Rear Bumper Main Reinforcement

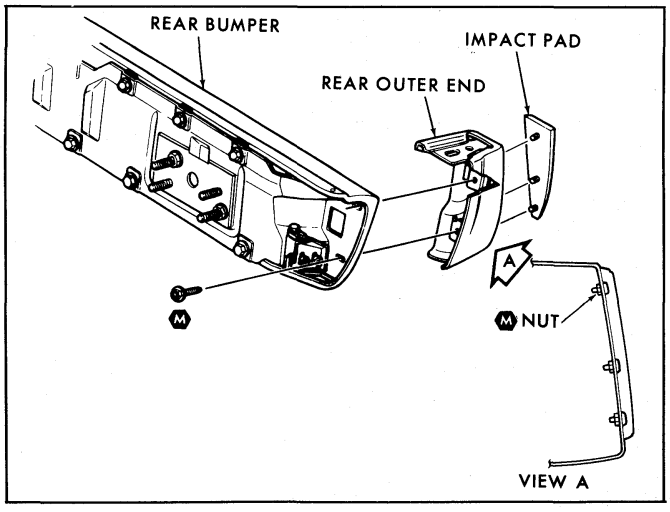


Fig. 2B-17 Rear Bumper Outer End and Impact Pad

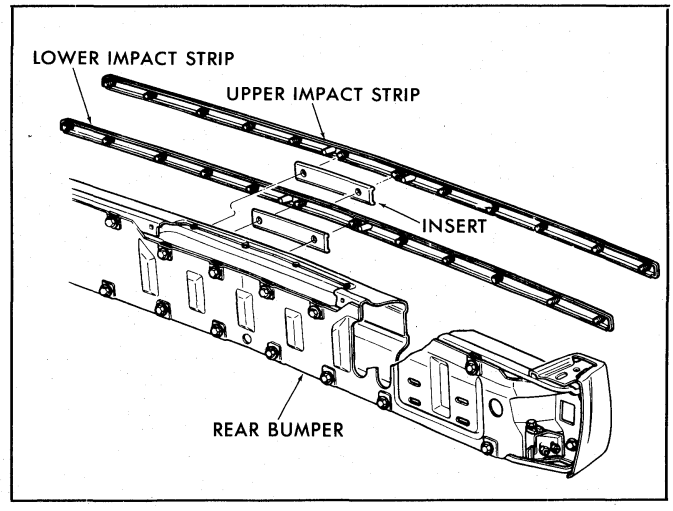


Fig. 2B-18 Rear Bumper Impact Strips

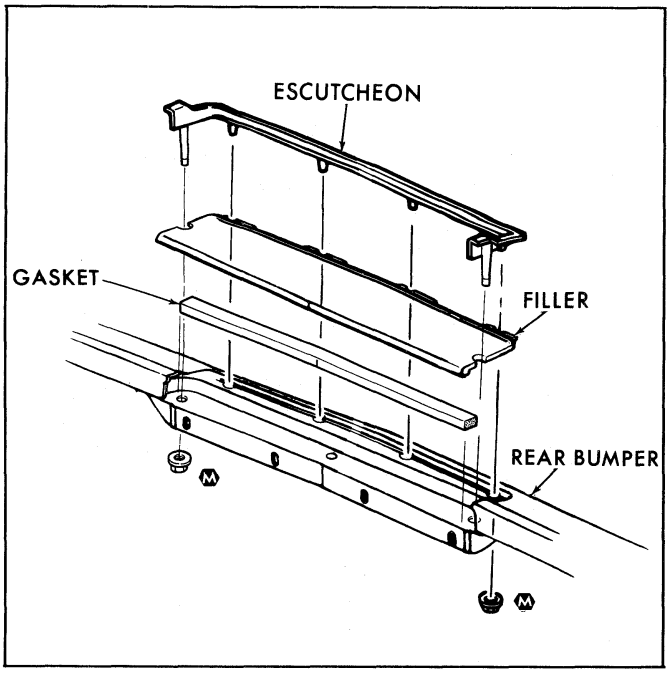


Fig. 2B-19 License Plate Filler

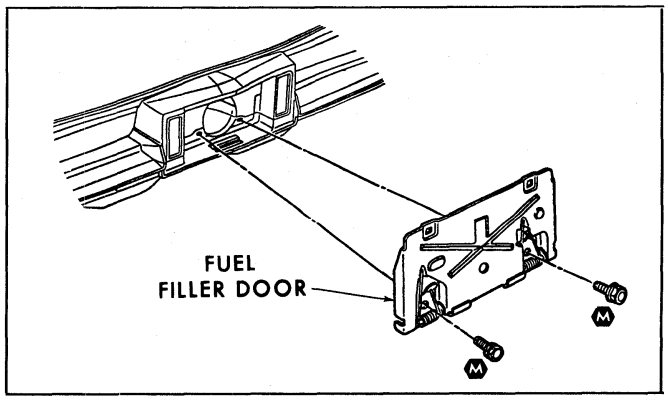


Fig. 2B-20 Fuel Filler Door

ON-CAR SERVICE-ELDORADO

Front Bumper

a. Removal

1. Support bumper at center with hydraulic jack.
2. If car is equipped with guidematic, remove two screws securing photosenser bellows to left side of upper grille and disconnect bellows from grille.
3. Remove four bolts and two retainers securing bumper to EA unit, Fig. 2B-21.
4. Remove nut, two cushions, two retainers and spacer securing support rod to bracket on bumper end, Fig. 2C-15. Do not disturb nut just above upper cushion, as it controls cushion load and position.
5. Open hood and remove two retainers securing air deflector to lower center bar.
6. Repeat steps 2 and 3 for other side of car and remove bumper.

b. Installation

1. Raise bumper into position. Make sure center air deflector and filler strips at headlight housings are resting on bumper.
2. Insert two retainers in position behind mounting holes in bumper, Fig. 2B-21, and install four bolts finger tight, securing each EA unit to bumper.
3. Install retainer, cushion, spacer, second cushion and retainer, and nut, Fig. 2C-15, securing each support rod to bumper bracket. Tighten nut to 18 foot-pounds.
4. Repeat steps two and three for other side of car.
5. Open hood and install two retainers securing air deflector to lower center bar.
6. Secure guide-matic bellows to grille with two screws if so equipped.
7. Before tightening, check bumper to assure proper alignment. Vertical and side-to-side adjustments can be made using slotted holes in EA unit and bumper. Tighten bolts to 32 foot-pounds and remove jack.

Front Energy Absorbing Unit and Mounting Brackets (Fig. 2B-21)

a. Removal

1. Remove front bumper as described in column 1 on this page.
2. Remove four nuts, washers and bolts securing EA bracket and friction plate to frame, and remove EA unit assembly.
3. Remove three bolts and nuts securing EA mounting bracket to EA frame bracket, Fig. 2B-21.
4. Remove one nut securing EA mounting stud to rear of EA mounting bracket. Slide EA unit forward and out of mounting bracket.

b. Installation

1. Insert EA mounting stud into rear of mounting bracket and install nut. Install three bolts and nuts, securing EA frame bracket to mounting bracket and tighten fasteners to 55 foot-pounds.

NOTE: Although there are four mounting holes in the EA frame bracket, only three are used. The upper left hole, Fig. 2B-21, is not used.

2. Line up holes in frame horn, friction plate, and EA mounting bracket. Install four bolts, nuts and washers so that bolt heads are inside frame horn. Tighten until snug. Do not torque at this time.
3. Install front bumper as described in column 1 on this page.

NOTE: Fore and aft adjustment can be made by means of slotted holes in the EA mounting brackets.

4. When proper alignment is achieved, tighten four bolts securing EA unit to bumper to 32 foot-pounds, and four bolts securing EA mounting bracket to frame to 70 foot-pounds;

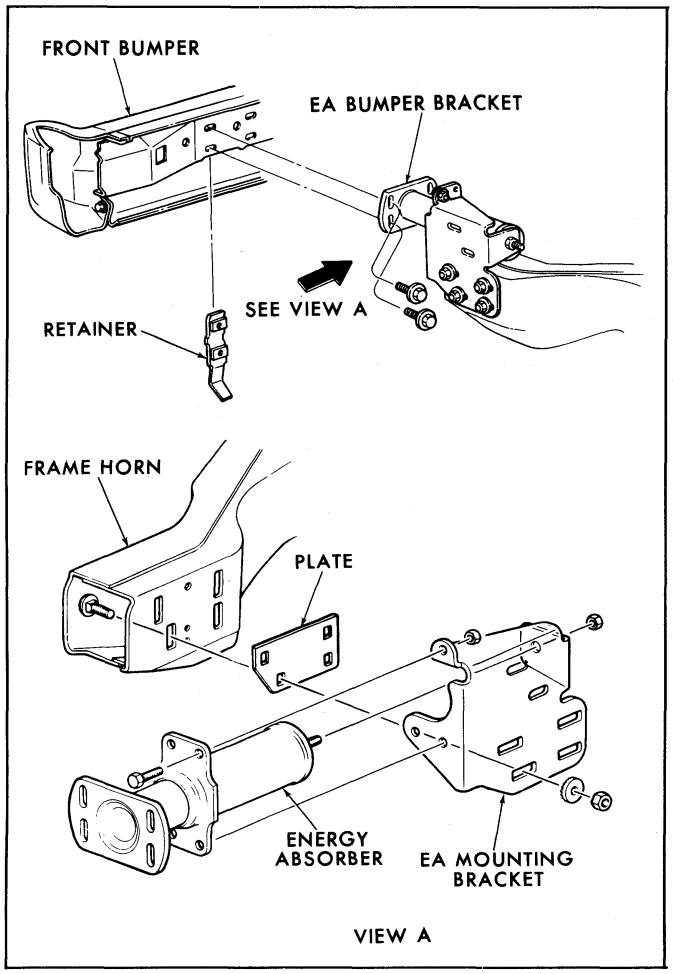


Fig. 2B-21 Front Energy Absorber Attachment

then remove hydraulic jack.

Front Bumper Guards and Bumper Guard Impact Strips-On Car (Fig. 2B-22)

a. Removal

1. Remove two long screws and washers securing bumper bracket and bumper guard to bumper upper center bar.

2. Remove one bolt, spacer and nut securing bumper guard to lower center bar and remove bumper guard.

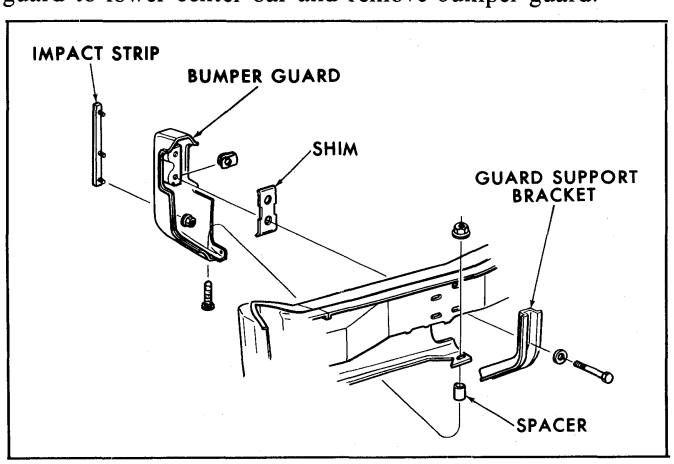


Fig. 2B-22 Front Bumper Guards and Bumper Guard Impact Strips

3. Remove three nuts securing impact strip to bumper guard and remove impact strip.

b. Installation

1. Install impact strip on bumper guard, securing with three nuts. Tighten nuts to 13 inch-pounds. Do not overtorque or strip may become distorted.

2. Position bumper guard and bumper bracket on bumper. Install two long screws and washers, tightening to 30 foot-pounds.

3. Install one bolt, spacer and nut securing bumper guard to lower center bar tightening to 18 foot-pounds.

Front License Plate Bracket (Fig. 2B-26)

a. Removal

1. Remove two screws securing (LH & RH) license bracket to upper center bar.

2. Remove one screw securing (LH & RH) lower end of license bracket to lower center bar and remove bracket.

b. Installation

1. Position one screw securing lower end of license bracket to lower center bar.

2. Install two screws securing license bracket to upper center bar. Tighten all fasteners to 50 inch-pounds.

Front Fender Filler Panel

a. Removal

1. Working under car, remove three screws and washers securing filler and reinforcement strip to forward end of fender.

2. Remove one screw and washer securing reinforcement strip to filler panel.

Painting (use specified material or equivalent)

All replacement filler panels are prepainted in either color code 11 or 81. If car being worked on is any color other than 11 or 81, filler panel must be repainted according to the following procedure.

1. Clean part in solvent to remove any dirt, grease, or oil.

2. Sand damaged area with #400 sandpaper to feather edge the damaged area. If repainting a replacement part, sand entire part to promote adhesion.

3. Wash again in solvent to remove loose material.

4. Spray on one coat of ti-coat primer, Part No. 105 1214, or equivalent, and air dry five minutes.

NOTE: Apply primer **only** if sanding has completely removed paint, exposing the black surface of the filler panel.

5. Spray on three coats of special elastomeric lacquer and air dry 15 minutes.

NOTE: Acrylic lacquer should not be used as its durability is not satisfactory.

6. If, after drying, panel is not sufficiently glossy, spray on one coat of clear lacquer, Part No. 105 0754, or equivalent, and air dry for 30 minutes.

c. Installation

1. Position reinforcement strip on filler panel and insert four screws and washers.

2. Position assembly on front fender and tighten mounting screws to 25 inch-pounds.

Front Bumper Outer End and Outer Cap

a. Removal

1. Remove bumper following procedure on page 2B-11.

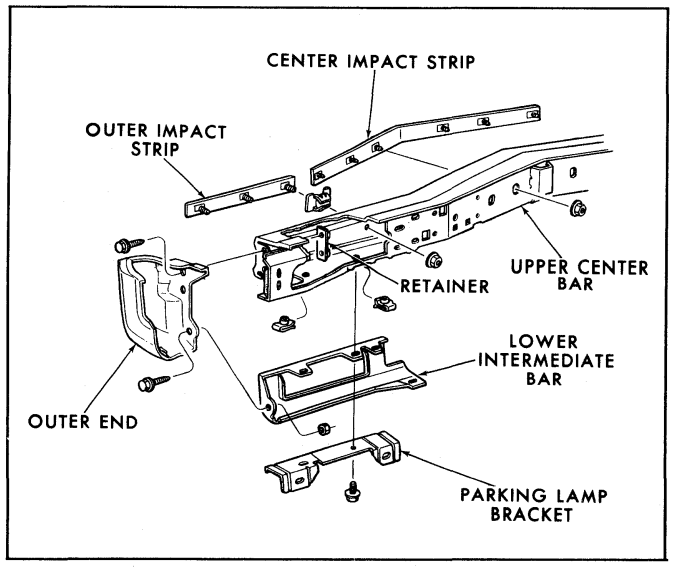


Fig. 2B-23 Front Bumper Outer End

2. Remove two bolt and washer assemblies and tapping plate securing outer end to center bar, Fig. 2B-23.

3. Remove one bolt and nut securing outer end to lower intermediate bar and remove outer end.

4. Remove three nuts securing impact pad, outer cap bracket assembly and bumper support bracket to outer end, and remove impact pad, outer cap bracket and support bracket, Fig. 2B-24.

5. Remove two nuts securing cap to cap bracket and remove.

b. Installation

1. Install two nuts securing outer cap to cap bracket. Tighten to 65 inch-pounds.

2. Assemble impact pad, outer cap bracket assembly and bumper support bracket to outer end securing with three nuts. Tighten to 25 foot-pounds.

3. Position outer end on bumper and secure to lower intermediate bar with one bolt and nut. Tighten to 30 foot-pounds.

4. Install two bolt and washer assemblies and tapping plates securing outer end to center bar. Tighten to 30 foot-pounds.

5. Install bumper as described on page 2B-11.

NOTE: Impact pad can be removed on-car for replacement.

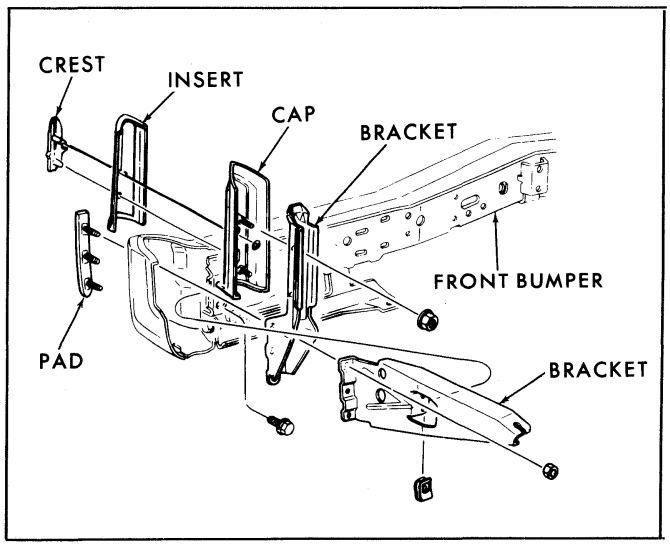


Fig. 2B-24 Front Bumper Outer Caps

Lower Guard (Fig. 2B-25)

a. Removal

1. Remove one bolt and washer assembly, spacer and washer and nut securing lower guard to support bracket.

2. Remove one bolt, spacer and nut securing lower guard to lower center bar and remove guard.

b. Installation

1. Install bracket to upper center bar, and secure with four bolts and washer assemblies. Tighten to 35 foot-pounds.

2. Position lower guard and install one bolt, spacer and nut securing guard to lower center bar. Tighten to 35 foot-pounds.

3. Remove four bolts and washer assemblies securing lower guard support to upper center bar and remove support bracket.

Lower Center Bar (Fig. 2B-26)

a. Removal

1. Open hood and remove two retainers securing air deflector to lower center bar.

2. Remove one bolt and washer assembly securing each end of lower center bar to its respective bumper guard.

3. Remove two bolt and washer assemblies securing grille to lower mounting brackets and lower center bar.

4. Remove two screw and washer assemblies securing license plate brackets to upper center bar.

5. Remove two screw and washer assemblies securing license plate assembly to lower center bar and remove license plate assembly.

6. Remove two bolts, spacers and nuts securing lower

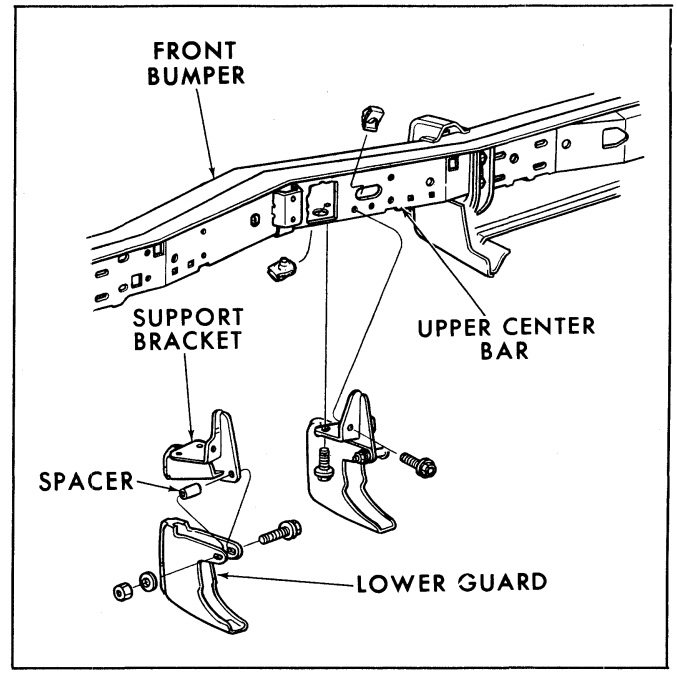


Fig. 2B-25 Lower Guard

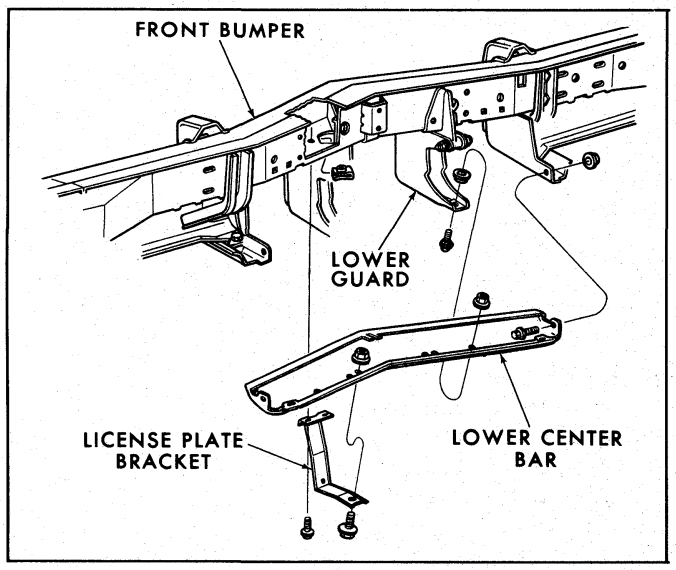


Fig. 2B-26 Lower Center Bar

leg of lower guard to lower center bar and remove lower center bar.

b. Installation

1. Position center bar and install two bolts, spacers and nuts securing lower leg of lower guard to lower center bar. Tighten to 20 foot-pounds.

2. Install two screw and washer assemblies securing license plate bracket to lower center bar. Tighten to 60 inch-pounds.

3. Install two screw and washer assemblies securing license plate brackets to upper center bar. Tighten to 60 inch-pounds.

4. Install two bolt and washer assemblies securing grille to lower mounting brackets and lower center bar. Tighten to 35 inch-pounds.

5. Install one bolt and washer assembly securing each end of lower center bar to its respective guard. Tighten to 20 foot-pounds.

6. Install two retainers securing air deflector to lower center bar.

Front Bumper Center Impact Strip - On Car (Fig. 2B-23)

a. Removal

1. Open hood and, using six access holes in rear of bumper center bar, remove six nuts securing impact strip to bumper and remove impact strip.

b. Installation

1. Position impact strip on bumper, engaging six studs in mounting holes. Check alignment of strip to bumper, as some side-to-side adjustment is possible.

2. Install six nuts on studs using access holes on rear face and underside of bumper. Tighten to 50 inch-pounds.

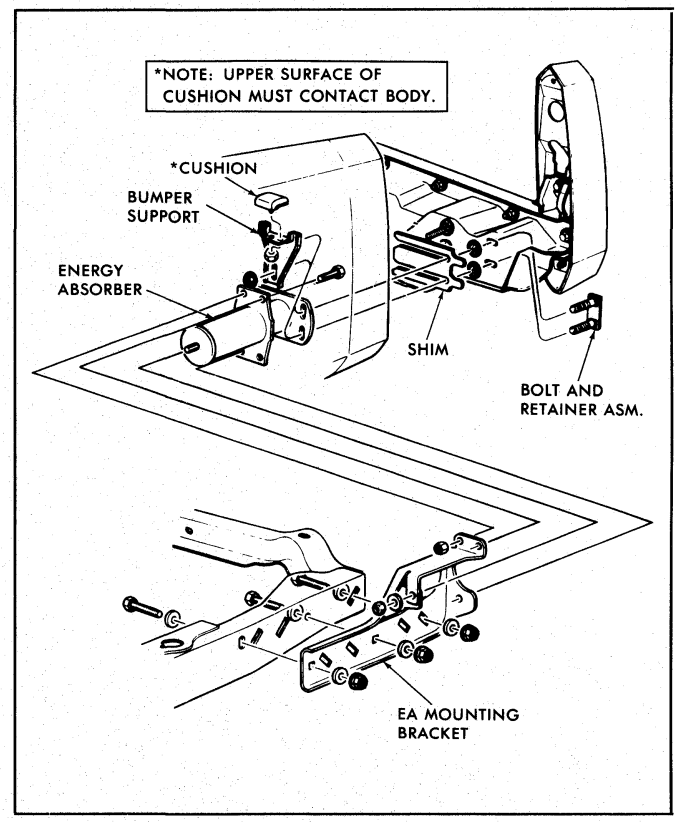


Fig. 2B-27 Rear Energy Absorber Attachment

Front Bumper Outer Impact Strip - On Car (Fig. 2B-23)

a. Removal

1. Remove two nuts securing strip to bumper center bar using access holes behind bumper bar.

2. Removal of center most attaching nut will have to be chiseled off.

NOTE: When replacing impact strip, a repair retainer is available.

b. Installation

1. Position impact strip on bumper, engaging each of three studs in mounting holes in bumper. Check alignment of strip to bumper.

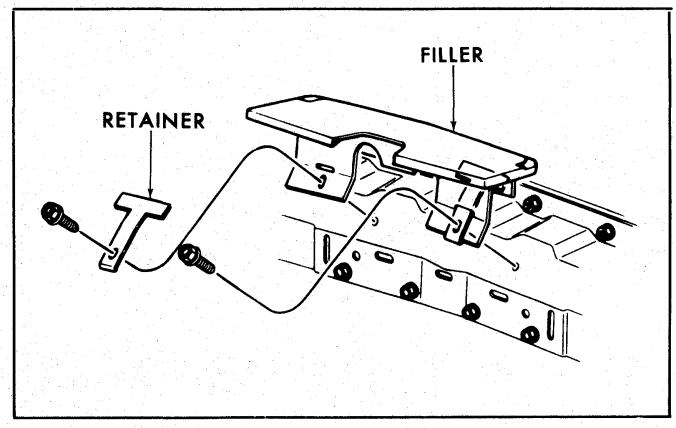


Fig. 2B-28 License Plate Filler

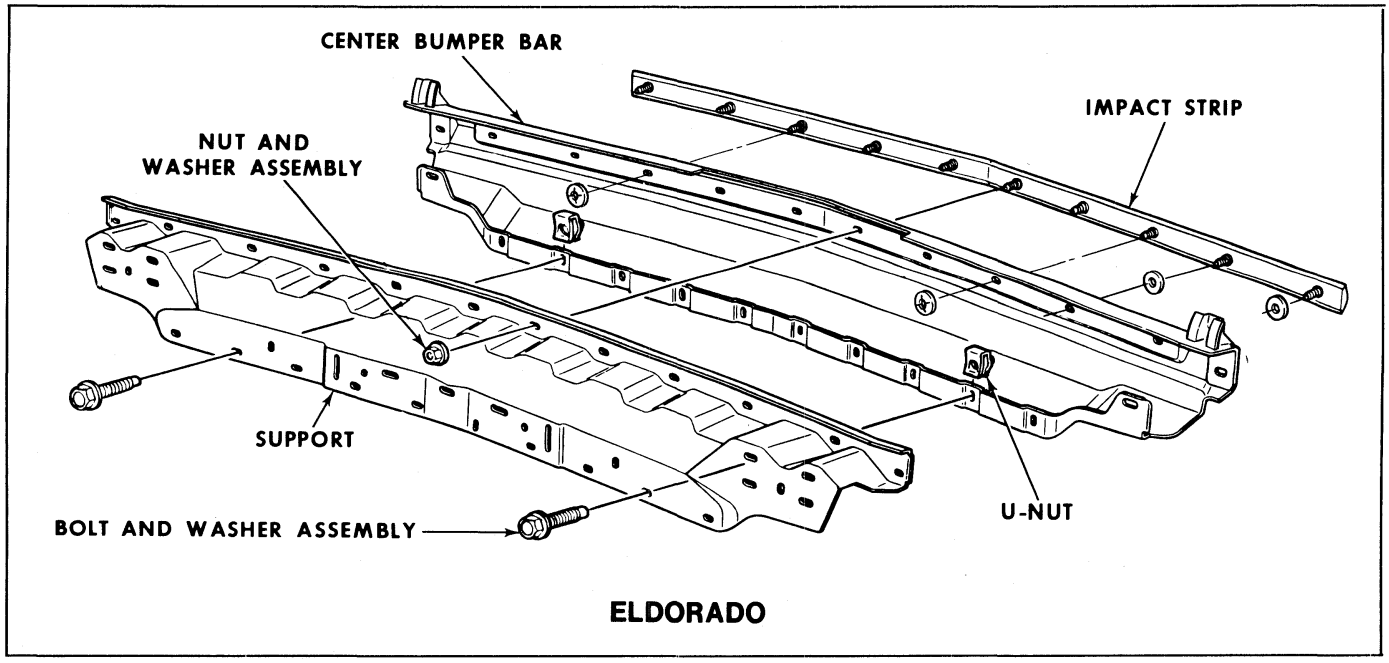


Fig. 2B-29 Rear Bumper Center Bar

2. Install two nuts securing impact strip to bumper center bar using access holes behind bumper. Tighten to 50 inch-pounds.

3. Install retainer at center most attaching.

Rear Bumper (Fig. 2B-27)

a. Removal

1. Scribe alignment marks on bumper at EA unit for proper orientation on assembly.

2. Support bumper at center with hydraulic jack.

3. Remove four nuts securing EA unit to bumper and remove jacking support bracket which is secured outboard of the EA unit.

4. Repeat Step 3 on other side of car.

5. Move bumper away from body and disconnect body connectors. Remove screws securing ground wires to frame.

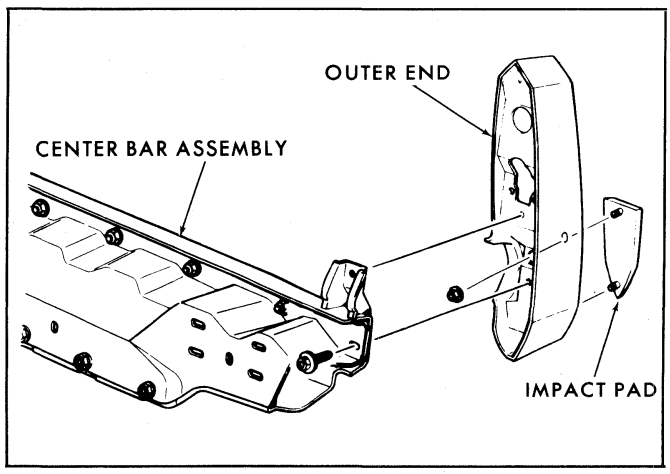


Fig. 2B-30 Rear Bumper Outer End and Impact Pad

6. Remove bumper and remove shims from EA unit mounting bolts.

NOTE: Count number of shims at each location so that the same number are installed during installation.

b. Installation

1. Place shims on EA unit mounting bolts as required.

2. Move bumper into position. Install screws securing ground wires to frame and connect body connectors.

3. Locate EA unit mounting bolts in their proper position and position outer end and deck lid fillers.

4. Position jacking support bracket on EA unit mounting bracket and install four nuts on each side of car. Do not tighten.

5. Position bumper according to scribed lines at EA units making sure jack support bracket is touching support on body, and tighten mounting nuts to 55 N·m (40 foot-pounds).

6. Remove hydraulic jack.

Rear EA Unit And Mounting Bracket (Fig. 2B-27)

a. Removal

1. Support bumper at center with hydraulic jack.

2. Scribe alignment mark on frame for proper orientation on assembly.

3. Remove four nuts and washers securing EA unit to bumper and remove jacking support bracket.

4. Remove three bolts, nuts, and washers securing mounting bracket to frame and remove EA unit with mounting bracket attached.

5. Remove three bolts and nuts securing EA unit mounting plate to bracket.

6. Remove one nut securing rear of EA unit to bracket. Slide EA unit forward and out of bracket.

b. Installation

1. Position EA unit in mounting bracket and secure to

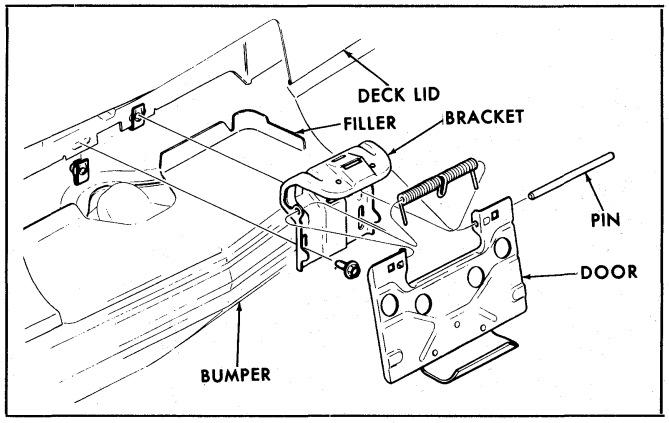


Fig. 2B-31 Fuel Filler Door (Eldorado)

front of bracket with three bolts and nuts. Tighten to 55 foot-pounds.

NOTE: Although there are four mounting holes in the EA unit, only three are used. The lower outboard hole is left blank.

2. Install nut on EA mounting stud. Tighten to 55 foot-pounds.

3. Position mounting bracket on frame and secure with three bolts, nuts and washers. Do not tighten at this time.

4. Install jacking support bracket and four nuts securing EA unit to bumper. Do not tighten at this time.

5. Align mounting bracket with scribe lines and tighten three nuts, mounting bracket to frame, to 75 foot-pounds.

6. Tighten four nuts securing EA unit to bumper to 55 N·m (40 foot-pounds) and remove hydraulic jack.

Rear Bumper Impact Strip and License Plate Filler

a. Removal

1. Working under bumper, remove two screws securing license plate filler and retainers, Fig. 2B-28.

2. Remove ten nuts and washers securing impact strip to bumper, Fig. 2B-29.

3. Remove license plate filler and retainers.

b. Installation

1. Position impact strip on bumper so that part number stamping is left of center of bumper.

CAUTION: *Do not overtorque or strip as it could take on a distorted appearance.*

3. Install license plate filler and retainers and secure with two screws. Tighten to 130 inch-pounds.

Rear Bumper Outer End and Impact Pad (Fig. 2B-30)

a. Removal

1. Remove two bolts securing outer end to rear bumper and remove outer end.

2. Remove two nuts securing impact pad and remove pad.

b. Installation

1. Position impact pad to outer end and secure with two nuts. Tighten to 50 inch-pounds.

2. Position outer end on bumper and secure with two bolts. Tighten to 25 foot-pounds.

Rear Quarter Filler Panel

a. Removal

1. Open trunk and pull trim away from outer end area.

2. Working from inside trunk, remove four nuts securing filler panel to body.

3. Pull filler panel away from outboard side of outer end and remove two screws securing filler panel to body.

4. Remove outer most screw on trunk lid filler and pull outer end filler panel up and away from body.

b. Installation

1. Position filler panel around outer end and under trunk lid filler panel.

2. Install outer most screw on trunk lid filler panel.

3. Pull filler panel away from outboard side of outer end and install two screws securing panel to body.

4. Working from inside trunk, install four nuts securing filler panel to body.

5. Reposition trunk trim and close trunk lid.

Fuel Filler Door (Fig. 2B-31)

a. Removal

Open door and remove two screws securing backing plate to body and remove assembly. Also remove clip securing lamp wiring to backing plate. Then disconnect wiring at body harness.

b. Installation

Make sure U-nuts are properly placed, then position door assembly and secure with two screws. Connect wiring at body harness and clip wire to backing plate.

ON-CAR SERVICE - SEVILLE

Front Bumper (Fig. 2B-32)

a. Removal

1. Support bumper at center with hydraulic jack.
2. Remove lower air deflector from front bumper main reinforcement.
3. Remove four nuts and shims on each side from flange on EA unit.

NOTE: Count number of shims at each location so that the same number are installed during installation.

4. Remove bumper.

b. Installation

1. Raise bumper into position. Make sure air deflector is resting on bumper.
2. Install four nuts and shims on each side to flange on EA unit, finger tight, secure air deflector.
3. Before tightening, check bumper to assure proper alignment. Vertical and side-to-side adjustments can be made using slotted holes in EA unit and bumper. Tighten bolts to 35 foot-pounds and remove jack.

Front Energy Absorbing Unit (Fig. 2B-32)

a. Removal

1. Remove front bumper assembly as described above.
2. Remove four nuts and bolts securing EA unit to frame bracket.
3. From top side of frame, remove bolt and washer located next to No. 1 body mount.
4. Slide EA unit forward and out of frame.
5. Remove bracket from EA unit.

b. Installation

1. Install bracket on new EA unit with weld nut facing up, tightening to 55 foot-pounds.
2. Position EA unit in frame. Align weld nut with hole in top side of frame and install bolts and washers finger tight.
3. Install four nuts and bolts securing EA unit to frame bracket. Tighten bolts until snug.
4. Install front bumper assembly as described above.
5. Tighten all fasteners to 55 foot-pounds.

Bumper Filler (Fig. 2C-18)

a. Removal

1. From behind bumper, remove two screws securing filler to reinforcement and remove filler.

b. Installation

1. Position filler to bumper reinforcement and install two screws, tightening to 130 inch-pounds.

Front License Bracket (Fig. 2B-33)

a. Removal

1. Remove two screws securing top of license bracket to center impact bar.
2. Remove two screws securing bottom of license bracket to center bar and remove bracket.

b. Installation

1. Position license bracket to front bumper and install two screws securing top of bracket to center bar.
2. Install two screws securing bottom of bracket to center bar. Tighten all fasteners to 50 inch-pounds.

Front License Plate Bumper Guards and Impact Strips (Fig. 2B-33)

a. Removal

1. Remove two screws securing bumper guard to center bar and remove guard.
2. Remove two nuts securing impact strip to bumper guard and remove strip.

b. Installation

1. Install impact strip to bumper guard and secure strip with two nuts. Tighten to 50 inch-pounds.
2. Position bumper guard to center bar and install two screws. Tighten to 18 foot-pounds.

Front Bumper Outer Guards and Impact Strips (Fig. 2B-34)

a. Removal

1. Remove front bumper as described in column 1 on this page.
2. Remove reinforcement as described on page 2B-18.
3. Remove two screws in vertical order securing outer guard to center impact bar.
4. Remove one screw and spacer securing bottom of bumper guard to lower impact bar and remove guard.
5. Remove two nuts securing impact strip to bumper guard and remove strip and bracket.

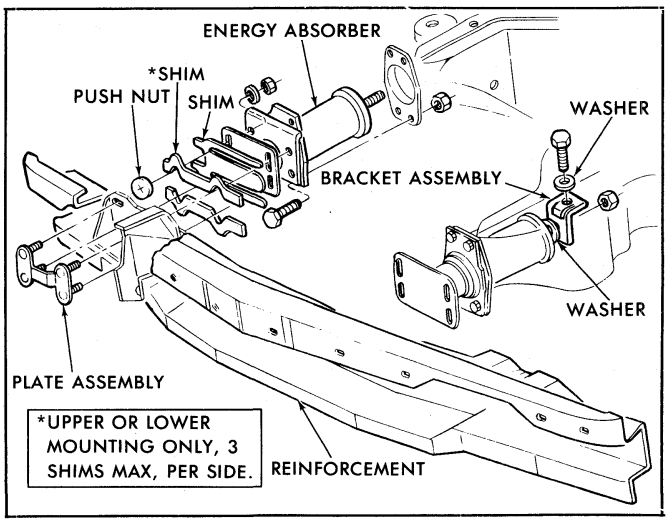


Fig. 2B-32 Front Energy Absorber Attachment

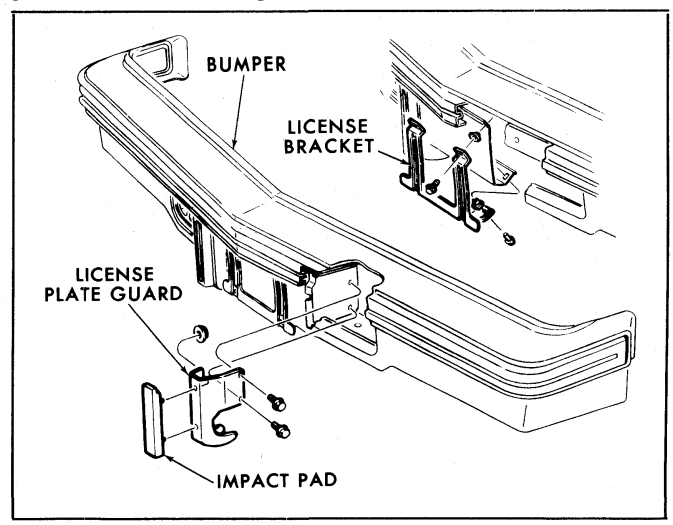


Fig. 2B-33 Front Bumper Guards and Impact Pads

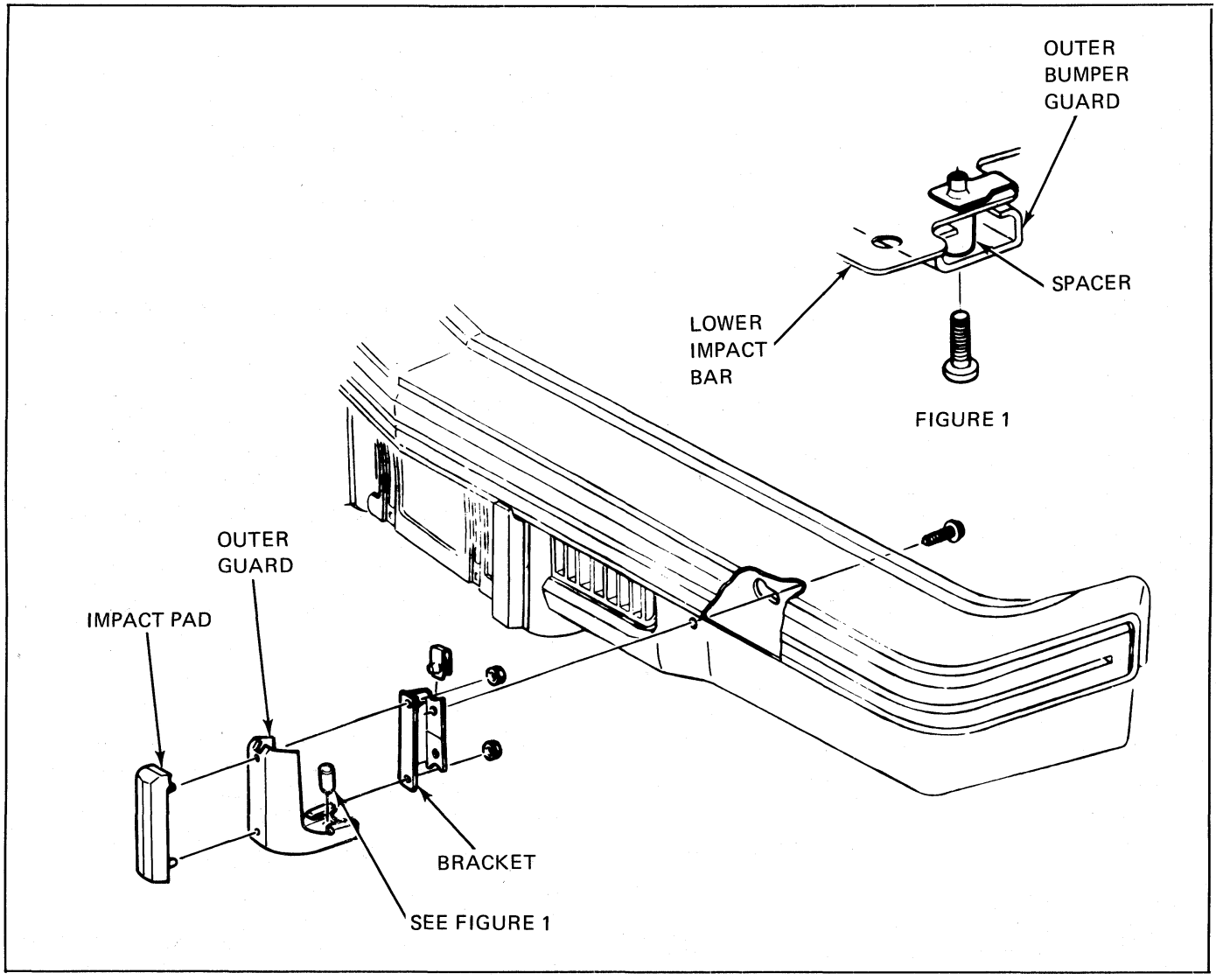


Fig. 2B-34 Front Bumper Outer Guards and Impact Pads

b. Installation

1. Position impact strip to bumper guard and position bracket. Install two nuts securing strip to bumper guard, tightening to 50 inch-pounds.
2. Position bumper guard assembly to bumper, installing two screws securing bumper guard to center impact guard.
3. Install one screw and spacer securing bottom of guard to lower impact bar. Tighten all fasteners to 18 foot-pounds.
4. Install reinforcement as described below.
5. Install bumper as described on page 2B-17.

Front and Rear Bumper Reinforcement and Strip - On Car (Fig. 2B-35)

a. Removal

1. Remove 12 attaching nuts from main reinforcement securing impact strip.
2. Remove impact strip.

b. Installation

1. Position impact strip on bumper, engaging 12 studs in mounting holes. Check alignment of strip to bumper. Stretch strip from center to line up the end holes.
2. Install main reinforcement and secure impact strip with 12 nuts. Tighten to 20 foot-pounds.

NOTE: On rear bumper, the outboard fasteners should

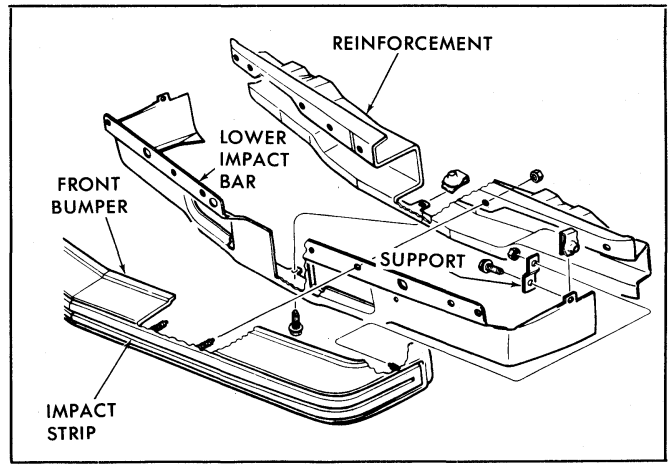


Fig. 2B-35 Front Bumper Reinforcement

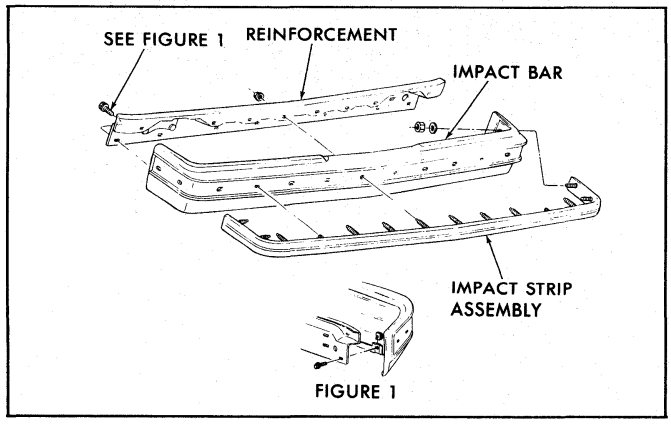


Fig. 2B-36 Rear Bumper Assembly

be torqued to 50 inch-pounds.

CAUTION: *Do not over torque or strip could take on a distorted appearance.*

Rear Bumper (Fig. 2B-36)

a. Removal

1. Scribe alignment marks on bumper at EA unit for proper orientation on assembly.
2. Support bumper at center with hydraulic jack.
3. Remove four nuts and two retainers on each side from flange securing EA unit to bumper.
4. Remove bumper.

b. Installation

1. Move bumper into position.
2. Install four nuts and two retainers on each side to flange securing EA unit to bumper. Do not tighten.
3. Position bumper according to scribe lines at EA units for proper alignment.
4. Tighten nuts to 55 foot-pounds.
5. Remove hydraulic jack.

Rear Energy Absorbing Unit (Fig. 2B-37)

a. Removal

1. Remove rear bumper assembly as described above.
2. Remove four nuts anf bolts securing EA unit to body-mounting flange.
3. From bottom side of body, remove bolt and washer.
4. Slide EA unit rearward and out of body.
5. Remove bracket from EA unit.

b. Installation

1. Install bracket on new EA unit with weld nut facing down.
2. Install EA unit in body.
3. Install bolt and washer at bottom side of body.
4. Install four nuts and bolts securing EA unit to rear body mounting flange. Tighten bolts until snug.
5. Install rear bumper assembly as described above.

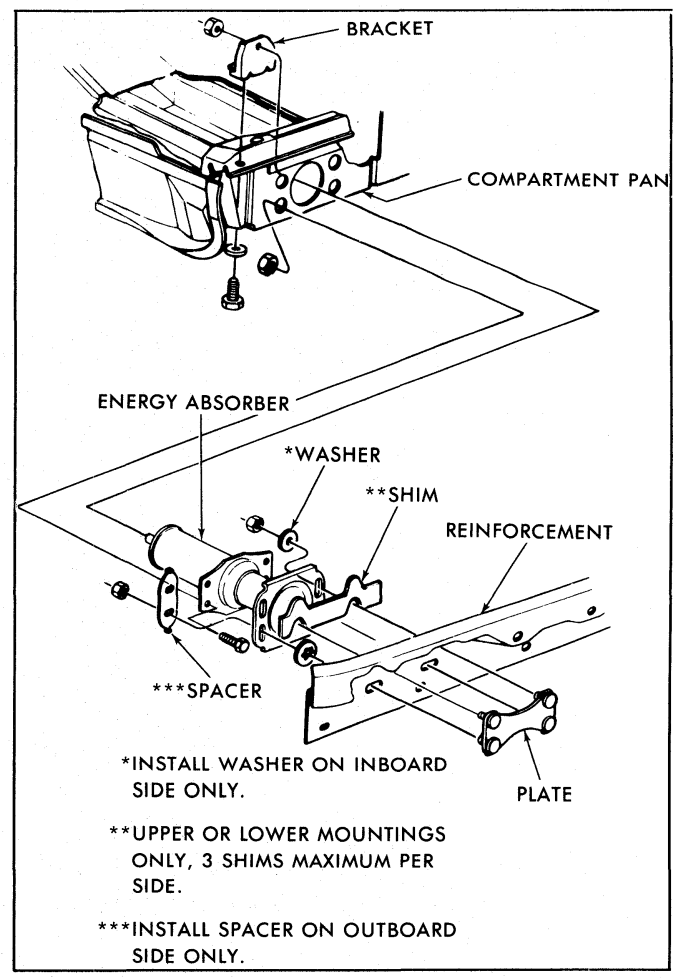


Fig. 2B-37 Rear Energy Absorber Attachment

Rear Quarter Filler Panel

a. Removal

1. Raise trunk quarter panel trim to gain access to filler panel retaining nut and remove nut.
2. Remove rearmost screw securing lower quarter panel trim to body and position filler panel to gain access to retaining screw. Remove screw.
3. Slide rear bumper filler panel out.

b. Installation

1. Slide rear bumper filler panel into position.
2. Install retaining screw securing filler panel to body and install rearmost screw securing lower quarter panel molding to body.
3. Install filler panel retaining nut.
4. Replace trunk trim.

TORQUE SPECIFICATIONS

Material No.	Application	Size	Newton Metres	Foot-Pounds
	C-Car			
500M	Bumper Guard to Bumper	8 x 1.25	30	22
510M	Center Impact Strip Nuts	8 x 1.25	20	14
510M	EA Frame Bracket to Frame Horn	10 x 1.5	55	40
500M	EA Rear Bracket to Frame	10 x 1.5	55	40
510M	EA Unit to Bumper Center Bar	10 x 1.5	55	40
510M	Outer End to Center Bar	8 x 1.25	30	22
500M	Reinforcement Bracket to Outer End	8 x 1.25	30	22
				Inch
1050M	Bumper Guard Impact Strip	5 x 0.8	5	25
1050M	Impact Strip Corner to Outer End	6.3 x 1.0	5	30
1050M	Outer Impact Strip to Outer End	6.3 x 1.0	5	30
1050M	Rear Bumper Guard Impact Pad	5 x 0.8	5	25
	Eldorado			**Ft. Lbs.**
280M	Bumper Guard to Center Bar Screws	3/8 — 16	—	30
286M	EA Mounting Bracket to Frame Nuts	1/2 — 13	—	70
275M	EA Unit to Bumper Center Bar Bolts	7/16 — 14	—	32
286M	EA Unit to Mounting Bracket Nuts	7/16 — 14	—	55
286M	Impact Strip to Outer End	3/8 — 16	—	25
275M/ 1050-65	Lower Center Support Rod Screws	5/16 — 18	—	18
510M	Rear EA Unit to Bumper Center Bar Nuts	10 x 1.5	55	40
301M	Rear Lower Mounting Bracket to Frame Nuts	1/2 — 13	—	75
286M	Rear Lower Mounting Plate to Frame	1/2 — 13	—	50
286M	Rear Outer End to Center Bar Nuts	3/8 — 16	—	30
275M/ 1050-65	Upper Outer End to Center Bar Bolts	3/8 — 16	—	30
				Inch
284M	Bumper Guard Impact Strip Nuts	1/4 — 20	—	13
284M	Impact Strip to Center Bar (Eldorado)	1/4 — 20	—	50
1010-20	License Plate Bracket to Upper & Lower Center Bars	1/4 — 20	—	50
1050M	Rear Bumper Center Impact Strips	3/8 — 16	—	50
284M	Rear Bumper Outer Impact Pad (Eldorado)	1/4 x 20	—	50
6010M	Rear License Lamp & Housing Screws	#10 — 24	—	30
	Seville			**Ft. Lbs.**
6010M	Bumper Guard to Center Bar Screws	5/16 — 18	—	18
286M	EA Unit Mounting to Frame Nuts	7/16 — 14	—	55
286M	EA Unit to Bumper Center Bar Nuts	7/16 — 14	—	55
286M	Rear Bumper Center Impact Strips	3/8 — 16	—	30
275M	Rear Bumper Plate to EA Unit Bolt	3/8 — 16	—	30
286M	Rear EA Unit Mounting to Frame Nut	7/16 — 14	—	50
286M	Rear EA Unit to Bumper Nut	7/16 — 14	—	50
				Inch
284M	Bumper Guard Impact Strip Nuts	1/4 — 20	—	50
284M	Impact Strip Nuts (Except Bumper Guards)	1/4 — 20	—	50
601M	License Plate Bracket to Center Bars	1/4 — 14	—	50

CHASSIS SHEET METAL

TABLE OF CONTENTS

Aluminum Hood Repair Information 2C-5
Fiberglass Repair 2C-7
General Description 2C-1
On-Car Service
"C"-Car Sheet Metal 2C-4
Eldorado Sheet Metal 2C-12
Seville Sheet Metal 2C-15
Sheet Metal Tolerances
"C"-Car 2C-23
Eldorado 2C-23
Seville 2C-23
Torque Specifications 2C-24

GENERAL DESCRIPTION

NOTE: For additional information pertaining to Eldorado and Seville, refer to the latter portion of this section.

The chassis sheet metal described in this section consists of the following items: hood, front fenders, wheelhousings, cowl panel and front end panel.

HOOD AND LATCHES

The hood is hinged near the cowl and opens from the front. The hood latch assembly for C-car and Seville consists of a hood primary lock, Fig. 2C-1, attached to a mounting bracket which is secured to the radiator support tie bar in the center by two screws. On Eldorado, the primary latch is secured to the radiator support tie bar with three attaching screws. The hood secondary latch release lever is attached to the hood inner panel by two screws, Fig. 2C-2. The hood pop-up spring is located on the hood inner panel except for Seville, which is located on the radiator support tie bar.

The hood is unlocked by pulling on the hood lock release handle that is located on the left kick panel just below the headlight switch, Fig. 2C-3. On C-cars, the hood secondary latch is accessible between the front edge of the hood panel and the rear edge of the front end panel after the primary lock has been actuated. On Eldorado and Seville, the secondary

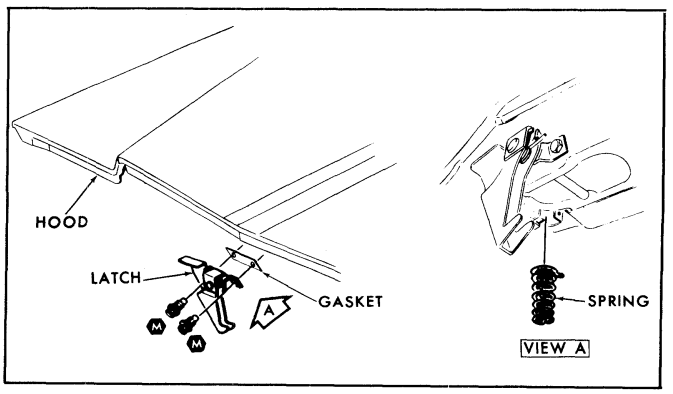


Fig. 2C-2 Hood Secondary Latch

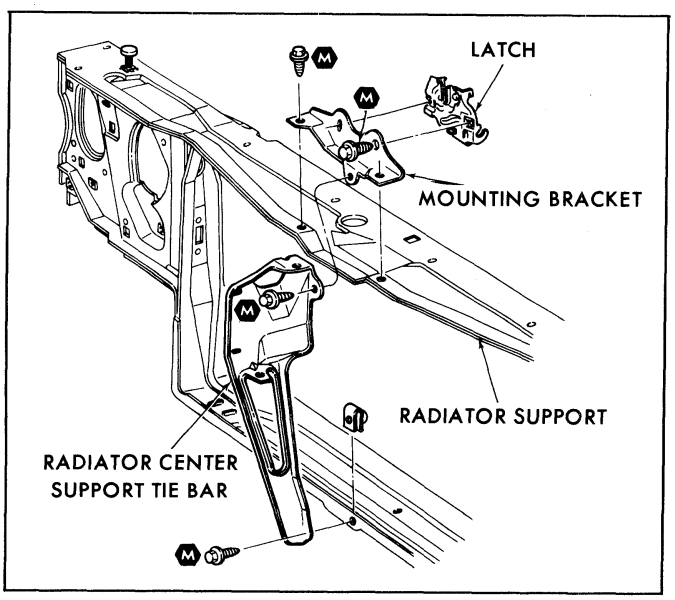


Fig. 2C-1 Hood Primary Latch

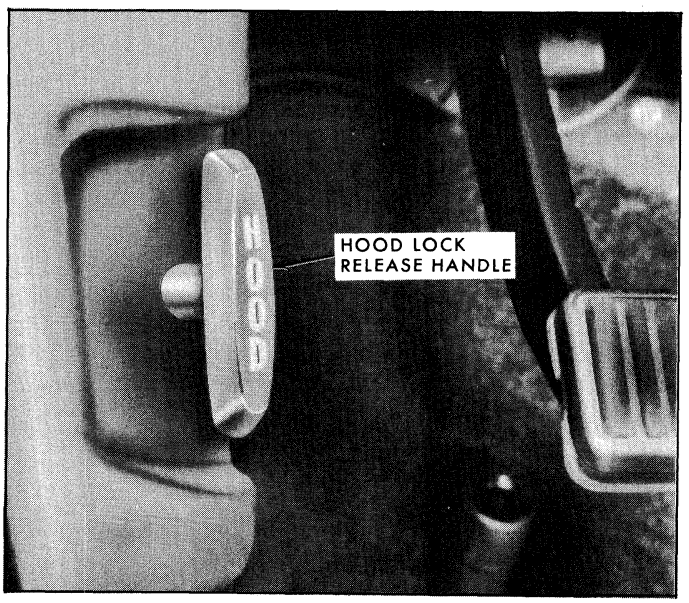


Fig. 2C-3 Hood Lock Release Handle

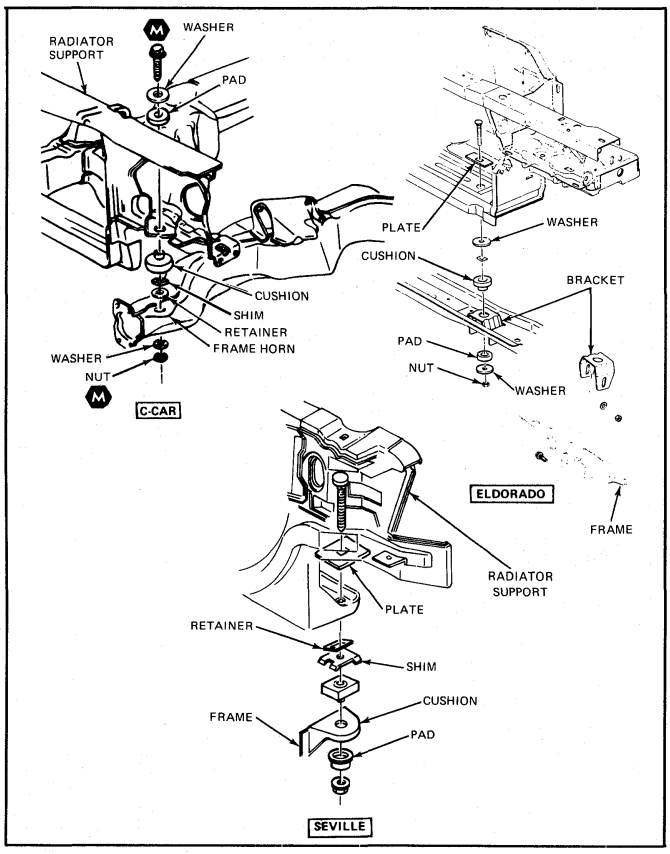


Fig. 2C-4 Radiator Support Mounts

latch is accessible between the grille and hood panel. Upward pressure on the hood latch secondary lever permits the hood to be raised.

EPOXY COATED FRONT SHEET METAL FASTENERS

Front sheet metal structural support components are retained with special microencapsulated, epoxy coated fasteners. The coating is applied to the threaded area of the fastener, and prevents loosening. The fasteners can be loosened and reused.

RADIATOR SUPPORT MOUNTS

All cars use two radiator support mounts which secure the radiator support to the frame, Fig. 2C-4. On the Eldorado, the mounts fasten to adjustable mounting brackets which, in turn, are fastened to the frame front crossmember by two bolts, nuts, and washers.

GRILLE

The grille is of chrome plated, injection-molded plastic construction. Both upper and lower grilles are mounted to the bumper and travel with the bumper during compression and rebound strokes of the energy absorbing units (except

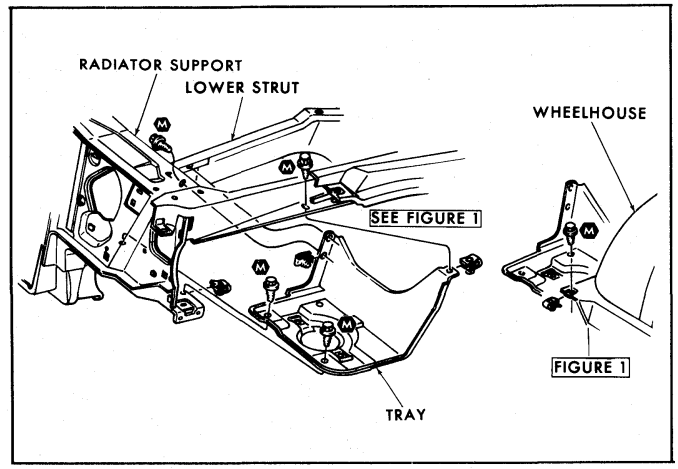


Fig. 2C-5 Battery or Evaporative Canister Tray

C-car upper grille which is mounted to the front end panel and radiator support brackets). Mounting provisions for the upper and lower grilles are independent of each other so that either portion may be removed without disturbing the other.

FRONT END PANEL (C-Car)

The front end panel is fabricated from sheet molded compound. The panel has three die cast bright chrome moldings at the front lower edge of the front end panel: a center molding and a left and right-hand outer molding.

Two types of hood ornaments are used; the see-through ornament for Coupe and Sedan deVilles, and the wreath ornament for Brougham, Limousine and Commercial.

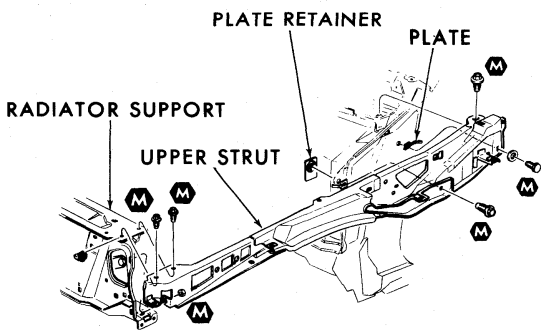
BATTERY OR EVAPORATIVE CANISTER TRAY (C-Car) (Fig. 2C-5)

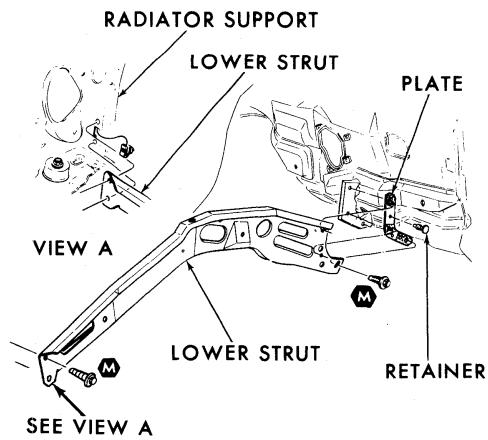
The canister tray on the left-hand side is made of aluminum and the battery tray is made of steel. The front of the canister tray attaches to the radiator support. The rear inboard side of the tray attaches to the lower strut. The tray rear outboard leg attaches to the upper strut.

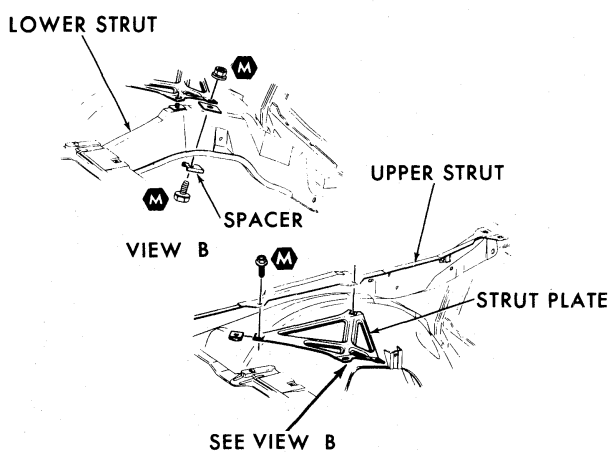
The battery tray on the right side attaches the same as the canister tray.

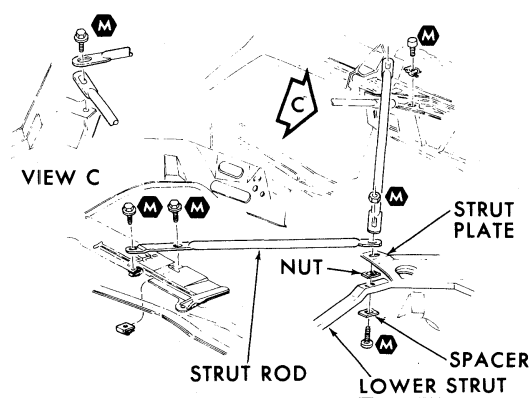
DURASTRUT (Fig. 2C-6)

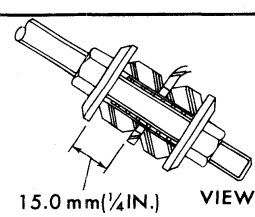
The 1977 Cadillac C-car has a durastrut front sheet metal structure designed to form a strong, rigid frame work. Durastrut consists of upper and lower struts which are securely bolted between the body and the radiator support. Rods and plates provide lateral stiffness.



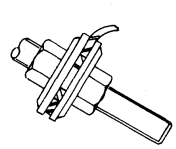








"C" CARS-WITH LOWER NUT LOOSE, COMPRESS UPPER CUSHION BY TIGHTENING UPPER NUT TO DIMENSION SHOWN IN VIEW D. THEN TIGHTEN LOWER NUT TO 24 N-m(18 FOOT-POUNDS).



"DA" AND "Z" CARS- WITH UPPER NUT LOOSE, TIGHTEN LOWER NUT TO 14 N-m(10 FOOT-POUNDS). THEN TIGHTEN UPPER NUT TO 24 N-m (18 FOOT-POUNDS).

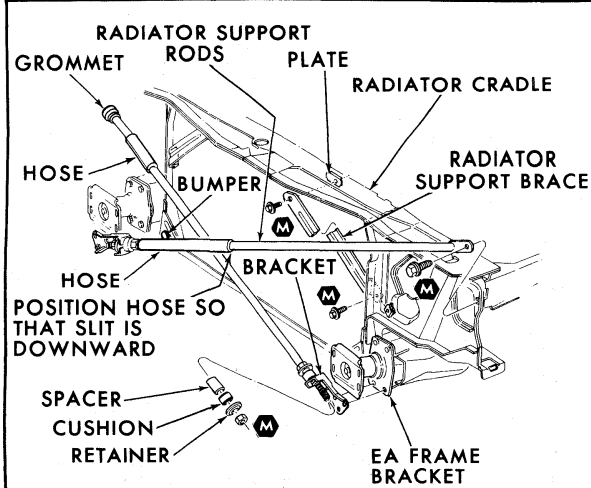


Fig. 2C-6 Durastrut Construction

ON-CAR SERVICE

The following caution applies to certain steps in the assembly procedure of components in this section. The critical fasteners to which this caution applies are identified by the terminology:

CAUTION: *See "CAUTION" on page 2C-4 of this section.*

CAUTION: *This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.*

HOOD LATCH MECHANISM ADJUSTMENT

The striker plate in the hood panel is large enough to take care of normal fore and aft adjustment. Cross car adjustment only is provided at the hood lock mounting bracket to radiator support (on Eldorado and Seville, adjustment is made at the primary latch assembly). Up and down adjustment is provided by loosening two screws securing latch to hood latch bracket. On Eldorado and Seville, up and down adjustment is provided in the lock itself which has an automatic take up latch.

When the hood latch assembly has been removed, the mounting screws loosened, or the hood adjustment changed, make certain that the proper alignment has been obtained before tightening the mounting screws. Proper cross car adjustment of the primary lock is achieved by slowly lowering the hood onto the lock with the two attaching screws loose (three on Eldorado). Raise the hood and tighten screws to 30 N·m or 22 foot-pounds (on Eldorado, 18 foot-pounds and on Seville, 21 foot-pounds).

CAUTION: *See "CAUTION" on page 2C-4 of this section.*

Failure to do so may result in damage to the latching assembly and/or excessive release handle efforts due to misalignment when the hood is closed. Except Eldorado, lower hood to a resting position on the primary latch and close securely.

The following procedure is for Eldorado only and is recommended for checking hood latch adjustments:

a. Drop hood from a height of 150 to 200mm (6 to 8 inches) above closed position. The latch must engage.

b. The latch must release when release handle is pulled without lifting the hood.

Hood latches that do not engage or release properly must be corrected by proper adjustment of the hood latch and the hood adjustable bumpers. These adjustments are also used to bring the hood flush with the fenders.

c. Lower hood slowly until the striker plate rests on the latch. With hood in this position, secondary latch must be engaged under hood latch tie bar on radiator support. A vertical pull up at one of the forward corners of the hood and the center will indicate that proper secondary installation has been performed, in that the hood will be restricted from opening beyond the hook of the secondary latch.

d. Both primary and secondary latches must be free of excess friction or binding when operated.

HOOD PANEL

a. Removal

1. Scribe hinge locations on underside of hood panel to aid in the fore and aft repositioning of the hood when it is reinstalled.

NOTE: Cross car adjustment is fixed for all cars.

2. Remove six screws and washers, three each side, retaining hinge assemblies to hood panel. On Seville, there are four screws and washers.

3. Remove hood with aid of a helper, using care to avoid damaging finish.

CAUTION: *When hood is removed from car, stand upright on rear corners, nose up. Body mount cushions should be used to protect corners from damage. Hood may also be positioned so that it rests on its side; otherwise, damage to sheet metal may result.*

b. Installation

NOTE: On Eldorado, install an exhaust manifold stud in center holes of hood retaining plate (on Seville, install stud in front and rear position) to help locate and position adjusting screws when installing hood.

1. With aid of helper, place hood in position so that hinges line up with scribe marks and install three screws and

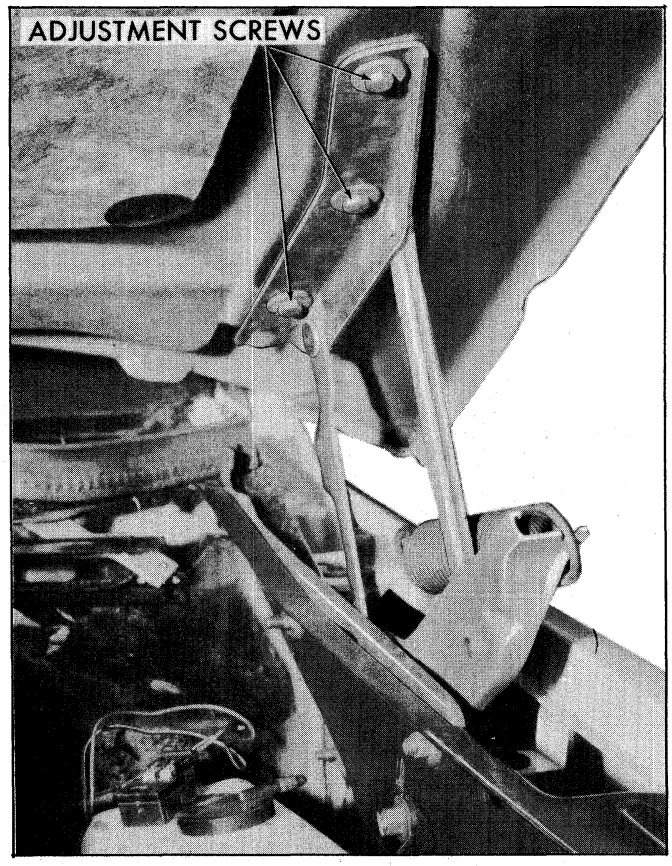


Fig. 2C-7 Hood Hinge

washers (two screws and washers on Seville) at each hinge assembly, tightening screws to 30 N·m or 22 foot-pounds (on Eldorado or Seville, tighten to 30 foot-pounds).

2. Carefully close hood and check alignment of hood at fender and grille opening.

3. Align hood, if necessary, as described below.

4. Adjust hood latch mechanism, if necessary, as described on page 2C-4.

HOOD PANEL ADJUSTMENT

1. Loosen hood attaching screws, three at each hood hinge (on Seville, two screws each hinge) Fig. 2C-7. Elongated holes in hinge provide fore and aft adjustment of hood. Position hood to the tolerances shown in Fig. 2C-22 (Fig. 2C-23 for Eldorado and Fig. 2C-24 for Seville).

2. Tighten hinge to hood attaching screws on both sides to 30 N·m or 22 foot-pounds (for Eldorado and Seville, 30 foot-pounds).

3. Adjust rubber bumpers, located on the tie bar, one each side, so that hood panel is flush with fenders at this point.

4. Adjust hood latch mechanism as described on page 2C-4.

ALUMINUM HOOD REPAIR INFORMATION

Aluminum hoods can be repaired successfully with only slight modifications to materials and techniques commonly used to refinish steel hoods. The necessary modifications can be broken down into two categories: 1. metal preparation; 2. painting.

Metal Preparation

1. Because aluminum is relatively easy to grind, care must be taken not to use overly coarse abrasive discs or excessive grinder speeds (greater than 2,000 RPM's), both of which will cause unnecessary metal removal and heat.

2. Surface scratches should normally be removed with 180 or 120 grit paper with scalloped edges. Hand sanding with 80 grit paper will usually be sufficient to remove excess body filler or heavy scratches again followed with 180 grit paper.

CAUTION: *Avoid scratching aluminum using 80 grit paper by hand.*

3. Foam back-up pads are recommended for grinders used on aluminum, rather than the stiffer rubber pads used for mounting abrasive discs used on steel. The foam pad helps to reduce head build-up and makes for better blending for feathering.

4. Localized heat, generated by grinding, can be minimized by the use of a grease stick, such as Formax F-160 or its equivalent. This does, however, tend to load up the grinding discs quickly, which should be periodically cleaned by rotating them against a brush wetted with solvent.

5. If out-pings or minor convex defects need to be filed, it is recommended to use a round edge, double-cut, flexible file with 22 teeth per inch overlaid with 52 teeth per inch (such as Nicholson #50-412 or its equivalent).

CAUTION: *Keep file clean or chips may scratch aluminum.*

The use of heat is not recommended, since the structural characteristics of aluminum are noticeably affected by heat. A bent or buckled aluminum hood, which exhibits strain cracks either before or after straightening, should be replaced.

Steel and aluminum hoods can be metal prepped and repaired with two part polyester filler materials in the same number of operations. The only differences being that less aggressive type files and abrasive discs be used; with care being taken not to overheat the aluminum.

Painting

Painting procedures for aluminum hoods differ very little from those used on steel hoods. Two precautions should, however, be observed:

1. Alkaline base paint removers are not recommended and should not be used.

2. Aluminum also requires a chemical cleaner such as DuPont 2255, Ditzler DX-533, or its equivalent be used on bare metal to remove contaminants and corrosion. After cleaning, a conversion coating such as DuPont 2265, Ditzller DX-503, or its equivalent should be applied to promote adhesion.

Beyond these considerations, painting aluminum hoods should present no increases in difficulty or modifications in procedure and technique.

UPPER GRILLE

a. Removal

1. Remove front end panel fillers as described on page 2C-6.

2. Remove screws securing upper grille to lower flange of front end panel, Fig. 2C-8.

3. Remove screws each side securing grille to front end panel support bracket.

4. Disconnect Guide-Matic support rod if so equipped.

5. Taking care not to damage bumper, slide grille forward and lift straight up.

b. Installation

1. Position grille to front end panel support brackets.

2. Connect Guide-Matic support rod if so equipped.

3. Install one screw each side and tighten to 5 N·m (60 inch-pounds).

4. Install four screws securing upper grille to front end panel. Tighten to 5 N·m (60 inch-pounds).

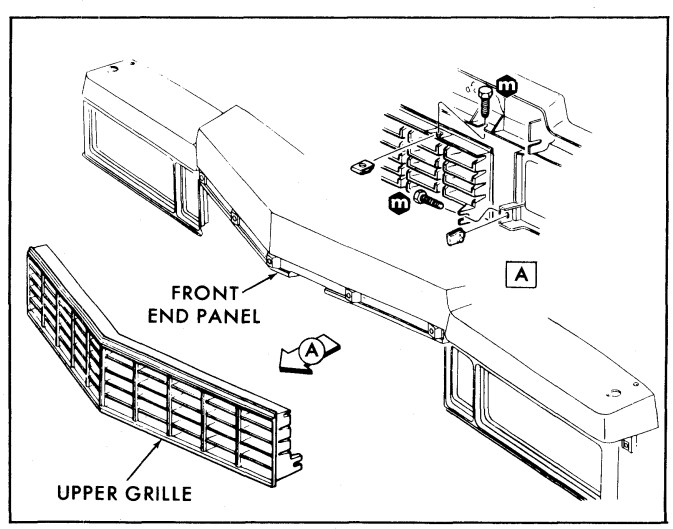


Fig. 2C-8 Upper Grille (C-Car)

5. Install front end panel fillers as described below.

LOWER GRILLE

a. Removal

1. Remove fasteners securing air deflector to lower bumper main reinforcement.
2. Remove two screws securing lower grille to lower bumper bar, Fig. 2C-9.
3. Pull out grille.

b. Installation

1. Position lower grille on bumper.
2. Install two screws securing grille to lower bumper bar. Tighten to 10 N·m (75 inch-pounds).
3. Secure air deflector to lower bumper main reinforcement.

FRONT END PANEL FILLERS

a. Removal

1. Remove nine screws securing right and left hand front end panel fillers to radiator support, Fig. 2C-10.
2. Remove six nuts and washers securing filler to front end panel and remove fillers.

b. Installation

1. Position fillers on radiator support and loosely install nine screws securing fillers to radiator support.
2. Install six nuts and washers securing filler to front end panel. Tighten to 10 N·m (90 inch-pounds).
3. Secure filler to radiator support and tighten to 5 N·m (55 inch-pounds).

CAUTION: *Be careful that the hood release cable is not pinched or distorted in its routing otherwise high release efforts may result.*

FRONT END PANEL

a. Removal

1. Remove cornering lamps as described on page 8-67.
2. Remove headlamp and loosen headlamp housing each side of car as described on page 8-66.
3. Remove front end panel fillers as described above.
4. Remove Guide-Matic if so equipped.
5. Remove two screws each side securing panel to radiator support brackets, Fig. 2C-11.
6. Remove five screws securing upper grille to front end panel, Fig. 2C-8.
7. Remove one nut securing panel to radiator center support bracket, Fig. 2C-11.
8. Remove one screw and shims (if any) each side of car securing panel to front of fender.

NOTE: Count number of shims at each location so that the same number are installed during installation.

9. Disconnect lamp monitor read-out as described on page 8-68.
10. Tilt front end panel forward and lift up to remove.

b. Installation

1. Position front end panel on car taking care not to damage bumper or grille finish.
2. Connect lamp monitor read-out as described on page 8-68.
3. Install shims (if any) and screw each side finger tight securing panel to fender.

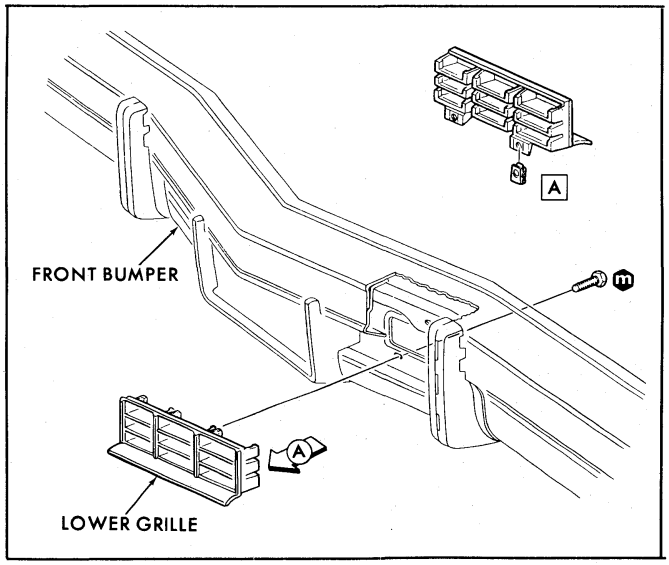


Fig. 2C-9 Lower Grille (C-Car)

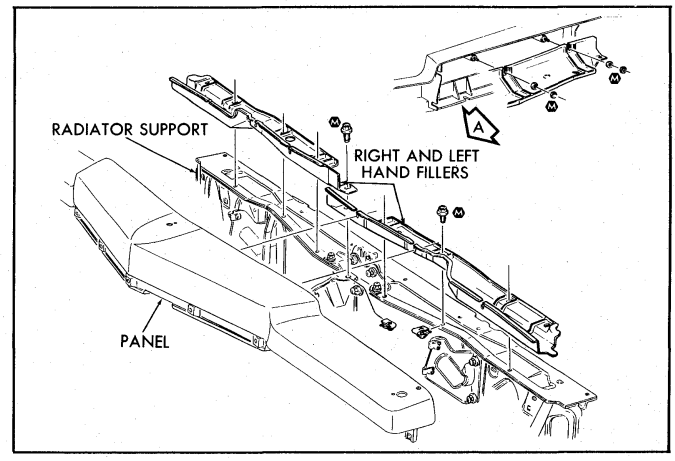


Fig. 2C-10 Front End Panel Fillers

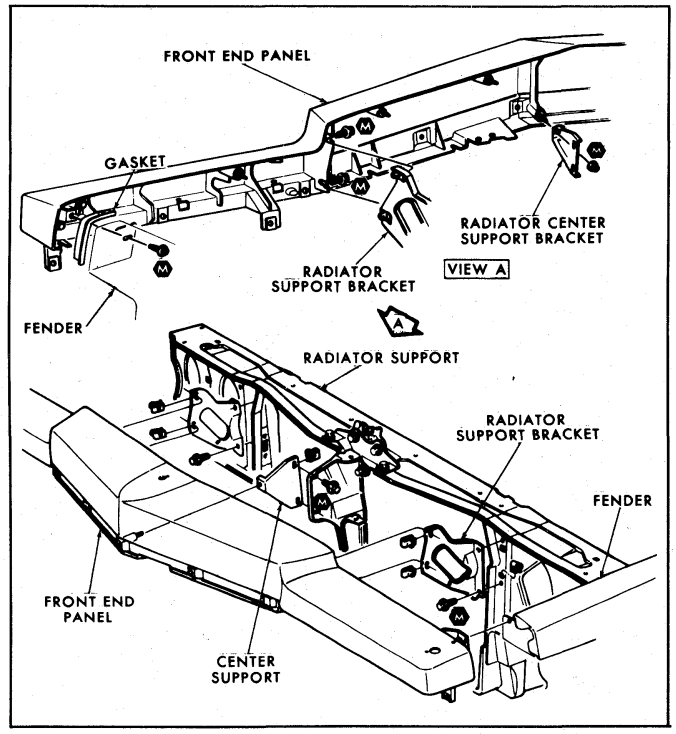


Fig. 2C-11 Front End Panel Mounting

4. Install four screws securing upper grille to front end panel. Tighten to 5 N·m (60 inch-pounds).

5. Install one nut securing panel to radiator center support bracket. Tighten to 10 N·m (90 inch-pounds).

6. Install two screws each side securing panel to radiator support brackets. Tighten to 75 N·m (55 inch-pounds).

7. Install Guide-Matic if so equipped.

8. Install front end panel fillers as described on page 2C-6.

9. Install headlamp bezel and tighten headlamp housing each side as described on page 8-66.

10. Install cornering lamps as described on page 8-67.

FIBERGLASS REPAIR

Most fiberglass damage can be repaired. A resin kit is available for major repairs and a plastic solder kit for minor repairs. Procedures and precautions must be followed for satisfactory repairs.

If welding is required, do not allow flame or welding heat to come into direct contact with the plastic panel. In the general area to be welded, the fiberglass panel should be protected with wet asbestos or any other like method to absorb the heat or a shield to direct the heat away from the fiberglass panel.

KIT RECOMMENDATIONS

WARNING: A PROTECTIVE HAND CREAM IS INCLUDED WITH THE KIT AND IS RECOMMENDED WHENEVER THE RESIN KIT MATERIALS ARE USED. FAILURE TO USE THE PROTECTIVE HAND CREAM WILL RESULT IN SKIN IRRITATION.

1. a. Wash hands clean. Dry thoroughly.

b. Squeeze about 1/2' of cream into palm of hand.

c. Spread evenly and lightly until cream disappears. Work cream into cuticle, between fingers and around wrists.

d. Apply second coat, repeating steps b and c.

e. Hold hands briefly under cold running water to set cream.

2. Remove resin mixture from hands as soon as possible and before mixture starts to gel. This can be observed by the action of the material being used. Resin may be removed with lacquer thinner first and then washing in soap and water.

3. Respirators are recommended when grinding. Also some minor skin irritation from glass and powered cured resin may be evident. If skin irritation occurs, avoid scratching skin. Washing in cold water will help to minimize irritation.

4. Use a sander with a vacuum attachment for dust control whenever possible.

5. Resin mixtures may produce toxic fumes and should be used in well ventilated areas.

6. Keep material, utensils, work area, and clothing clean and dry, these repairs involve chemical reactions and dirt or moisture may upset the chemical balance and produce unsatisfactory results.

7. Before starting any repair operation, look for hidden damage by applying force around the damaged area, looking for hairline cracks, split laminations, and other breakage.

RESIN REPAIR KIT

The resin repair kit is used for major repairs, such as cracks and fractures. The resin repair kit contains resin, hardener, fiberglass cloth, powdered filler, protecting cream, and mixing utensils.

Damage that had broken through a fiberglass panel will require the use of fiberglass cloth. One or two layers of cloth should be used as a backing if possible.

The cloth applied to the surface side should be first cut to size matching the repair area. Additional layers of cloth, as required, to fill the repair area should be cut larger than each one before it. The final layer should be approximately 2″ larger than the repair area.

Cleanliness is most important. Be certain all containers are dry and clean and the resin and hardener cans kept closed when not in use. Do not use waxed cups for mixing, and do not allow resin to enter hardener can or vice versa.

The material is mixed 4 parts resin to 1 part hardener. The powdered filler is used to make the resin mixture the thickness desired. The amount of resin mixture will depend on the size of the repair.

The pre-cut layers of fiberglass cloth are saturated in the resin mixture and placed on the damaged area. Remove wrinkles and maintain original contour of area. Apply heat lamp approximately 12 inches from surface to help the material to harden.

NOTE: Once resin and hardener are mixed together, the "work life" of the mixture is approximately 15 minutes. Resin mixture must be applied and all tools, skin, clothing, etc. that have made contact with the resin mixture should be cleaned before the period expires.

PLASTIC SOLDER KIT

The plastic solder kit is used for minor damage, such as scratches and surface imperfections. The material must be mixed according to instructions furnished with kit.

Apply the material, using a putty knife or rubber squeegee. Work the material into the repair and build the material up to the desired contour. For deep filling, several layers may be used, each about 1/4″ thick. Material may be finished by grinding, filing, sanding, and painting in the usual manner.

REPAIR PROCEDURES PREPARATORY STEPS

Perform these four steps prior to beginning any fiberglass repair:

1. Check shop temperature and humidity against recommendations on resin can label. Normal room temperature and humidity are usually specified.

NOTE: Cool temperatures may retard or prolong curing, while high temperatures will reduce curing time. High humidity may result in moisture being absorbed in the resin which may inhibit curing and leave the surface tacky.

2. Gather required tools and materials.

3. Clean the damaged area, both inside and outside, with solvent; then inspect the area closely, and

4. push on the area immediately surrounding and underneath the crack to determine the extent of damage.

SCRATCHES AND GOUGES

Definition

In general, a scratch or gouge is minor damage that penetrates through the paint and only slightly into the laminate.

Repair Steps

1. Using a burr bit on a power drill, rout the length of the scratch or gouge. Form a V groove tapered no more than 45 degrees. Do not cut through the laminate.

CAUTION: *Wear goggles and respirator when cutting, grinding or sanding.*

2. Remove flaky edges and feather the painted surface back about 1/2 inch beyond the damaged area by hand-sanding or power-sanding with 360-grit sandpaper. Clean the area with a dry cloth or air.

CAUTION: *Do not wipe with solvent.*

3. Mask off the undamaged surface, leaving a working area of approximately 5 inches surrounding the repair area.

4. Following the manufacturer's instructions, mix enough body filler to re-establish surface.

5. Apply and spread filler with a plastic squeegee, making sure to remove air bubbles. Allow filler to extend above original surface to allow for shrinkage.

6. Allow filler to set up until it is rubbery but not fully hardened. Then re-establish original contour by planing and/or filing off excess, still leaving the filler level slightly higher than that of the original surface.

7. Shrink filler, using a heat gun or heat lamp. A minimum temperature of 49°C (120°F) is required for shrinkage.

CAUTION: *Keep heat source at least 12 inches away from repair area or damage may result.*

8. After the filler has set, power-sand the filler with 360-grit sandpaper using an orbital or reciprocating sander until it is smooth and even with the original surface.

9. If the filler is slightly porous (has fine pinholes), apply a thin coat of glazing putty, and allow to cure under a heat gun or heat lamp.

Finish by sanding with a sanding block and 360-grit sandpaper. However, if the filler is pockmarked, do not use glazing putty at this time. Instead, apply another layer of body filler, following steps 4 through 10.

10. Complete the repair by cleaning the area with air; remask, if necessary; spot prime, wet sand with 400- to 600-grit sandpaper, and paint.

HAIRLINE CRACKS

Definition

A crack is an obvious hairline separation extending completely through the laminate. Cracks can occur in the center of the laminate or extend from the laminate edge due to stress beyond normal operational limits.

NOTE: Refer to "Preparatory Steps" on page 2C-7.

Repair Steps

1. Using a tapered bit or a saber saw, remove the cracked and flaked fiber glass until the crack is at least 1/8 inch wide.

CAUTION: *Wear goggles and respirator when cutting, grinding or sanding.*

2. If panel is out of alignment, realign it with C-clamps and/or other hardware.

3. Mask off undamaged surface, leaving a working area of approximately 5 inches surrounding the crack.

NOTE: Steps 4 to 9, following, describe the preparation of a backing patch. For ease of illustration, the method describes a patch being formed to the outside surface. However, whenever possible it is more desirable to form the patch to the inside surface.

4. Cut a piece of plastic separating film large enough to extend approximately 3 inches beyond the edge of the repair area. Tape the film to the outside repair surface.

5. Refer to the table below, and then, using a cardboard template, cut the required pieces of mat large enough to extend 2 inches beyond the edges of the repair area.

6. Mix the recommended amount of polyester resin according to the instructions on the label of the can.

7. Apply some resin to the working area of the separating film. Then place the first layer of mat on the separating film. Saturate the mat with resin, using a stippling motion.

8. Now lay up by hand the remaining piece or pieces of mat. Saturate each piece with resin, using a stippling motion.

NOTE: After application tape a piece of plastic film over the patch to prevent it from sliding on a vertical surface.

9. Allow the patch to harden; then pop it off and remove the separating film.

10. Working from the outside and using a file or grinder, taper the edges of the crack at an angle of no more than 45 degrees.

11. Remove flaky edges and feather the painted surface back about 1/2 inch beyond the damaged area by hand-sanding or power-sanding with 360-grit sandpaper.

12. Clean the area with a dry cloth or air.

CAUTION: *Do not wipe with solvent.*

13. Sand the underside of the repair area with 80-grit (or less) sandpaper to create a rough bonding surface approximately 2 inches from the center of the crack.

14. Trim the patch. Then sand the mating surface of backing patch with 80-grit sandpaper (or less), checking for smooth fit to the underside. Clean all surfaces with air.

15. Hold the backing patch in position under the damaged area. Mark its position relative to the underside of the panel. Outline the outer edge of the damaged area on the patch. This will give you a reference point when applying the epoxy adhesive.

16. Use C-clamps to hold backing patch in place.

17. Mix epoxy adhesive according to instruction.

18. Apply the adhesive to underside of the repair area; within the area outlined, and to the patch (try not to get adhesive into the area under the groove). Press patch in place until epoxy squeezes out from all edges.

19. Hold backing patch with clamps or screws and allow

Consult the following table in determining the number of layers of mat required in making a preformed backing patch:

MAT REQUIREMENTS

THICKNESS OF ORIGINAL MOLDED LAMINATE (IN.)	LAYERS OF FIBER GLASS MAT (HAND LAY-UP PATCH)
0.100	3 (1½ oz.)
0.110	3 (1½ oz.)
0.120	2 (1½ oz.) 1 (2 oz.)
0.130	1 (1½ oz.) 2 (2 oz.)
0.140	3 (2 oz.)
0.170	2 (1½ oz.) 2 (2 oz.)

the adhesive to harden for the time given in the manufacturer's instructions.

NOTE: If the adhesive is squeezed into the tapered groove during bonding, clean it out before the adhesive sets; roughen any remaining adhesive with 360-grit sandpaper after it hardens.

20. Following the manufacturer's instructions, mix enough body filler to re-establish surface.

21. Work the filler into the tapered crack with a squeegee, making sure to fill all voids and removing large air bubbles. Allow filler to extend above the original surface to allow for shrinkage.

22. When the filler is firm to the touch, plane and/or file off the excess, still leaving the filler level slightly above that of the original surface.

23. Shrink the filler, using a heat gun or heat lamp. A minimum temperature of 49°C (120°F) is required for shrinkage.

CAUTION: *Keep heat source at least 12 inches away from repair area or damage may result.*

24. Power-sand the filler with 360-grit sandpaper until it is smooth and even with the original surface.

25. If the filler is slightly porous (has fine pinholes), apply a thin coat of glazing putty. If the filler is pockmarked, do not use glasing putty at this time. Instead, apply another layer of body filler, following steps 20 through 25 above.

26. Allow glazing putty to cure under heat gun or heat lamp. Finish with a sanding block and 360-grit sandpaper.

27. Complete the repair by cleaning the area with air. Remask, if necessary; spot prime, wet sand with 400 to 600 grit sandpaper and paint.

SMALL FRACTURES - SIMPLE CURVE

Definition

Small fractures are punctures of 3 inches or less in size.

Repair Steps

1. Using a tapered bit or a saber saw, remove the cracked and flaked edges from the fracture.

CAUTION: *Wear goggles and respirator when cutting, grinding or sanding.*

2. If the fracture is at the edge of the panel and if panel is out of alignment, realign it with C-clamps and/or other hardware.

3. Mask off undamaged surface, leaving a working area of approximately 5 inches surrounding the fracture.

NOTE: Steps 4 to 9, following, describe the preparation of a backing patch. For ease of illustration, the method describes a patch being formed to the outside surface. However, whenever possible, it is more desirable to form the patch to the inside surface.

4. Cut a piece of plastic separating film large enough to extend approximately 3 inches beyond the edge of the repair area. Tape the film to the outside repair surface.

5. Refer to the table on page 2C-8 and then, using a cardboard template, cut the required pieces of mat large enough to extend 2 inches beyond the edges of the repair area.

6. Mix the recommended amount of polyester resin according to the instructions on the label of the can.

7. Apply some resin to the working area of the separating film. Then place the first layer of mat on the separating film. Saturate the mat with resin, using a stippling motion.

8. Now lay up by hand the remaining piece or pieces of mat. Saturate each with resin, using a stippling motion.

NOTE: After application, tape a piece of plastic film over the patch to prevent it from sliding on a vertical surface.

9. Allow the patch to harden; then pop it off and remove the separating film.

10. Working from the outside and using a file or grinder, taper the edges of the hole at an angle of no more than 45 degrees.

11. Remove flaky edges and feather the painted surface back about 1/2 inch beyond the damaged area by hand-sanding or power-sanding with 360-grit sandpaper.

12. Clean the area with a dry cloth or air.

CAUTION: *DO NOT wipe with solvent.*

13. Sand the underside of the repair area with 80-grit (or less) sandpaper to create a rough bonding surface approximately 2 inches from the edges of the hole.

14. Trim the patch. Then sand the mating surface of backing patch with 80-grit sandpaper (or less), checking for smooth fit to the underside. Clean all surfaces with air.

15. Hold the backing patch in position under the damaged area. Mark its position relative to the underside of the panel. Outline the outer edge of the damaged area on the patch. This will give you a reference point when applying the epoxy adhesive.

16. Determine the method of holding backing patch in place (C-clamps, self-tapping screws, etc.) and trial test.

NOTE: If you use self-tapping screws, pre-drill the holes. Then, before finishing the surface, remove the screws and fill holes with body filler.

17. Mix epoxy adhesive according to instructions.

18. Apply the adhesive to underside of the repair area, within the area outlined, and to the patch (try not to get adhesive into the area within the hole outline). Press patch in place until epoxy squeezes out from all edges.

19. Hold backing patch with clamps or screws and allow the adhesive to harden for the time given in the manufacturer's instructions.

NOTE: If the adhesive is squeezed into the tapered groove during bonding, clean it out before the adhesive sets; roughen any remaining adhesive with 360-grit sandpaper after it hardens.

20. Following the manufacturer's instructions, mix enough body filler to re-establish surface.

21. Work the filler into the hole with a squeegee, making sure to fill all voids and removing large air bubbles. Allow filler to extend above the original surface to allow for shrinkage.

22. When the filler is firm to the touch, plane and/or file off the excess, still leaving the filler level slightly above that of the original surface.

23. Shrink the filler, using a heat gun or heat lamp. A minimum temperature of 49°C (120°F) is required for shrinkage.

CAUTION: *Keep heat source at least 12 inches away from repair area as damage could result.*

24. Power-sand the filler with 360-grit sandpaper until it is smooth and even with the original surface.

25. If the filler is slightly porous (has fine pinholes), apply a thin coat of glazing putty. If the filler is pockmarked, do not use glazing putty at this time. Instead, apply another layer of body filler, following steps 20 through 25 above.

26. Allow glazing putty to cure under heat gun or heat lamp. Finish with a sanding block and 360-grit sandpaper.

27. Complete the repair by cleaning the area with air. Remask, if necessary; spot prime, wet sand with 400-to 600-grit sandpaper, and paint.

LARGE FRACTURES - SIMPLE CURVE

Definition

Large fractures are punctures that are 3 inches or more in length.

Repair Steps

1. Use steps 1 through 19 on page 2C-9,"Small Fractures", then use the following procedures:

20. While the adhesive is hardening, cut some pieces of mat to fit into the hole.

NOTE: The mat will serve as a filler; not as a structural reinforcement.

21. Following the manufacturer's instructions, mix enough resin to saturate the pieces of mat.

22. Using a stippling motion of your brush, lay up the pieces of mat by hand, one piece at a time, until the top layer is just below the edge of the hole.

23. Allow the mat to harden. Then rough sand with 80-grit sandpaper.

24. Following the manufacturer's instructions, mix enough body filler to re-establish surface.

25. Work the filler into the hole with a squeegee, making sure to fill all voids and removing large air bubbles. Allow filler to extend above the original surface to allow for shrinkage.

26. When the filler is firm to the touch, plane and/or file off the excess, still leaving the filler level slightly above that of the original surface.

27. Shrink the filler, using a heat gun or heat lamp. A minimum temperature of 49°C (120°F) is required for shrinkage.

CAUTION: *Keep heat source at 12 inches away from repair area as damage could result.*

28. Power-sand the filler with 360-grit sandpaper until it is smooth and even with the original surface.

29. If the filler is slightly porous (has fine pinholes), apply a thin coat of glazing putty at this time. If the filler is pockmarked, do not use glazing putty. Instead, apply another layer of body filler, following steps 20 through 25 above.

30. Allow glazing putty to cure under heat gun or heat lamp. Finish with a sanding block and 360-grit sandpaper.

31. Complete the repair by cleaning the area with air. Remask, if necessary; spot prime, wet sand with 400- to 600-grit sandpaper and paint.

FRACTURES - INACCESSIBLE UNDERSIDE

Definition

A fracture, large or small, which cannot be reached or can be reached only with great difficulty is inaccessible.

Repair Steps

1. Using a tapered bit or a saber saw, remove the cracked and flaked fiberglass until you have a hole through which you can slip a backing patch.

CAUTION: *Wear goggles and respirator when cutting, grinding or sanding.*

2. Use steps 2 - 12 on page 2C-9, "Small Fractures", then use the following procedures below:

13. Reaching through the hole, sand the underside of the repair area with 80-grit (or less) sandpaper to create a rough bonding surface approximately 2 inches from the edges of the repair area.

14. Sand the mating surface of backing patch with 80-grit sandpaper (or less).

15. To trial test the method of holding the backing patch in place, drill two holes in the patch at least 3/4 inch apart (farther apart if possible).

16. Thread the ends of the wire through the two holes in the backing patch. Then slip the patch into the hole and hold it in place by wrapping the wires around the wood strips. Trim patch to size as required.

NOTE: Wax the wires for easy removal after adhesive has been applied.

17. While the patch is in position, trace an outline of the damaged area to be used later as a guide when applying epoxy adhesive. Then remove patch and set aside.

18. Mix epoxy adhesive according to instructions.

19. Apply the adhesive to underside of repair area (if possible) and to patch.

20. Slip the patch through the hole; then pull up hard on the wires until adhesive squeezes out on all sides.

NOTE: If the adhesive is squeezed into the tapered groove during bonding, clean it out before the adhesive sets; roughen any remaining adhesive with 360-grit sandpaper after it hardens.

21. Twist the wires around the strips of wood to hold the backing patch in position until the adhesive sets.

22. When the backing patch is firmly in place, remove the wood strips. Remove the wires if possible; if not, clip them off as close to the surface of the patch as you can.

23. If the fracture is less than three inches in length, complete the repair by following steps 17 through 27 on page 2C-9 under "Small Fractures - Simple Curve".

24. If the fracture is greater than three inches in length, complete the repair by following steps 25 through 27 below and then, 20 through 31 under "Large Fractures - Simple Curve" in column 1 on this page.

25. Mix epoxy adhesive according to instructions.

26. Apply the adhesive to underside of the repair area, within the area outlined, and to the patch (try not to get adhesive into the area within the hole outline). Press patch in place until epoxy squeezes out from all edges.

27. Hold backing patch with clamps or screws and allow the adhesive to harden for the time given in the manufacturer's instructions:

NOTE: If the adhesive is squeezed into the tapered groove during bonding, clean it out before the adhesive sets; roughen any remaining adhesive with 360-grit sandpaper after it hardens.

COMPOUND CURVES

Definition

The term "compound curves" refers to surfaces having curvature in more than one direction. Repairing such curves is a rather difficult procedure in that a form must be molded to the contour to provide a base for a backing patch.

Repair Steps

1. Using a tapered bit or a saber saw, remove the cracked and flaked fiber glass leaving a clean hole outlining the damage.

CAUTION: *Wear goggles and respirator when cutting, grinding or sanding.*

2. If panel is out of alignment, realign it with C-clamps and/or other hardware.

3. Mask off undamaged surface, leaving a working area of approximately 5 inches surrounding the hole.

4. Using a foamed plastic, clay, or balsa, form a mold of the underside of the damaged area.

CAUTION: *When working with foamed plastic, keep it away from solvents and resins.*

5. Cut a piece of plastic separating film and cover the mold with it.

6. Refer to the table on page 2C-8 and then, using a cardboard template, cut the required pieces of mat large enough to extend 2 inches beyond the edges of the repair area.

7. Mix the recommended amount of polyester resin according to the instructions on the label of the can.

8. Apply some resin to the working area of the separating film. Then place the first layer of mat on the separating film. Saturate the mat with resin, using a stippling motion.

9. Now lay up by hand the remaining piece or pieces of mat. Saturate each with resin, using a stippling motion.

NOTE: After application tape a piece of plastic film over the patch to prevent it from sliding on a vertical surface.

10. Allow the patch to harden; then pop it off and remove the separating film. Check the fit of the backing patch to the underside of the repair area.

11. If the fracture is less than three inches in length, complete the repair by following steps 17 through 27 on page 2C-9 under "Small Fractures - Simple Curve".

12. If the fracture is greater than three inches in length, complete the repair by following steps 13 through 15 below and then, 20 through 31 on page 2C-10 under "Large Fractures - Simple Curve".

13. Mix epoxy adhesive according to instructions.

14. Apply the adhesive to underside of the repair area, within the area outlined, and to the patch (try not to get adhesive into the area within the hole outline). Press patch in place until epoxy squeezes out from all edges.

15. Hold backing patch with clamps or screws and allow the adhesive to harden for the time given in the manufacturer's instructions:

NOTE: If the adhesive is squeezed into the tapered groove during bonding, clean it out before the adhesive sets; roughen any remaining adhesive with 360-grit sandpaper after it hardens.

FRONT FENDER (Right or Left) Fig. 2C-12

a. Removal

1. Apply masking tape to rear edge of fender to avoid scratching finish when removing fender.

2. Raise front end of car and remove wheel on side of car from which fender is being removed.

3. Remove rocker panel molding.

4. If working on right fender, remove battery and remove or disconnect power antenna.

5. If working on left side of car, remove washer bottle.

NOTE: Count number of shims at each attaching location so that the same number are installed during installation.

6. Remove one screw and shims retaining fender to body pillar.

7. Remove one screw and shims that hold rear bottom of fender to rocker panel.

8. Remove one screw securing wheelhouse to lower strut.

9. Remove one vertical screw in battery tray, securing wheelhouse to tray. If working on left side of car, vertical screw is located in cannister tray.

10. Remove cornering lamp as described on page 8-67.

11. Remove one screw and shims (if any) securing nose of fender to front end panel.

12. Remove four screws and shims securing fender to upper strut.

13. Remove fender by lifting outward and slightly backward.

b. Installation

All fender attaching bolts should be loosely installed until fender alignment is obtained. Install the same number of shims at each location as were removed, and then tighten to proper torque specification. Loosen wheelhousing attaching screws if necessary to align fender properly.

1. Position fender in approximate location being careful not to damage leading edge of door or trailing edge of fender.

2. Install four screws and shims securing fender to upper strut.

3. Install one screw and shims (if any) securing fender to front end panel.

4. Install cornering lamp as described on page 8-67.

5. Install one screw securing wheelhouse to lower strut.

6. Position and install one screw in battery tray securing

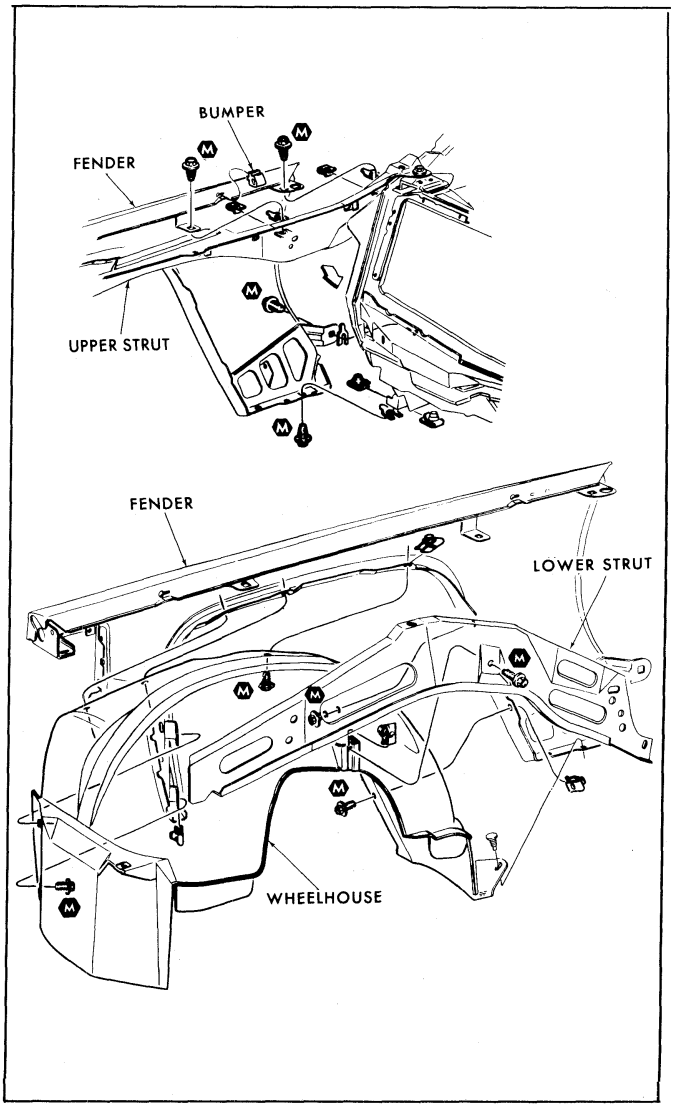


Fig. 2C-12 Front Fender Disassembly (C-Car)

wheelhouse to tray. If working on left side of car, install screw in canister tray.

7. Install one screw and shims securing fender to rocker panel.

8. Install one screw and shims securing fender to lower body pillar.

9. Obtain proper alignment of fender and tighten all screws installed in Steps 2 through 8 to proper torque.

10. If working on left side of car, install washer bottle.

11. Install wheel and rocker panel molding.

12. If working on right fender, install battery and install or connect power antenna.

FRONT FENDER WHEELHOUSING (Right and Left) (Fig. 2C-12)

a. Removal

1. For added clearance, raise car so that wheels are off the floor.

2. If removing left wheelhousing, remove two attaching screws securing washer bottle to wheelhousing.

3. Remove one screw in battery tray securing wheelhouse to tray. For left wheelhousing, screw is located in canister tray.

4. Remove splash seal fasteners from frame.

5. Remove seven screws securing wheelhousing to fender.

6. Remove one attaching screw securing wheelhousing to lower strut. Remove wheelhousing.

b. Installation

1. Position wheelhousing in approximate location and loosely install seven screws attaching wheelhousing to fender.

2. Loosely install one screw attaching wheelhousing to lower strut.

3. Secure splash seal to frame.

4. Loosely install one screw in battery tray (canister tray if working on left side) attaching wheelhouse to tray.

5. Check alignment of wheelhousing and tighten all screws to 10 N·m (90 inch-pounds).

6. If working on left side, install washer bottle.

7. Lower car.

ON-CAR SERVICE - ELDORADO

UPPER GRILLE (Fig. 2C-13)

a. Removal

1. Open hood.

2. If car is equipped with Guide-Matic, remove two screws securing Guide-Matic photo amplifier to grille and one screw securing bottom of strut rod to center bumper bar.

3. Remove two screws securing each end of grille to upper grille reinforcement.

4. Loosen one screw securing each of two rear grille mounting tabs to vertical grille support.

5. Remove one screw securing center support rod to center bumper bar.

6. Taking care not to damage bumper, slide grille forward until disengaged from supports and reinforcement, then lift straight up.

b. Installation

1. Install U-nuts on four upper attaching lugs on grille.

2. Slide grille carefully into position to avoid scratching bumper. Engage slots in rear grille mounting tabs with retaining screws on grille supports and line up screw holes in grille upper lugs with holes in grille upper reinforcement.

3. Insert two screws securing each end of grille reinforcement, tightening to 30 inch-pounds.

4. Tighten screws securing grille tabs to left and right supports to 30 inch-pounds.

5. Install one screw securing center support rod to center bumper bar.

6. If car is equipped with Guide-Matic, position photoamplifier and strut rod to center bumper bar and secure with three screws.

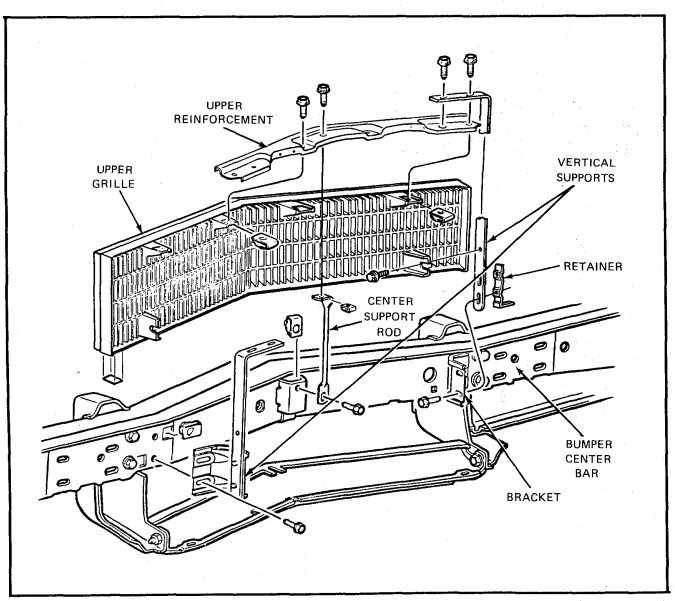


Fig. 2C-13 Upper Grille - Eldorado

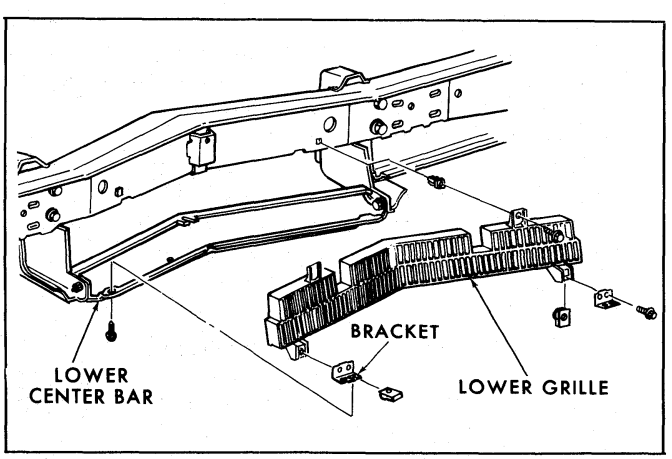


Fig. 2C-14 Lower Grille - Eldorado

7. Close hood and check alignment of grille. Readjust as required.

LOWER GRILLE (Fig. 2C-14).

a. Removal

1. Remove fasteners securing air deflector to lower center bar.
2. Remove four bolts securing lower grille to lower center bar.
3. Remove two screws securing lower grille to bumper upper center bar.
4. Pull grille straight back then tip one end up and drop grille straight down and out of car.

b. Installation

1. Lift lower grille into position and secure to bumper upper center bar with two screws, tightening to 30 inch-pounds.
2. Install four bolts between lower center bar and grille. Tighten to 18 inch-pounds.
3. Allow air deflector to rest on lower center bar and secure to lower center bar with fasteners.

FRONT FENDER (Right or Left) Fig. 2C-15

a. Removal

1. If left fender is to be removed, disconnect negative battery cable and remove hood. If right fender is to be removed, remove coolant reservoir, battery, power antenna, ALC compressor, and hood.

NOTE: Count number of shims at each attachment so that same number are installed during installation.

2. Apply masking tape to rear edge of fender to avoid scratching finish when removing fender.
3. Raise front of car and remove wheel at fender being replaced.

NOTE: When removing left front fender, disconnect forward lamp harness from retaining straps on fender reinforcement.

4. Disconnect wiring connector for parking, turn signal, cornering and side marker lamps. Also remove monitor conductors from headlamp connectors.
5. Remove fender extension as described on page 2C-15.
6. Open door and remove one screw and shims securing lower rear edge of fender inside door opening.
7. Remove seven screws securing rocker panel molding to body and remove molding.
8. Remove one screw, washers and shims securing bottom rear edge of fender to rocker panel.
9. Remove one screw and washer securing lower rear corner of wheelhousing to rocker panel.
10. Remove one screw from front wheelhousing splash shield to fender.
11. Remove three screws, washers and shims securing top rear of fender to cowl under hood.
12. Remove one screw securing fender bracket to side of the radiator support.
13. Remove two screws securing top front of fender to radiator support.
14. Remove one bolt securing front lower corner of fender to radiator support strut rod.
15. Remove six screws securing fender to wheelhousing.
16. Remove two screws securing fender to top of wheelhousing.
17. Remove front fender.

b. Installation

1. Position fender on car and loosely install two screws securing fender to top of wheelhousing.

NOTE: When installing left fender, make sure wiring harness and hood release cable are routed between fender and wheelhousing.

2. Loosely install two screws securing fender to top of wheelhousing.
3. Loosely install six screws securing fender to bottom of wheelhousing.
4. Loosely install one bolt and U-nut securing front lower corner of fender to radiator support strut rod.
5. Loosely install one screw securing front wheelhousing splash shield to fender.
6. Loosely install one screw securing fender to bracket on side of the radiator support.
7. Loosely install three screws, washers and shims securing top rear of fender to cowl under hood.
8. Loosely install one screw and washer securing lower rear corner of wheelhousing to rocker panel.
9. Loosely install one screw securing lower rear corner of fender to rocker panel.
10. Loosely install one screw and shims securing lower rear edge of fender inside door opening.
11. Check alignment and tighten all screws to proper torque.
12. Position rocker panel molding to body and secure with seven screws.
13. Install fender extension as described on page 2C-15.
14. Position and connect wiring connector for parking, turn signal, cornering, and side marker lamps. Also, install monitor conductors into headlamp connectors.

NOTE: If installing left front fender, connect underhood wiring harness to retaining straps on fender reinforcement.

15. With front end of car still raised, install wheel previously removed.
16. Remove masking tape from rear edge of fender.
17. If left fender was removed, install negative battery cable and hood. If right fender was removed, install battery, power antenna (see section 9), ALC compressor (see page 3D-20 or 3D-21 if Seville) and hood.

FRONT FENDER WHEELHOUSING (Right or Left) Fig. 2C-15

a. Removal

1. Remove fender as described in column 1, this page.
2. If working on left side, remove horn from wheelhousing. If removing right wheelhousing, remove heater and A/C hoses from clip on wheelhousing and support and position hoses out of way.
3. Remove two screws securing forward portion of wheelhousing to bracket on radiator support.
4. Remove one screw from rear wheelhousing splash shield to frame.
5. Remove wheelhousing from car.

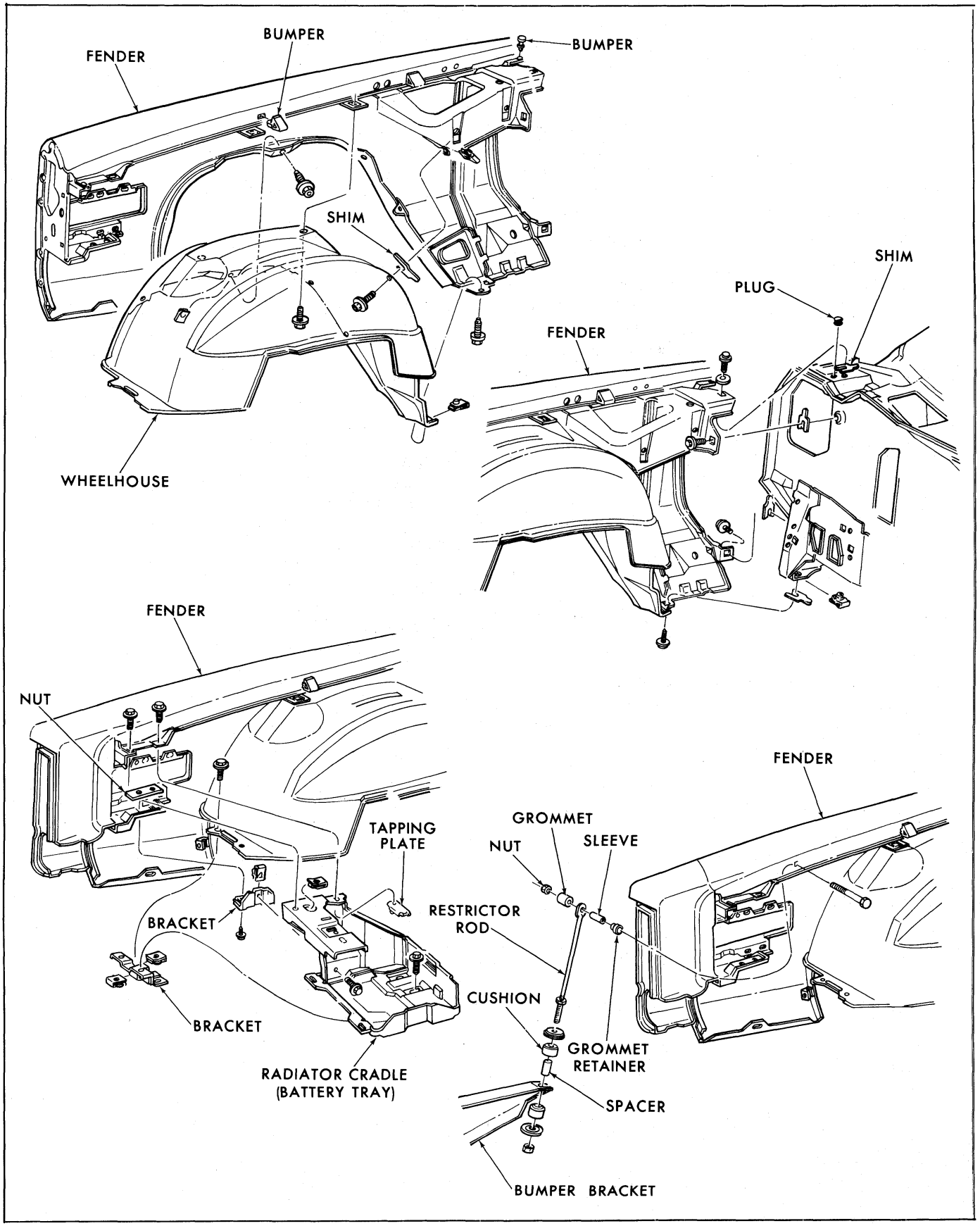


Fig. 2C-15 Front Fender Disassembly (Eldorado)

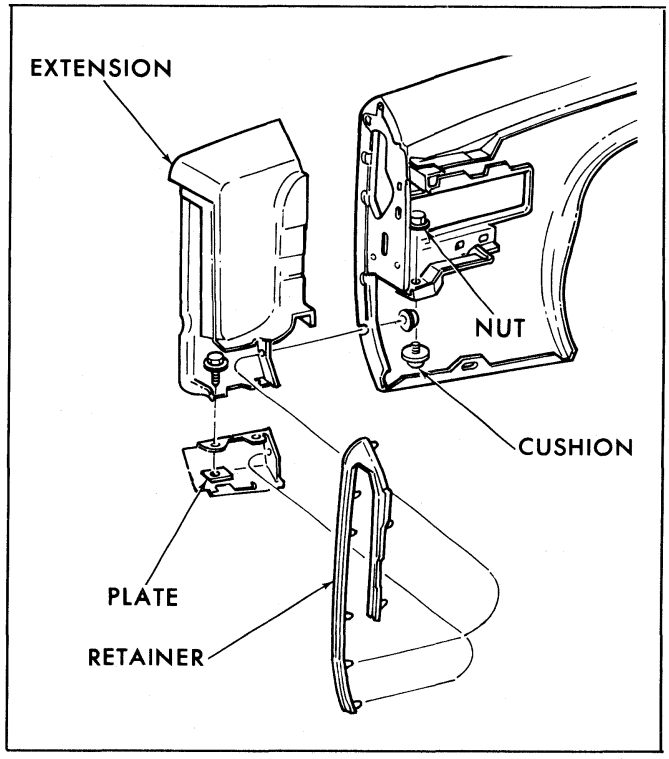


Fig. 2C-16 Fender Extension

b. Installation

1. Position wheelhousing in approximate location.
2. Install one screw securing rear wheelhousing splash shield to frame.
3. Install two screws and tapping plates securing forward portion of wheelhousing to bracket on radiator support.
4. If working on left side, position horn to wheelhousing and secure with fastener. If installing right wheelhousing, position heater and A/C hoses beneath clip on side of wheelhousing.
5. Install fender as described on page 2C-13.

FENDER EXTENSION (Right or Left) Fig. 2C-16

a. Removal

1. Remove side marker light (see page 8-71).
2. Remove nine nuts securing fender extension to fender.
3. Pull fender extension forward and up to remove.

b. Installation

1. Position fender extension to fender.
2. Install nine nuts securing fender extension to fender.
3. Install side marker light (see page 8-71).

ON-CAR SERVICE - SEVILLE

UPPER GRILLE (Fig. 2C-17)

a. Removal

1. Open hood.
2. Remove two screws securing Guide-matic Photocell (if car is so equipped) to rear of left side of grille.
3. Remove four screws securing grille to upper grille reinforcement.
4. Loosen one screw securing each of two rear grille mounting tabs to vertical grille supports.
5. Taking care not to damage bumper, slide grille forward until disengaged from supports and reinforcement, then lift straight up.

b. Installation

1. Install U-nuts on four upper attaching lugs on grille.
2. Slide grille carefully into position to avoid scratching bumper. Engage slots in rear grille mounting tabs with retaining screws on grille supports and line up screw holes in grille upper lugs with holes in grille upper reinforcement.
3. Install four screws securing grille reinforcement, tighten to 30 inch-pounds.
4. Tighten screws securing grille tabs to left and right supports to 30 inch-pounds.
5. If car is equipped with Guide-matic, position photocell on left rear of grille and secure with two screws.

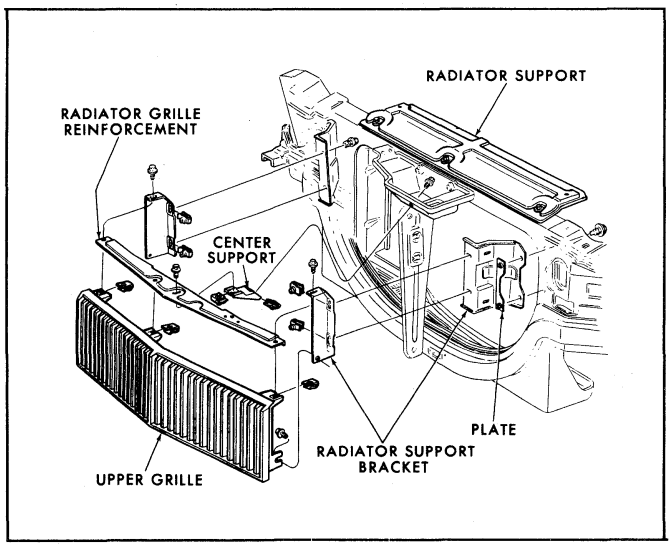


Fig. 2C-17 Upper Grille - Seville

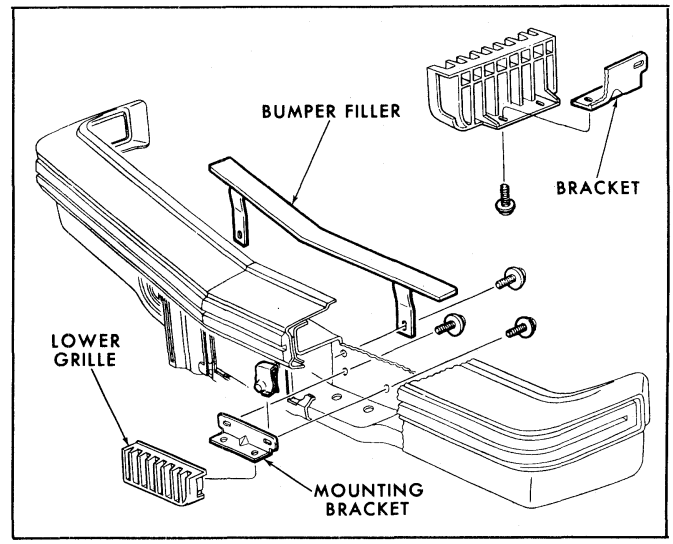


Fig. 2C-18 Lower Grille - Seville

6. With car on level surface, check level of Guide-matic photocell and adjust as described in Section 9.

7. Close hood and check alignment of grille. Readjust as required.

LOWER GRILLE (Fig. 2C-18)

a. Removal

1. From underneath bumper remove two bolts securing lower grille to mounting bracket.

2. Pull grille straight and out through front of bumper.

b. Installation

1. Position lower grille in bumper opening.

2. Secure lower grille to mounting bracket with two attaching bolts.

3. Check alignment of grille in bumper.

FRONT FENDER (Right or Left) Fig. 2C-19

a. Removal

1. If left fender is to be removed, disconnect negative battery cable. If right front fender is to be removed, remove the battery and coolant reservoir and disconnect wires to horn.

NOTE: Count number of shims at each attaching so that same number are installed during installation.

2. Scribe hood hinge to fender, support hood front and rear, remove two screws from hood hinge to fender.

3. Remove front bolt and loosen rear bolt on fender strut, move strut out of way.

4. Apply masking tape to rear edge of fender, front of door edge and windshield pillar.

5. Raise front end of car and remove wheel on side of car from which fender is being removed.

6. Remove rocker panel molding and rocker shield.

NOTE: When removing left front fender, disconnect wires to windshield washer low fluid warning switch and disconnect hose from switch.

Remove access plate from wheel housing. Disconnect two hoses from evaporative loss control canister. Remove one screw holding bracket to fender and remove canister. Remove two screws securing washer bottle to fender bracket and remove bottle. Remove two screws securing ALC compressor bracket to fender. Position compressor out of way and secure. Disconnect ALC hoses.

7. Remove cornering lamp as described on page 8-77 and remove three light monitor fiber optic cables from light source.

8. Remove screws from wheelhousing to fender.

NOTE: Seven screws on right side. Eight screws on left side.

9. Remove two screws from radiator support to fender and one screw from fender to headlamp bezel.

10. Remove lower bracket to fender screw accessible from battery area on the right hand, evaporative canister on the left hand.

11. Remove bolt from cowl to fender accessible through hole in cowl.

12. Remove two bolts securing fender to fire wall.

13. Remove two screws securing lower fender to body.

14. Open door to remove bolt from lower window pillar.

15. Remove escutcheon holding antenna.

16. Remove fender from body.

b. Installation

NOTE: If difficulty is encountered in installing fender due to binding or misalignment, a floor jack may be placed under the dash to chassis frame brace on body, and the body raised until the front end is unloaded adequately to unstrain the fender and provide adequate screw hole clearance. An alternate method, prior to removing the fender, is to attach a diagonal rod from the radiator support upper outer corner to the cowl attachment bracket for the fender to cowl rod.

All fender attaching bolts should be loosely installed until fender alignment is obtained. Install the same number of shims at each location as were removed. Then tighten to proper torque specifications. Loosen wheelhousing attaching screws if necessary to align fender properly.

1. Position fender in approximate location, being careful not to damage leading edge of door or trailing edge of fender.

2. Install 2 screws lower fender to body.

3. Install two bolts securing fender to firewall.

4. Open door to install bolt at lower window pillar.

5. Install bolt from cowl to fender accessible through hole in cowl.

6. Install lower bracket to fender screw accessible from battery area on the right. Evaporative canister on the left.

7. Install two screws from radiator support to fender and one screw from fender to bezel.

8. Install screws from fender to wheelhousing.

NOTE: Seven screws on right side. Eight screws on left side.

9. Install access plate to wheelhousing. (Left side).

10. To obtain proper alignment of fender, tighten all screws installed in Steps 2 through 7 to proper torque.

11. Install cornering lamp as described on page 8-77, and install three headlamp monitor fiber optic cables to light source.

12. Install rocker panel molding and rocker shield.

13. Install front bolt and tighten rear bolt to fender strut.

14. Position hood hinge to fender and install two screws with proper alignment.

15. Remove all masking tape from rear edge of fender, front door edge and windshield pillar.

16. Install wheel, lower car to floor.

NOTE: When installing left front fender, connect wires to windshield washer low fluid warning switch and connect hose from switch. Connect two hoses from evaporative lost control canister, install one screw holding bracket to fender and install canister. Install two screws securing washer bottle to fender bracket and install bottle.

Install two screws securing ALC compressor bracket to fender. Connect ALC hoses.

Install escutcheon holding antenna. Connect negative battery cable.

When installing right front fender, install the battery, the coolant reservoir and connect wires to horn.

FRONT FENDER WHEELHOUSING (Right or Left) Fig. 2C-19

a. Removal

1. Raise car by positioning jacks under dash brace on body and remove front wheel.

2. Remove five screws securing wheelhousing to fender at wheel opening.

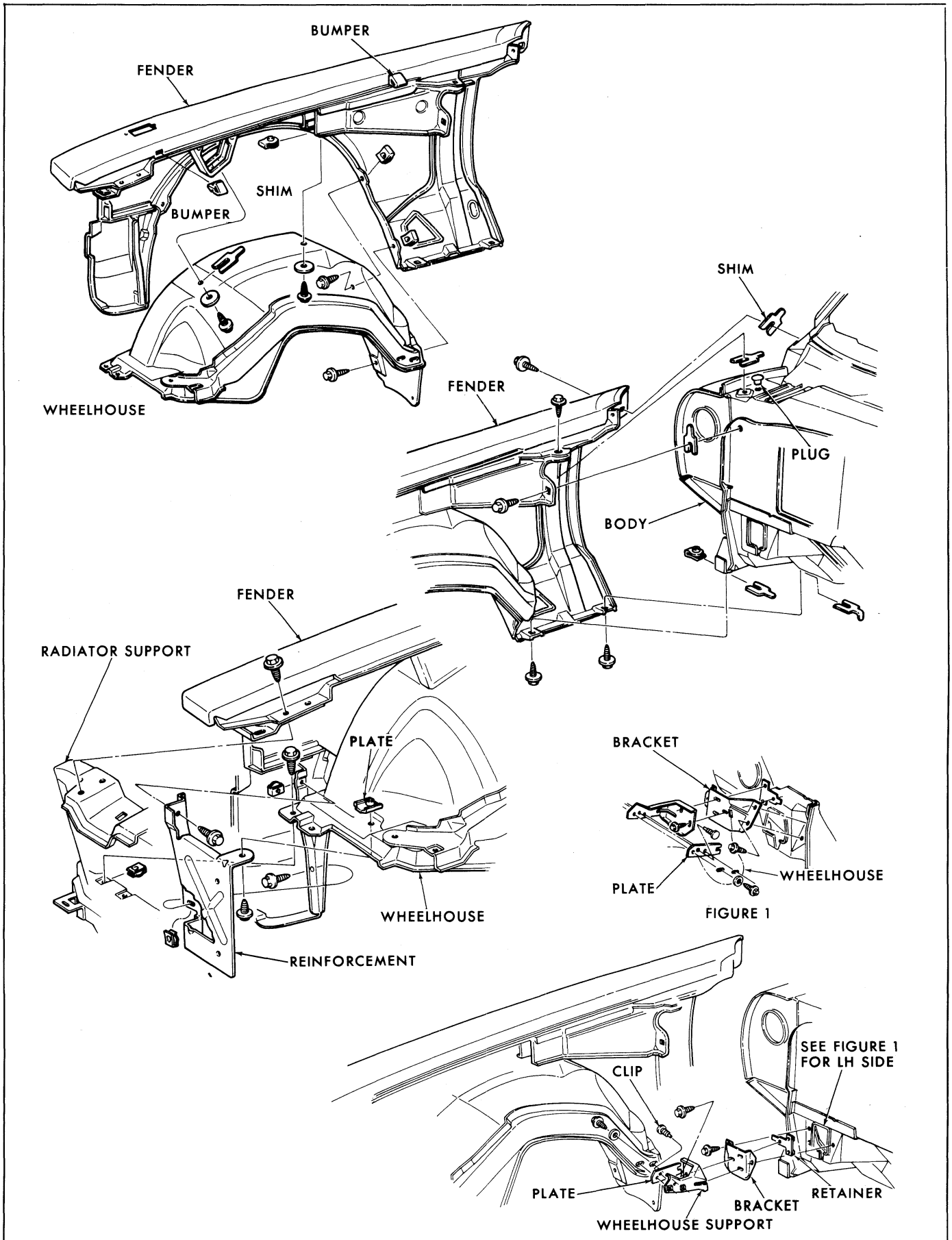


Fig. 2C-19 Front Fender Disassembly (Seville)

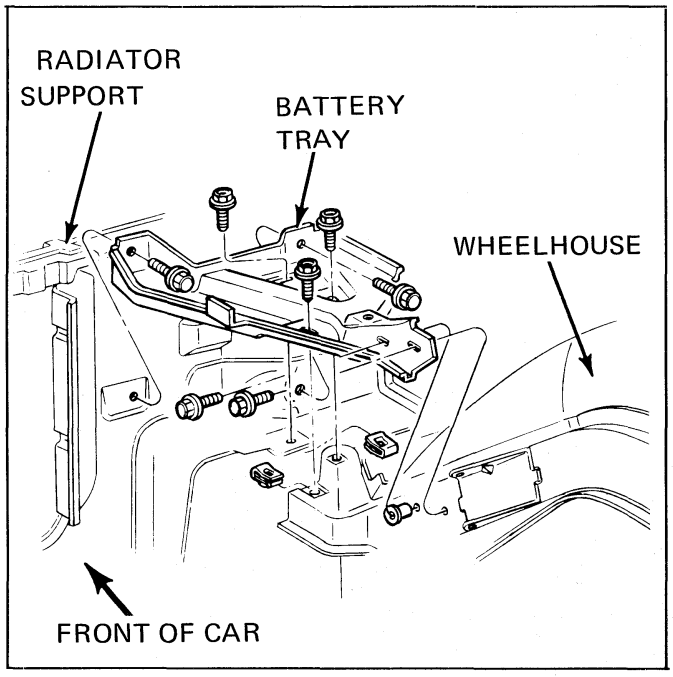


Fig. 2C-20 Battery Tray

3. Remove two screws securing wheelhousing to fender at catwalk.

4. Remove three plastic nails securing wheelhousing seal at rear of wheelwell, front of wheelwell and at fender, forward of wheel opening.

5. Remove two screws behind acromat at rear of wheelwell securing wheelhousing to cowl brace.

NOTE: When removing right front wheelhousing, working underhood, remove battery as described in Section 6D. Remove battery tray by removing seven screws as shown in Fig. 2C-20.

NOTE: When removing left front wheelhousing, disconnect wires to windshield washer low fluid warning switch and disconnect hose from switch.

Remove access plate from wheelhousing disconnect radio antenna. Disconnect two hoses from evaporative loss control canister. Remove one screw holding bracket to fender and remove canister. Remove two screws securing washer bottle to fender bracket and remove bottle.

Remove two screws securing ALC compressor bracket to fender. Position compressor out of way and secure. Disconnect ALC hoses.

6. Remove three screws and retainer securing wheelhousing to radiator support accessible under horns.

7. Wheelhousing fasteners have now been removed and wheelhousing may be removed from vehicle. Some prying and bending may be required, however, deforming of the part is not necessary.

b. Installation

1. Position wheelhousing to fender and body. Some prying and bending may be required, however, deforming of the part is not necessary.

2. Install five screws securing wheelhousing to fender at wheel opening. Torque screws to 15 to 22 foot-pounds.

3. Install two screws securing wheelhousing to fender at catwalk. Torque screws to 15 to 22 foot-pounds.

4. Install two screws securing wheelhousing at cowl. Torque screws to 25 to 35 foot-pounds.

5. Secure wheelhousing seal at three locations; rear of wheelwell, front of wheelwell and bottom edge of fender in front of wheel opening.

6. Install wheel and lower car.

7. Working underhood install three screws and retainer securing wheelhousing to radiator support under horns.

NOTE: When installing right front wheelhousing, install battery tray in position and secure with seven screws as shown in Fig. 2C-20. Torque screws to 17 to 24 foot-pounds. Install battery as described in Section 6D.

NOTE: When installing left front wheelhousing, connect wires to windshield washer low fluid warning switch and connect hose from switch.

Connect two hoses from evaporative loss control canister, install one screw holding bracket to fender and install canister. Install two screws securing washer bottle to fender bracket and install bottle.

Install two screws securing ALC compressor bracket to fender. Connect ALC hoses.

Install radio antenna and access plate, and replace access plate fasteners.

COWL PANEL (Fig. 2C-21)

a. Removal

1. Open hood.

2. Remove five screws from front edge of cowl panel.

3. Remove two screws (one on each end) from front edge by removing screw through access hole to fender.

NOTE: Center reinforcement bracket will remain on cowl panel when removing panel.

4. Remove cowl panel.

b. Installation

1. Position cowl panel to proper location with center bracket attached.

2. Install two screws (one on each end) through access hole to fender. Torque screws to 5 foot-pounds.

3. Install five screws from front edge of cowl panel. Torque screws to 25 inch-pounds.

ADJUSTING SHEET METAL TOLERANCES

a. Front Fender

1. Loosen all screws at the following locations:

a. Fender reinforcement to radiator support bracket.

b. Cowl.

c. Front hinge pillar.

d. Rocker panel extension to underside of fender.

e. Fender to wheelhousing inside of wheel opening.

2. Remove rubber bumpers that fit between fender and hood.

3. Adjust fender so that clearances are as shown in chart on page 2C-23.

4. After obtaining adjustment, tighten all screws to proper torque specifications as shown at the end of this section.

5. Install rubber bumpers that fit between fender and hood.

b. All Body Clearances

The adjustment procedures for clearances are described in the body service manual. These clearances should be adjusted to the specifications shown in chart on page 2C-23.

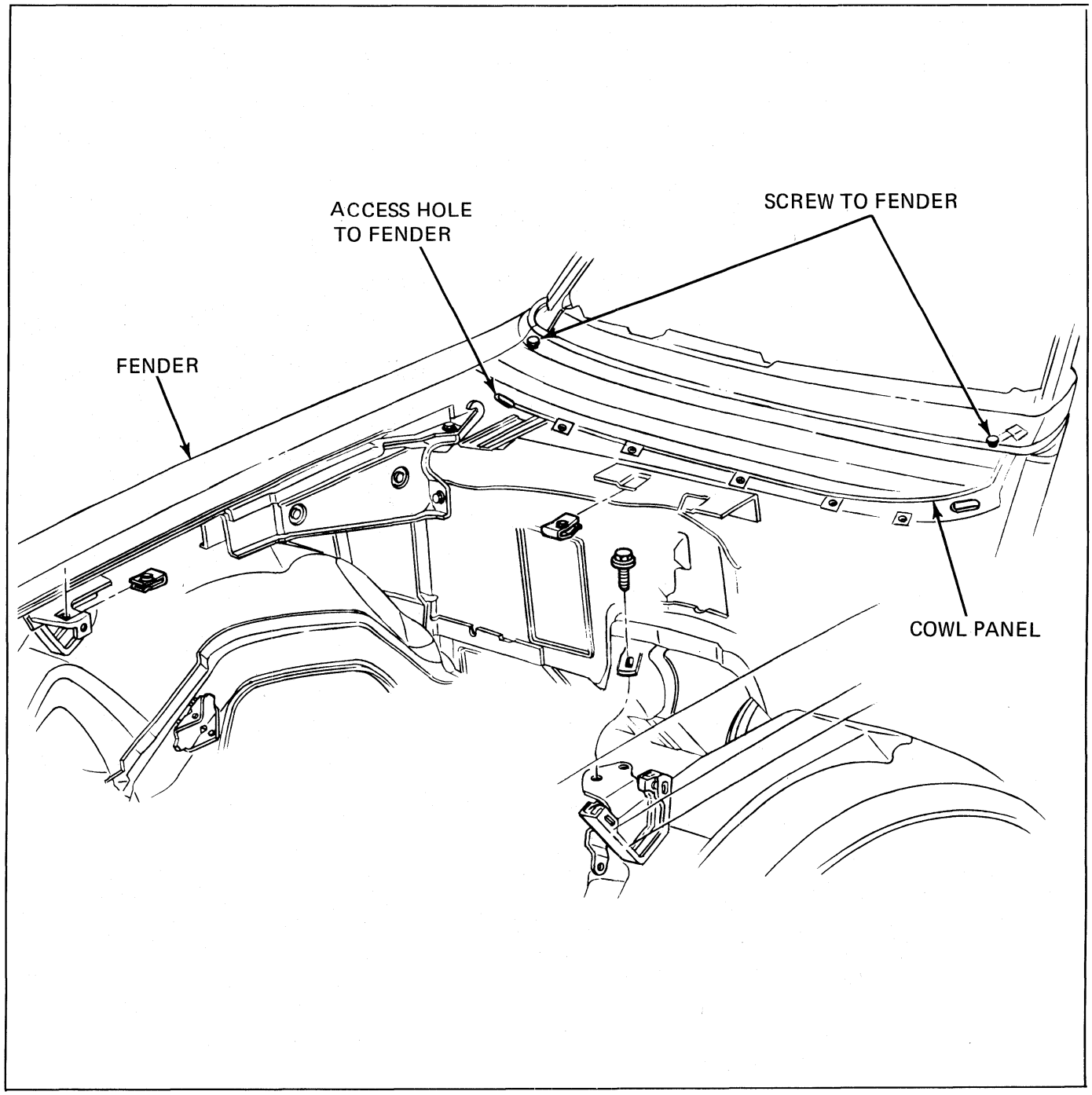


Fig. 2C-21 Cowl Panel

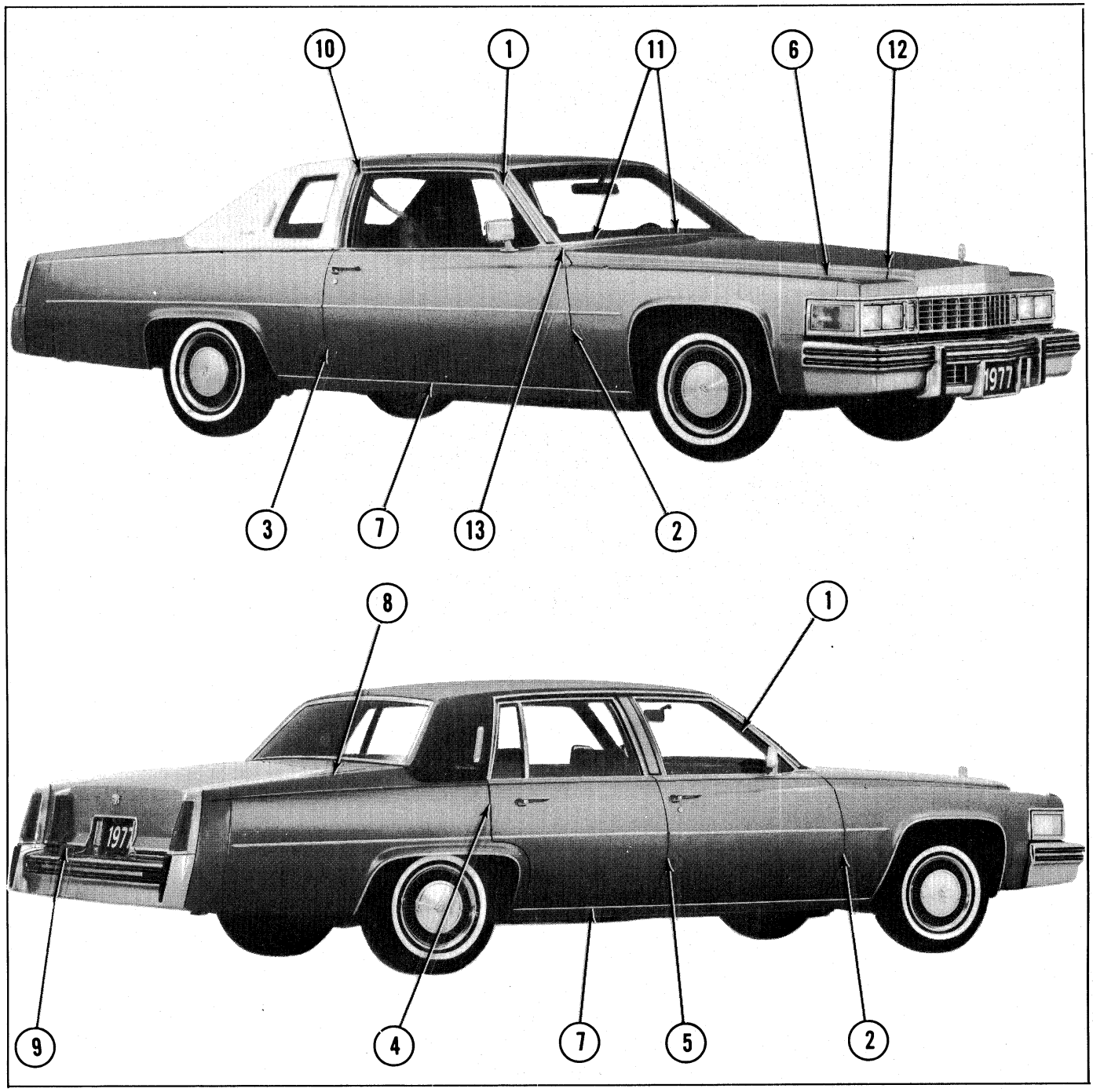


Fig. 2C-22 Sheet Metal Tolerance (C-Car)

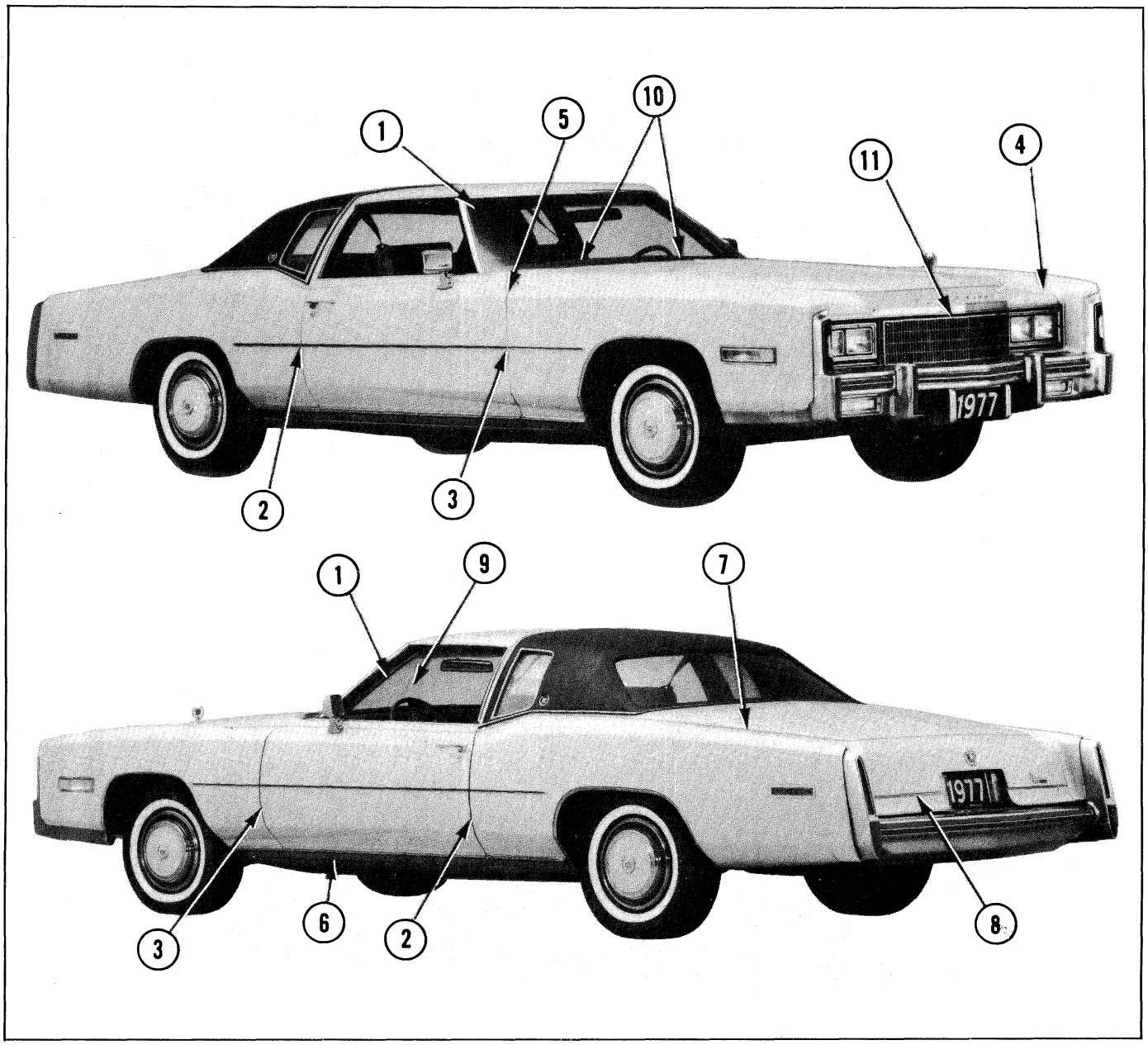


Fig. 2C-23 Sheet Metal Tolerance (Eldorado)

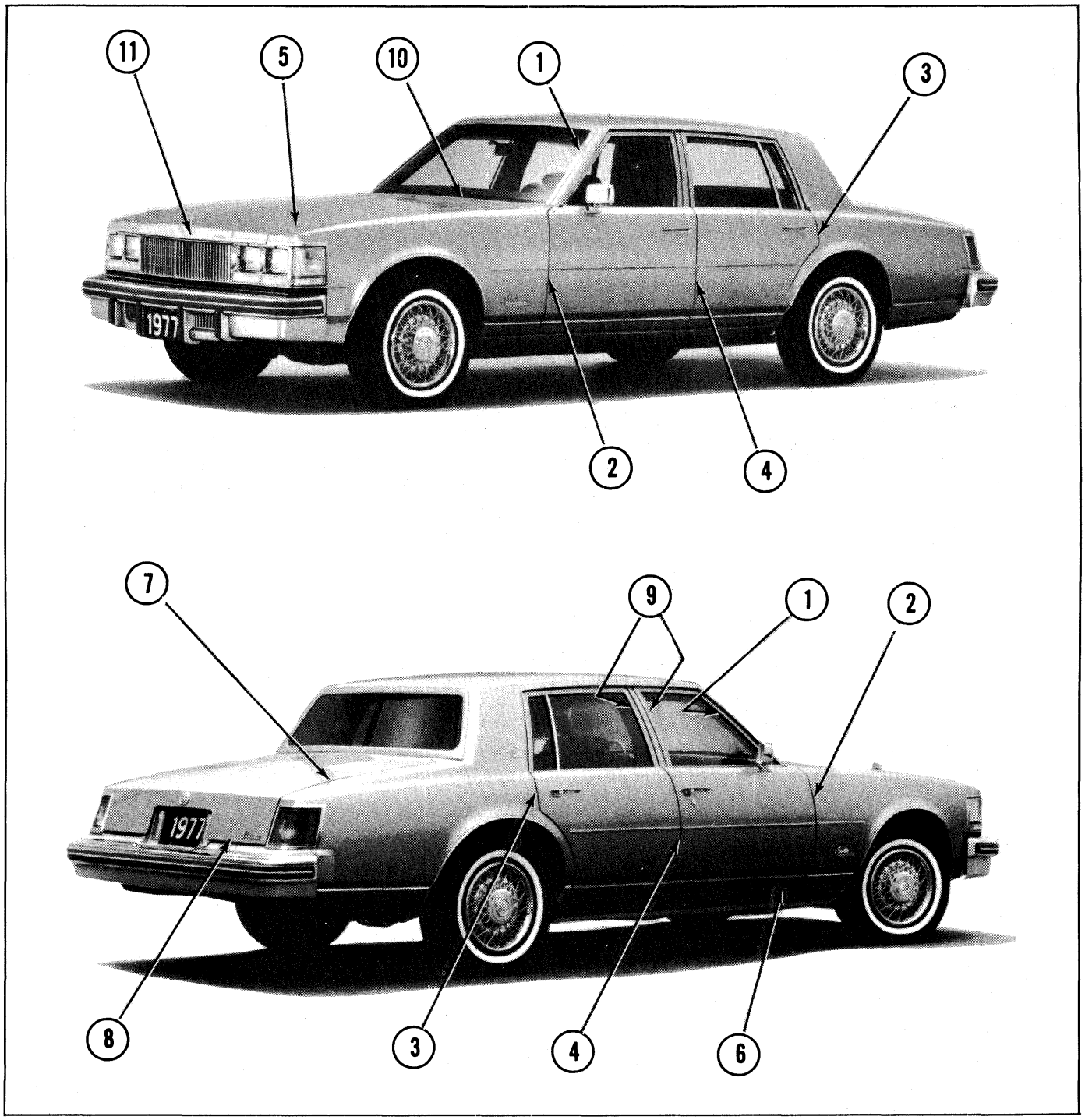


Fig. 2C-24 Sheet Metal Tolerance (Seville)

Sheet Metal Tolerances (C-Car)

LOCATION	CLEARANCE GAP MM	FLUSHNESS
1. Side Window to Windshield	5.0 ± 1.5mm	—
2. Door to Fender	5.0 + 1.5 − 0.0mm	Flush to 1mm up
3. Door to Quarter Panel (2-Door)	5.0mm	—
4. Door to Quarter Panel (4-Door)	5.0 + 1.5 − 1mm	Clearance for Rear Door: Flush +0.0 − 1.5mm to Front Door
5. Front Door to Rear Door	5mm	Clearance for Rear Door: Flush + 0.0 − 1.5mm to Front Door
6. Hood to Fender	3.0 + 2.0 − 1mm	Flush to 1mm up
7. Door to Rocker Panel	7.5mm	—
8. Trunk Lid to Quarter Panel	4.0mm	—
9. Trunk Lid to Bumper	10mm	—
10. Windows	5 + 1.5 − 0.0mm	*
11. Hood to Windshield Wiper Arm	3.0 Min.	—
12. Hood to Front End Panel	3.0 ± 1.0mm	—
13. Hood to Door	5.0 + 1.5 − 0.0mm	Flush to 1.0mm up
14. Front and Rear Upper to Center Pillar — Sedan De Ville	5.0 ±1.5mm	—
15. Front and Rear Upper to Center Pillar — Brougham	6.0 + 1.5 − 1.0mm	—

*May be out of plane if weathership provides watertight seal.

Sheet Metal Tolerances (Eldorado)

LOCATION	CLEARANCE GAP IN.	FLUSHNESS
1. Side Window to Windshield	.58	—
2. Door to Quarter Panel	.18	—
3. Door to Fender	.22 + .06 − 0.0	Flush to .04 out and up
4. Fender to Hood Panel Rear Extension	.14 + .08 − .04	Flush to .04 up
5. Hood to Door	.22 + .06 − 0.0	Flush to .04 up
6. Door to Rocker Panel	.30	—
7. Trunk Lid to Quarter Panel	.16	—
8. Trunk Lid to Bumper	.34 ± .06	—
9. Windows	.19	*
10. Hood to Windshield Wiper Arm	.12 Min.	—
11. Hood to Grille	.66 ± .18	—

*May be out of plane if weatherstrip provides watertight seal.

Sheet Metal Tolerances (Seville)

LOCATION	CLEARANCE GAP IN.	FLUSH
1. Side Window to Windshield	.18 ± .06	—
2. Door to Fender	.22 + .06 − .00	Flush to .04 out and up
3. Door to Quarter Panel	.18 + .04 − .06	± .06
4. Front Door to Rear Door	.22 + .04 − .06	± .06
5. Hood to Fender	.14 + .08 − .04	Flush to .04 up
6. Door to Rocker Panel	.25 ± .06	—
7. Trunk Lid to Quarter Panel	.16 ± .06	± .06
8. Trunk Lid to Bumper	.31 + .18 − .06	Parallel Within .04
9. Front and Rear Upper to Center Pillar	.19 + .04 − .06	—
10. Hood to Cowl Panel	.18 + .03 − .09	Flush to .03 up and down
11. Hood to Grille	.07 ± .06	—

TORQUE SPECIFICATIONS

Material No.	Application	Thread Size	Newton-Metres	Foot-Pounds
	C-CAR			
500M	Battery/Canister Tray Screws	8 x 1.25	30	22
500M	Center Support Bracket to Radiator Support	8 x 1.25	30	22
500M	Fender to Lower Body Pillar	10 x 1.5	50	35
500M	Fender to Rocker Panel	10 x 1.5	50	35
500M	Fender to Upper Strut	8 x 1.25	30	22
500M	Hood Hinge to Hood	8 x 1.25	30	22
500M	Hood Primary Latch Screws	8 x 1.25	*30	*22
500M	Hood Secondary Latch Screws	8 x 1.25	*30	*22
500M	Lower Strut to Body	10 x 1.5	50	35
500M	Lower Strut to Radiator Support	8 x 1.25	30	22
500M	Radiator Support Brace	6.3 x 1.0	90	65
500M	Radiator Support Mounts	12 x 1.75	70	50
500M	Radiator Support to Frame Rods	8 x 1.25	30	22
510M	Strut Plate to Lower Strut	8 x 1.25	30	22
500M	Strut Plate to Upper Strut	8 x 1.25	30	22
510M	Strut Rod Nuts	8 x 1.25	40	30
500M	Strut Rod Screws	8 x 1.25	30	22
500M	Upper Strut to Body	10 x 1.5	50	35
510M	Upper Strut to Radiator Support Nut	8 x 1.25	30	22
500M	Upper Strut to Radiator Support Screws	8 x 1.25	30	22
				Inch-Pounds
510M	Filler to Front End Panel Nuts	6.3 x 1.0	10	90
500M	Fillers to Radiator Support Screws	6.2 x 1.0	5	55
510M	Front End Panel to Center Support Bracket	6.3 x 1.0	10	90
500M	Front End Panel to Fender	6.3 x 1.0	5	55
500M	Front End Panel to Support Bracket	6.3 x 1.0	5	55
500M	Lower Grille to Center Bar	6.3 x 1.0	10	75
500M	Upper Grille to Front End Panel	6.3 x 1.0	5	60
500M	Wheelhouse to Fender	6.3 x 1.0	10	90
				Foot-Pounds
	ELDORADO			
275M	Fender Edge to Wheelhousing	5/16 - 18	—	20
275M	Fender to Body Side	3/8 - 16	—	30
275M	Fender to Cowl	3/8 - 16	—	30
275M	Fender to Radiator Support	5/16 - 18	—	15
275M	Fender to Radiator Support Strut Rod	5/16 - 18	—	15
275M	Fender to Rocker Panel	3/8 - 16	—	30
275M	Hood Hinge to Hood	3/8 -16	—	30
275M	Primary Latch to Tie Bar	5/16 - 18	—	*20
275M	Secondary Latch to Hood	5/16 - 18	—	*20
286M	Strut to Wheelhousing Nut	5/16 - 18	—	20
6010M	Wheelhousing Splash Shield to Frame	5/16 - 12	—	10
275M	Wheelhousing to Brace	5/16 - 18	—	20
275M	Wheelhousing to Cradle	5/16 - 18	—	15
275M	Wheelhousing to Fender	5/16 - 18	—	20

TORQUE SPECIFICATIONS (Cont'd.)

Material No.	Application	Thread Size	Newton-Metres	Inch Pounds
	ELDORADO (Cont'd.)			
284M	Fender Extension to Fender	10 - 24	—	25
				Foot-Pounds
	SEVILLE			
275M	Front Fender Catwalk to Radiator Support	5/16 - 18	—	20
275M	Front Fender to Cowl	3/8 - 16	—	30
275M	Front Fender to Hinge Pillar	3/8 - 16	—	30
275M	Front Fender to Rocker Panel Lower Cowl	3/8 - 16	—	30
275M	Hood Hinge to Cowl Fender	3/8 - 16	—	30
275M	Hood Hinge to Hood	3/8 - 16	—	30
275M	Primary Latch to Tie Bar & Support	5/16 - 18	—	*18
275M	Radiator Support to Wheelhouse Brace	5/16 - 18	—	20
275M	Secondary Latch to Hood	5/16 - 18	—	*18
275M	Wheelhouse Support to Body	5/16 - 18	—	20
275M	Wheelhouse Support to Wheelhouse and/or Battery Tray	5/16 - 18	—	20
275M	Wheelhouse to Fender Catwalk	5/16 - 18	—	20
275M	Wheelhouse to Wheelhouse Brace	5/16 - 18	—	20

*CAUTION: These hood latch assembly fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with equivalent parts if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.

FRONT END ALIGNMENT

TABLE OF CONTENTS

Caster and Camber Adjustment (Exc. Eldorado) 3A-3
Caster and Camber Adjustment (Eldorado) 3A-13
Front Wheel Alignment (Exc. Eldorado) 3A-2
Front Wheel Alignment (Eldorado) 3A-12
Standing Heights (Exc. Eldorado) 3A-2
Standing Heights (Eldorado) 3A-12
Toe-In Adjustment 3A-6
Toe-In Adjustment (Eldorado) 3A-15

GENERAL DESCRIPTION

Service information pertaining only to Eldorado front end alignment is included at the end of this section, beginning on page 3A-12.

Front alignment refers to the angular relationship between the front wheels, the front suspension attaching parts and the ground. The angle of the knuckle away from the vertical, the pointing in or "toe-in" of the front wheels, the tilt of the front wheel from vertical (when viewed from the front of the vehicle) and the tilt of the suspension members from vertical (when viewed from the side of the vehicle), - all these are involved in front alignment.

Caster - Fig. 3A-1

Caster is the tilting of the front steering axis either forward or backward from the vertical (when viewed from the side of the vehicle). A backward tilt is said to be positive (+) and a forward tilt is said to be negative (-).

set to toe-in slightly when the vehicle is standing still, they tend to roll parallel on the road when the vehicle is moving.

Camber - Fig. 3A-1

Camber is the tilting of the front wheels from the vertical when viewed from the front of the vehicle. When the wheels tilt outward at the top, the camber is said to be positive (+). When the wheels tilt inward at the top, the camber is said to be negative (-). The amount of tilt is measured in degrees from the vertical and this measurement is called the camber angle.

Toe-In - Fig. 3A-1

Toe-in is the turning in of the front wheels. The actual amount of toe-in is normally only a fraction of an inch. The purpose of a toe specification is to ensure parallel rolling of the front wheels. (Excessive toe-in or toe-out may increase tire wear.) Toe-in also serves to offset the small deflections of the wheel support system which occurs when the vehicle is rolling forward. In other words, even when the wheels are

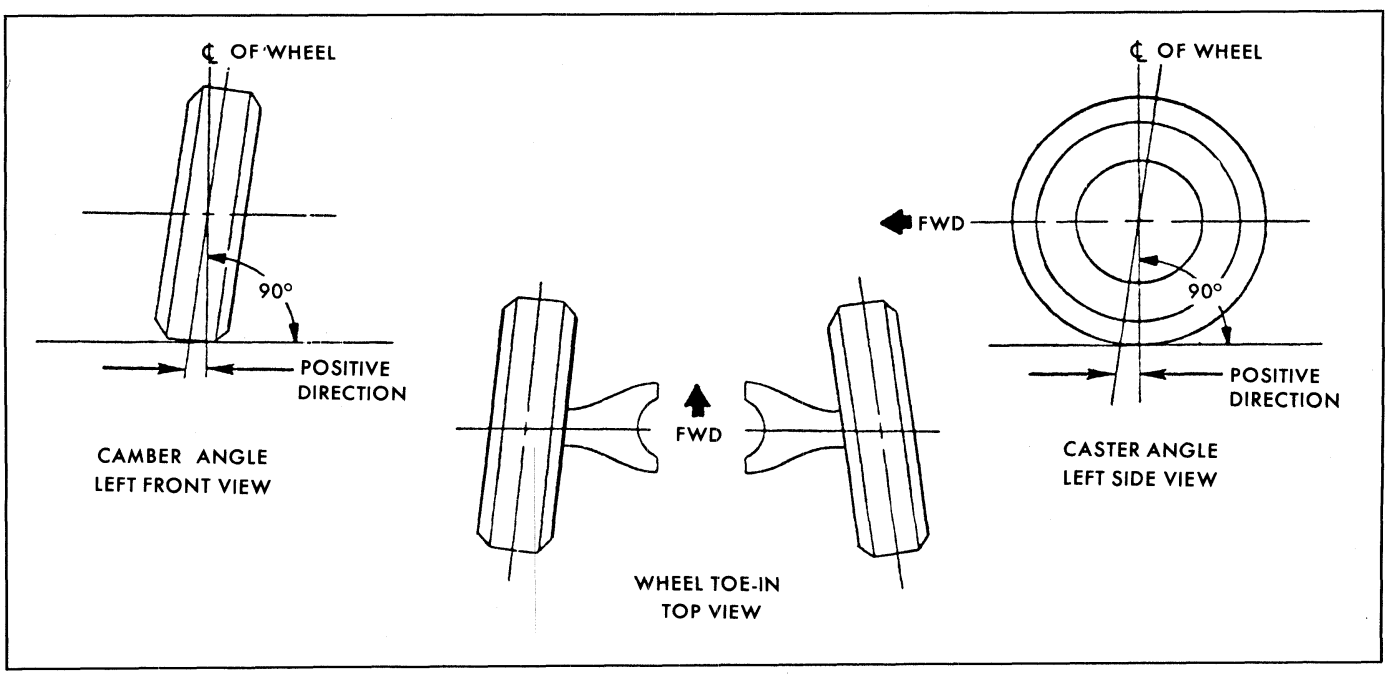


Fig. 3A-1 Caster, Camber and Toe-In

ON-CAR SERVICE

CAUTION: *If any mispositioning, incorrect assembly, or failure of components in the area of the brake system pipes, hoses, or cylinders is observed, be sure to check for any brake system damage that may have resulted from such a condition and correct as required. Components that could damage the brake system due to mispositioning, incorrect assembly, or failure include the exhaust system, shock absorbers, springs, suspension control arms, stabilizer bar, power steering pump hoses, and transmission cooler pipes.*

The following caution applies to certain steps in the assembly procedure of components in this section. The critical fasteners to which this caution applies are identified by the terminology:

CAUTION: *See "CAUTION" on page 3A-2 of this section.*

CAUTION: *This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.*

Checking Front Standing Spring Height

Before checking standing (spring) height, make sure the trunk is empty except for spare tire and jack and that there is a full tank of gasoline, or use compensating weight as shown in Fig. 3A-2 (if working on Seville, Fig. 3A-3), as all specifications are based on this curb weight. Normalize position of springs by bouncing bumper up and down. Slowly reduce the force applied until the car seeks its own level.

a. Front Springs

Measure the distance from the center of the lower suspension arm front bushing bolt head, to the lowest point on the inboard corner of the lower spherical joint. Standing heights should be equal on both sides of car within 9mm (3/8 inch). If heights are unequal, it will be necessary to replace the spring on the low side.

See Fig. 3A-4 for checking points and specifications.

b. Ride Complaints

In case of hard riding, the first items to investigate are tire pressures, standing heights, and shock absorbers. If these are correct, the amount of friction in the front suspension system should be checked.

The procedure for checking excessive friction in the front suspension is as follows:

1. Disconnect front shock absorbers.

2. With aid of a helper, lift up on the front bumper and raise the front end of the car as high as possible. Slowly release the bumper and allow the car to assume normal standing height. Measure distance from the floor to center of bumper. Then push down on bumper, release slowly, and allow car to assume normal standing height; again take measurement at same point on bumper.

If the difference between these two measurements is 32mm (1-1/4 inch) or more, it indicates excessive friction in the suspension system. Probable causes include damaged seals on the spherical joints permitting dirt and water in the joints, bound up steering linkage, or excessive binding in the stabilizer bar mounting bushings.

Front Wheel Alignment

Satisfactory vehicle operation may occur over a wide range of front end (wheel) alignment settings. Nevertheless, should settings vary beyond certain tolerances, readjustment of alignment is advisable. The specifications stated in column 1 of the specifications chart should be used by owners, dealers, and repairmen as guidelines in vehicle diagnosis either for repairs under the new vehicle warranty or for maintenance service at customer's request. These specifications provide an acceptable all-around operating range in that they prevent abnormal tire wear caused by wheel alignment.

Governmental Periodic Motor Vehicle Inspection programs usually include wheel alignment among items that are inspected. To provide useful information for such inspections, the specifications stated in column 2 of the specification chart are given and these are well within the range of safe vehicle operation.

In the event the actual settings are beyond the specifications set forth in column 3 or 4 (whichever is applicable), or whenever for other reasons the alignment is being reset, use the specifications given in columns 1 and 2 of the specification chart.

a. Sequence of Operations

Front wheel alignment must be checked whenever the standing height is changed due to a spring replacement, removal and installation of an upper suspension arm assembly, a lower suspension arm, or a steering knuckle.

Wheel alignment equipment manufacturers provide detailed instructions for checking wheel alignment with their alignment equipment. These instructions should be carefully followed.

In addition to the manufacturer's instructions, be sure to observe the following recommendations:

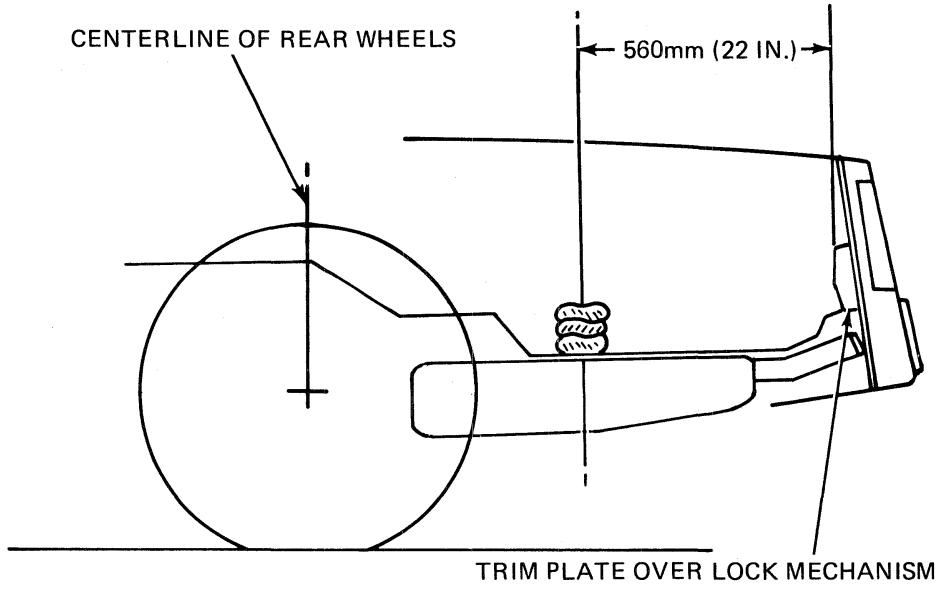
1. Check straight ahead position of steering wheel by driving car a short distance. Place a piece of tape on steering wheel at straight ahead position of wheel for future reference, so that any correction needed can be made during the toe-in adjustment.

2. Car must be on a level surface, gas tank full or a compensating weight added as shown in Fig. 3A-2 (if working on Seville, Fig. 3A-3), front seat all the way to the rear, and front and rear tires adjusted to the recommended pressures. Refer to Tire Inflation Label on the glove box door or Fig. 3E-1 in this manual. Both doors must be closed and no passengers or additional weight should be in car or trunk.

3. Check front standing height. Refer to column 1.

4. Check front wheel alignment and reset if necessary.

5. After removing the car from the alignment machine, check the straight ahead position of the steering wheel to determine if it is properly centered. If further correction is required, repeat the toe-in portion of the wheel alignment procedure so that the necessary changes can be made.



FUEL GAGE READING	AMOUNT OF WEIGHT* (BAGS OF SHOT OR EQUIVALENT)
FULL	0
3/4	15 kg (33 LBS.)
1/2	30 kg (66 LBS.)
1/4	45 kg (99 LBS.)
ALMOST EMPTY	60 kg (132 LBS.)

*WITH FUEL GAGE OPERATING PROPERLY AND INDICATING LESS THAN A FULL TANK OF GASOLINE.

THE PROPER OBSERVED LOAD CONDITION CAN BE SIMULATED WITH WEIGHTS IN THE LUGGAGE COMPARTMENT AS INDICATED BELOW BEING PLACED ON THE CENTERLINE OF CAR.

Fig. 3A-2 Compensating Weights (C-Car)

b. Alignment Preliminary Steps

Several different types of machines are available for checking all the factors of front wheel alignment. The instructions furnished with each particular machine should be followed. In all cases, however, checks should be made with the car on a level surface and at curb weight.

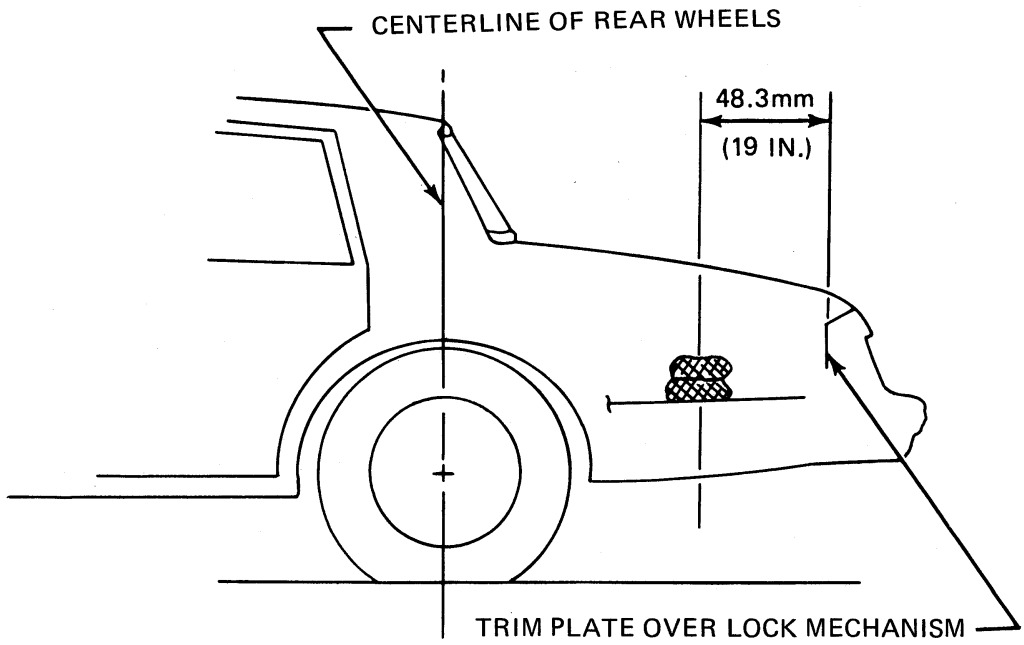
Since steering and vibration complaints are not always the result of improper alignment, a check should be made to see if any of the following conditions exist. Any such conditions should be corrected before proceeding further:

1. Unbalanced or underinflated tires.
2. Steering gear housing loose at frame.
3. Excessive wear or play in spherical joints or steering shaft flex coupling.
4. Tie rod or steering connections loose.
5. Improper front standing heights.
6. Steering gear loose or improperly adjusted.
7. Shock absorbers not operating properly.
8. Suspension arms loose.
9. Stabilizer bar attachments missing.
10. Possibility of tire lead due to worn or improperly manufactured tires.

c. Caster and Camber

NOTE: Before adjusting caster and camber angles, the front bumper should be raised and released three times to allow car to return to its normal standing height.

Caster and camber adjustments are made by means of shims inserted between the upper suspension arm shaft and the frame bracket, Fig. 3A-5. On Seville, should shim removal requirements exceed available shim thickness, the



FUEL GAGE READING	AMOUNT OF WEIGHT* (BAGS OF SHOT OR EQUIVALENT)
3/4	14 kg (30 LBS.)
1/2	27 kg (60 LBS.)
1/4	38 kg (85 LBS.)
ALMOST EMPTY	52 kg (115 LBS.)

*WITH FUEL GAGE OPERATING PROPERLY AND INDICATING LESS THAN A FULL TANK OF GASOLINE.

THE PROPER OBSERVED LOAD CONDITION CAN BE SIMULATED WITH WEIGHTS IN THE LUGGAGE COMPARTMENT AS INDICATED ABOVE BEING PLACED ON THE CENTERLINE OF CAR.

Fig. 3A-3 Compensating Weights (Seville)

special tapered shim block may be removed for alignment purposes.

NOTE: A normal design shim pack is 10mm (.4 inches) front and rear. For adjustment, front and/or rear can have from 0 to 5mm (.6 inches) maximum shim pack at either position. The total difference between the two must not exceed 10mm (.4 inches).

Shims may be added, subtracted or transferred to change the readings as follows:

1. CASTER - transfer shims, front to rear or rear to front.

The transfer of one shim to the rear bolt from the front bolt will increase positive caster.

2. CAMBER - change shims at both the front and rear of the shaft.

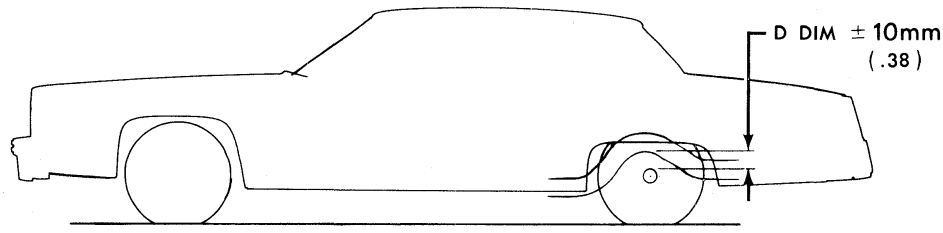
Subtracting an equal number of shims at both front and rear of the support shaft will increase positive camber.

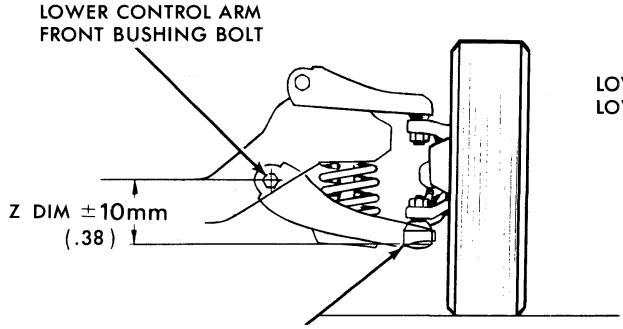
NOTE: Caster and camber can be adjusted in one operation. Toe-in must be checked after changing camber or caster.

To adjust for caster and camber, loosen the upper suspension arm shaft to frame nuts, add or subtract shims as required and retorque nut to 75 foot-pounds.

CAUTION: *See "CAUTION" on page 3A-2 of this section.*

Caster, camber and toe-in specifications will be found





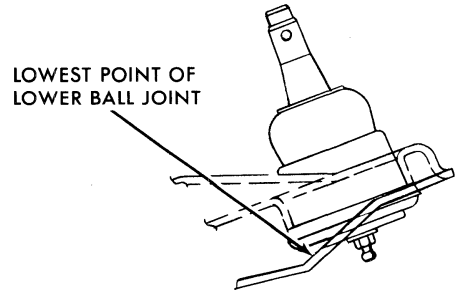


FIGURE 1

SERIES		LOAD CONDITION	VEHICLE STANDING HEIGHTS			
			"Z" FRONT		"D" REAR	
			MILLIMETRES	INCHES	MILLIMETRES	INCHES
Coupe de Ville	Standard	Observed	54 TO 73	2 1/8 TO 2 7/8	146 TO 165	5 3/4 TO 6 1/2
	*with ALC		54 TO 73	2 1/8 TO 2 7/8	136 TO 156	5 3/8 TO 6 1/8
Sedan de Ville	Standard	Observed	54 TO 73	2 1/8 TO 2 7/8	146 TO 165	5 3/4 TO 6 1/2
	*with ALC		54 TO 73	2 1/8 TO 2 7/8	136 TO 156	5 3/8 TO 6 1/8
Brougham	*Standard	Observed	48 TO 67	1 7/8 TO 2 5/8	136 TO 156	5 3/8 TO 6 1/8
Fleetwood Limousine	*Standard	Observed	46 TO 67	1 13/16 TO 2 5/8	136 TO 156	5 3/8 TO 6 1/8
Fleetwood Formal Limousine	*Standard	Observed	46 TO 67	1 13/16 TO 2 5/8	136 TO 156	5 3/8 TO 6 1/8
SEVILLE	*Standard	Observed	63	2 1/2	89	3 1/2
					** 98	**3 7/8

*WITH ALC DISCONNECTED

**WITH ALC CONNECTED

Fig. 3A-4 Measuring Standing Heights

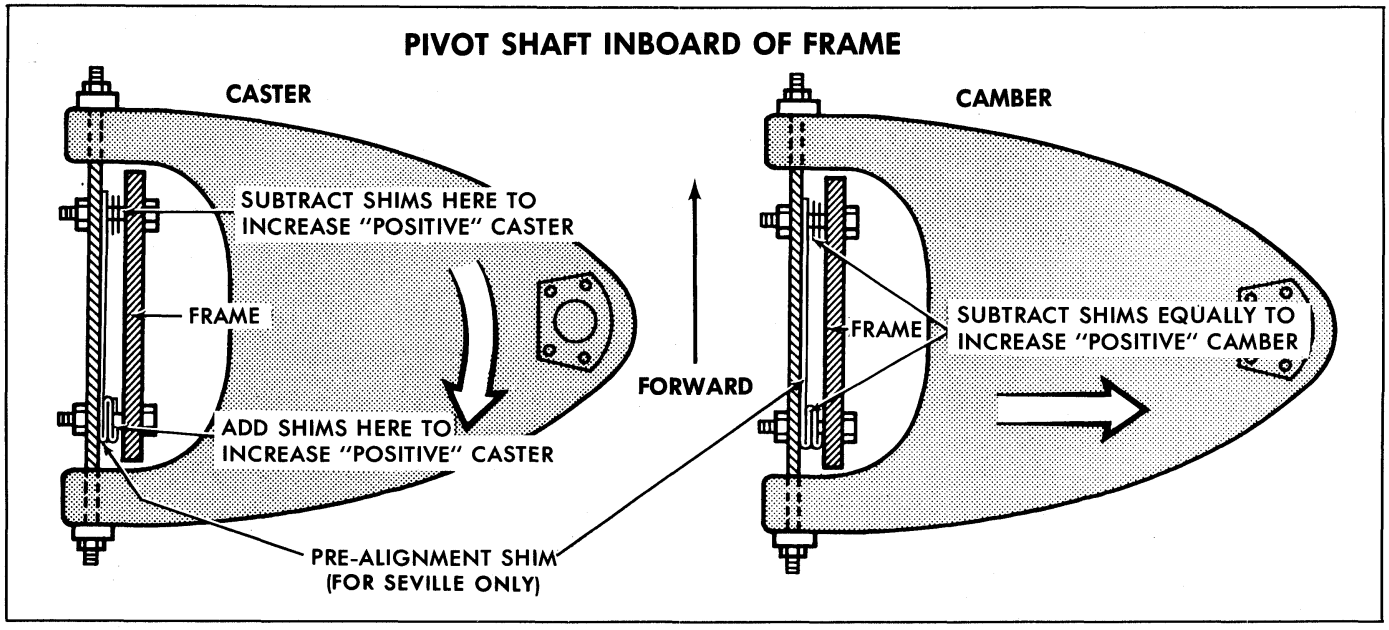


Fig. 3A-5 Caster and Camber Adjustment

in the alignment chart, Fig. 3A-10 for C-Car and 3A-11 for Seville.

NOTE: A normal shim pack will leave at least two (2) threads of the bolt exposed beyond the nut. Difference between front and rear shim packs must not exceed 10mm (.4 inches).

If these requirements cannot be met in order to reachs pecifications, check for damaged frame, suspension arms and related parts.

CAUTION: *See "CAUTION" on page 3A-2 of this section.*

NOTE: Always tighten the thinner shim packs' nut first for improved shaft to frame clamping force and torque retention.

d. Alignment Correction Chart (Fig. 3A-8 or 3A-9)

Determine the present alignment of the car. Find the camber reading on the chart and the caster reading. Trace to the point of intersection. The decimal for front and rear bolts indicates the shim change necessary to arrive at the proper specification. Add or subtract shims from the front or rear bolt as indicated. Retorque bolts and check corrected alignment setting.

NOTE: A normal shim pack should contain a maximum of one small and one medium shim, in addition, (Seville only), to the special tapered shim which remains in place as the base adjustment. Adjust shim pack as necessary without changing final dimension to meet this requirement.

e. Steering Axis Inclination (Fig. 3A-6)

"Camber" is the outward tilt of the wheel and "steering axis inclination" is the inward tilt of the knuckle. Correct specifications will be found in the alignment chart. If, with the camber correctly adjusted, the steering axis inclination does not fall within the specified limits, the knuckle is bent and should be replaced.

If a new knuckle is installed, caster, camber and toe-in must be readjusted.

f. Toe-in (Fig. 3A-7)

Toe-in, the inward pointing of both front wheels, is checked with the wheels in the straight ahead position and the steering wheel set straight ahead. It is the difference between the distance measured between the front and rear of both front wheels. Correct toe-in specifications will be found in the alignment chart, Fig. 3A-10 for C-Car and 3A-11 for Seville.

NOTE: Toe-in must be adjusted after caster and camber adjustment.

1. If the equipment being used measures the toe-in of each wheel individually:

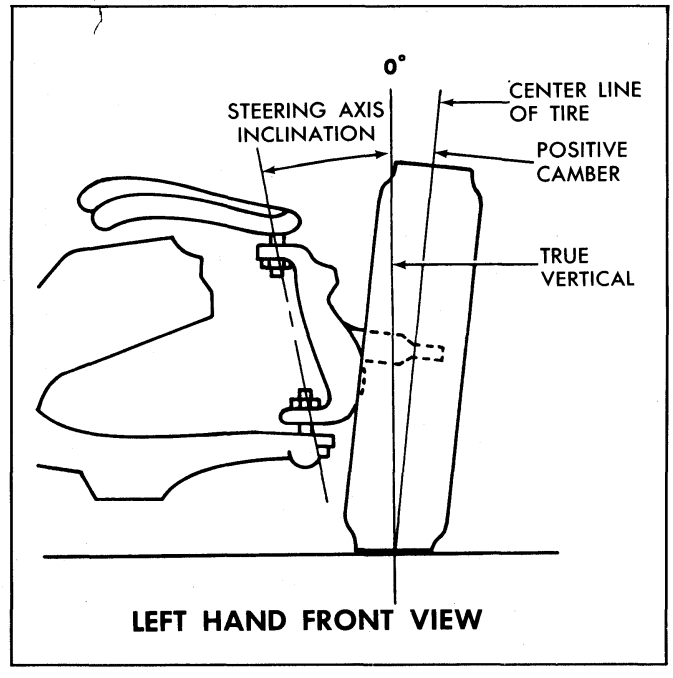


Fig. 3A-6 Steering Axis Inclination

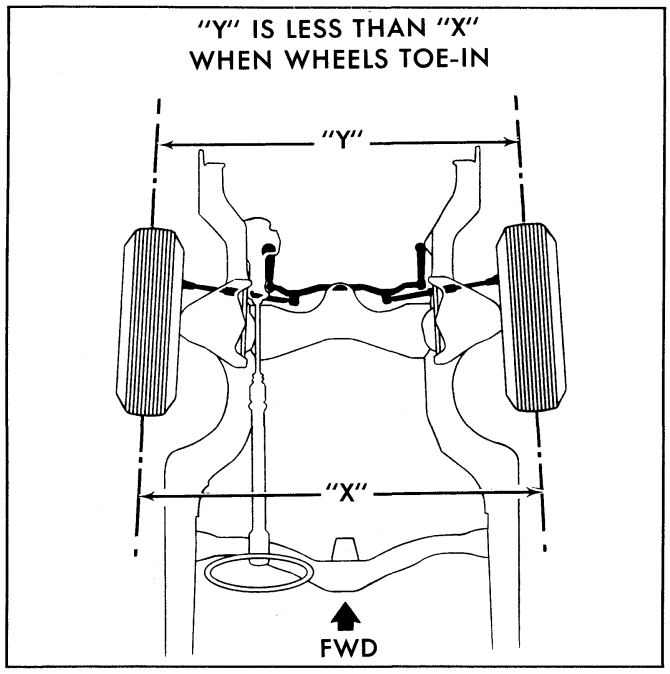


Fig. 3A-7 Toe-In Adjustment

a. Set the steering gear on the high point by positioning the front wheels in a straight ahead position. Mark 12 o'clock position on the steering shaft and position the steering wheel for straight ahead driving.

b. Loosen the clamp bolt at each end of each tie rod and adjust to the total toe-in as given in the alignment chart, (1/2 of total per wheel).

CAUTION: *To prevent damage to the tubes, do not use a pipe wrench or heavy tool to free tie rod adjuster tubes if they are seized, rusted, or corroded. If necessary, use penetrating oil or pry tie rod adjuster tubes open with a flat bladed tool. Replace tie rod adjuster tubes, or tie rod outer pivots if damaged. If torque required to remove nuts from bolt after breaking nut loose exceeds 84 inch-pounds, discard nut and bolt.*

The tie rod adjuster tubes should be lubricated with chassis lubricant if disassembled from tie rods for any reason. When turning adjuster tubes, be careful not to turn tie rod ends so that they bottom out, as seals could become pinched between stud and socket and become damaged. If this happens, the entire pivot must be replaced.

2. If a tram gauge is being used, proceed as follows:

a. Set the front wheels in the straight ahead position.

b. Loosen the clamp bolts on one tie rod and adjust for the proper toe-in as given in the alignment chart.

NOTE: 1/8″ sum toe-in is equivalent to an angle measurement of .12° per wheel.

c. Loosen the clamp bolts on the other tie rod. Turn both rods the same amount and in the same direction to place the steering gear on its high point and position the steering wheel in its straight position.

3. After the adjustment has been made, see Section 3B for tie rod clamp orientation and positioning.

SUGGESTED SHIM CHANGE TO CORRECT CASTER–CAMBER ALIGNMENT

MEASURED CASTER READING (CURB)

MEASURED CAMBER READING (CURB)

		+4½°	+4°	+3½°	+3°	+2½°	+2°	+1½°
+ 1½°	FRONT	+.27	+.24	+.21	+.18	+.15	+.12	+.09
	REAR	+.045	+.09	+.135	+.18	+.225	+.27	+.315
+1°	FRONT	+.18	+.15	+.12	+.09	+.06	+.03	+.00
	REAR	–.045	.00	+.045	+.09	+.135	+.18	+.225
+½°	FRONT	+.09	+.06	+.03	.00	–.03	–.06	–.09
	REAR	–.135	–.09	–.045	.00	+.045	+.09	+.135
0°	FRONT	.00	–.03	–.06	–.09	–.12	–.15	–.18
	REAR	–.225	–.18	–.135	–.09	–.045	.00	+.045
-½°	FRONT	–.09	–.12	–.15	–.18	–.21	–.24	–.27
	REAR	–.315	–.27	–.225	–.18	–.135	–.09	–.045
-1°	FRONT	–.18	–.21	–.24	–.27	–.30	–.33	–.36
	REAR	–.405	–.36	–.315	–.27	–.225	–.18	–.135

+ = ADD SHIM – = REMOVE SHIM

SHIM SIZES .030, .060, .120

SHIM USAGE THICKNESS DIFFERENCE BETWEEN FRONT AND REAR ATTACHMENT SHOULD NOT EXCEED 10mm (.4 INCHES).

MAXIMUM SHIM USAGE THICKNESS BETWEEN FRONT AND/OR REAR SHOULD NOT EXCEED 15mm (.6 INCHES).

Fig. 3A-8 Alignment Correction Chart (C-Car)

SUGGESTED SHIM CHANGE TO CORRECT CASTER–CAMBER ALIGNMENT

MEASURED CAMBER READING (CURB)		MEASURED CASTER READING (CURB) +3°	+2½°	+2°	+1½°	+1°	+½°	0°
+1°	FRONT	+.27	+.24	+.21	+.18	+.15	+.12	+.09
	REAR	+.09	+.12	+.15	+.195	+.24	+.285	+.33
+½°	FRONT	+.18	+.15	+.12	+.09	+.06	+.03	.0
	REAR	.0	+.03	+.075	+.12	+.18	+.22	+.27
0°	FRONT	+.06	+.03	.0	−.03	−.06	−.09	−12
	REAR	−.09	−.045	.0	+.045	+.09	+.135	+.18
−½°	FRONT	+.03	+.06	−.09	−.12	−.15	−.18	−.21
	REAR	−.18	−.135	−.09	−.045	.0	+.045	+.09
−1°	FRONT	−.24	−.21	−.18	−.21	−.24	−.27	−.30
	REAR	−.27	−.225	−.18	−.135	−.09	−.045	.0
−1½°	FRONT	−.21	−.24	−.27	−.30	−.33	−.36	−.39
	REAR	−.36	−.315	−.27	−.225	−.18	−.135	−.09

+ = ADD SHIM − = REMOVE SHIM

SHIM SIZES .030, .045, .060, .120

SHOULD SHIM REMOVAL REQUIREMENTS EXCEED AVAILABLE SHIM THICKNESS, THE TAPERED SHIM BLOCK MAY BE REMOVED FOR ALIGNMENT PURPOSES. HOWEVER, RESULTING SHIM USAGE THICKNESS DIFFERENCE BETWEEN FRONT AND REAR ATTACHMENT SHOULD NOT EXCEED .4".

Fig. 3A-9 Alignment Correction Chart (Seville)

C-CAR WHEEL ALIGNMENT SPECIFICATIONS*

ITEM	SET AND CHECK TO (MEAN)	SERVICE SETTING TOLERANCE	TOLERANCE FOR DIAGNOSIS FOR WARRANTY REPAIRS OR CUSTOMER PAID SERVICE	TOLERANCE FOR PERIODIC MOTOR VEHICLE INSPECTION
Camber	+ .50° (+ 1/2°)	± .40° (± 3/8°)	± .80° (± 3/4°)	± 1.50° (± 1 1/2°)
Cross Camber (LH Minus RH)	0°	± .50° (± 1/2°)	± 1°**	—
Caster	+3°	± .50° (± 1/2°)	± 1°	± 2°
Cross Caster (LH Minus RH)	0°	± .50° (± 1/2°)	± 1°**	—
Toe-In Per Wheel	.12° (1/8°)	± .06° (± 1/16°)	± .12°*** (± 1/8°)	± .38° (± 3/8°)
Sum Toe-In	0"	± 1/16"	—	± 3/8"
Spoke Angle	0°	± 5°	± 10°	—

* Vehicle must have full lubricant, coolant and fuel levels with no passengers or luggage.

**Cross camber and cross caster not to exceed 1^{O} maximum per vehicle.

***1/8" Toe is equivalent to an angle measurement of $.12^{O}$ Per Wheel.

NOTE: VEHICLE MUST BE JOUNCED 3 TIMES BEFORE CHECKING ALIGNMENT TO ELIMINATE FALSE. GEOMETRY READINGS.

( ) Reference Data: Future specifications will be expressed only as decimal degrees.

Fig. 3A-10 Wheel Alignment Specifications (C-Car)

SEVILLE WHEEL ALIGNMENT SPECIFICATIONS*

ITEM	SET AND CHECK TO (MEAN)	SERVICE SETTING TOLERANCE	TOLERANCE FOR DIAGNOSIS FOR WARRANTY REPAIRS OR CUSTOMER PAID SERVICE	TOLERANCE FOR PERIODIC MOTOR VEHICLE INSPECTION
Camber	0°	± .40° (± 3/8°)	± .80° (± 3/4°)	± 1.50° (± 1 1/2°)
Cross Camber (LH Minus RH)	0°	± .50° (± 1/2°)	± 1° **	—
Caster	+ 2°	± .50° (± 1/2°)	± 1°	± 2°
Cross Caster (LH Minus RH)	0°	± .50° (± 1/2°)	± 1° **	—
Toe-In Per Wheel	.06° (1/16°)	± .06° (± 1/16°)	± .12° *** (± 1/8°) ***	± .38° (± 3/8°)
Sum Toe-In	1/16"	± 1/16"	± 1/8"	± 3/8"
Spoke Angle	0°	± 5°	± 10°	—

*Vehicle must have full lubricant, coolant and fuel levels with no passengers or luggage.

**Cross camber and cross caster not to exceed 1° maximum per vehicle.

***1/8" Toe is equivalent to an angle measurement of .12° Per Wheel.

NOTE: VEHICLE MUST BE JOUNCED 3 TIMES BEFORE CHECKING ALIGNMENT TO ELIMINATE FALSE GEOMETRY READINGS.

( ) Reference Data: Future specifications will be expressed only as decimal degrees.

Fig. 3A-11 Wheel Alignment Specifications (Seville)

ELDORADO FRONT END ALIGNMENT
ON-CAR SERVICE

STANDING HEIGHT ADJUSTMENT

The standing height must be checked, and adjusted if necessary, before performing the front end alignment procedure. The standing height is controlled by the adjustment setting of the torsion bar adjusting bolt.

Clockwise rotation of the bolt increases the front height; counterclockwise decreases the front height.

Car must be on a level surface, gas tank full (or a compensating weight added as shown in Fig. 3A-12), front seat all the way to the rear, and front and rear tires inflated to the proper pressures. Refer to Tire Pressure Chart, Fig. 3E-1. Both doors must be closed and no passengers or additional weight should be in car or trunk.

It is recommended that a wheel alignment pit be used for checking standing heights rather than channel type hoists due to the possibility of hoist deflection under vehicle weight which distorts the standing height measurements.

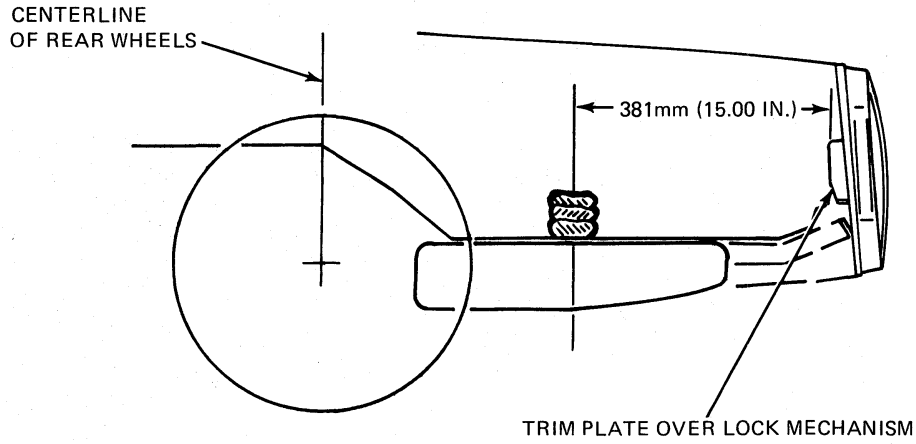
To measure standing heights, check the frame to axle clearance (rear) and lower edge of front shock absorber dust tube to centerline of lower attachment (front.) See Fig. 3A-13 for Eldorado standing height specifications.

NOTE: Before checking rear standing height, loosen air line connection at shock absorbers and remove all air from shock absorbers. Also, be sure to bounce front of car several times, gradually reducing bouncing effort, to normalize standing height.

After standing height is adjusted, check and adjust front wheel alignment as described below.

Front Wheel Alignment

Satisfactory vehicle operation may occur over a wide range of front end (wheel) alignment settings. Nevertheless, should settings vary beyond certain tolerances, readjustment of alignment is advisable. The specifications chart, Fig. 3A-14, should be used by owners, dealers, and repairmen as guidelines in vehicle diagnosis either for repairs under the

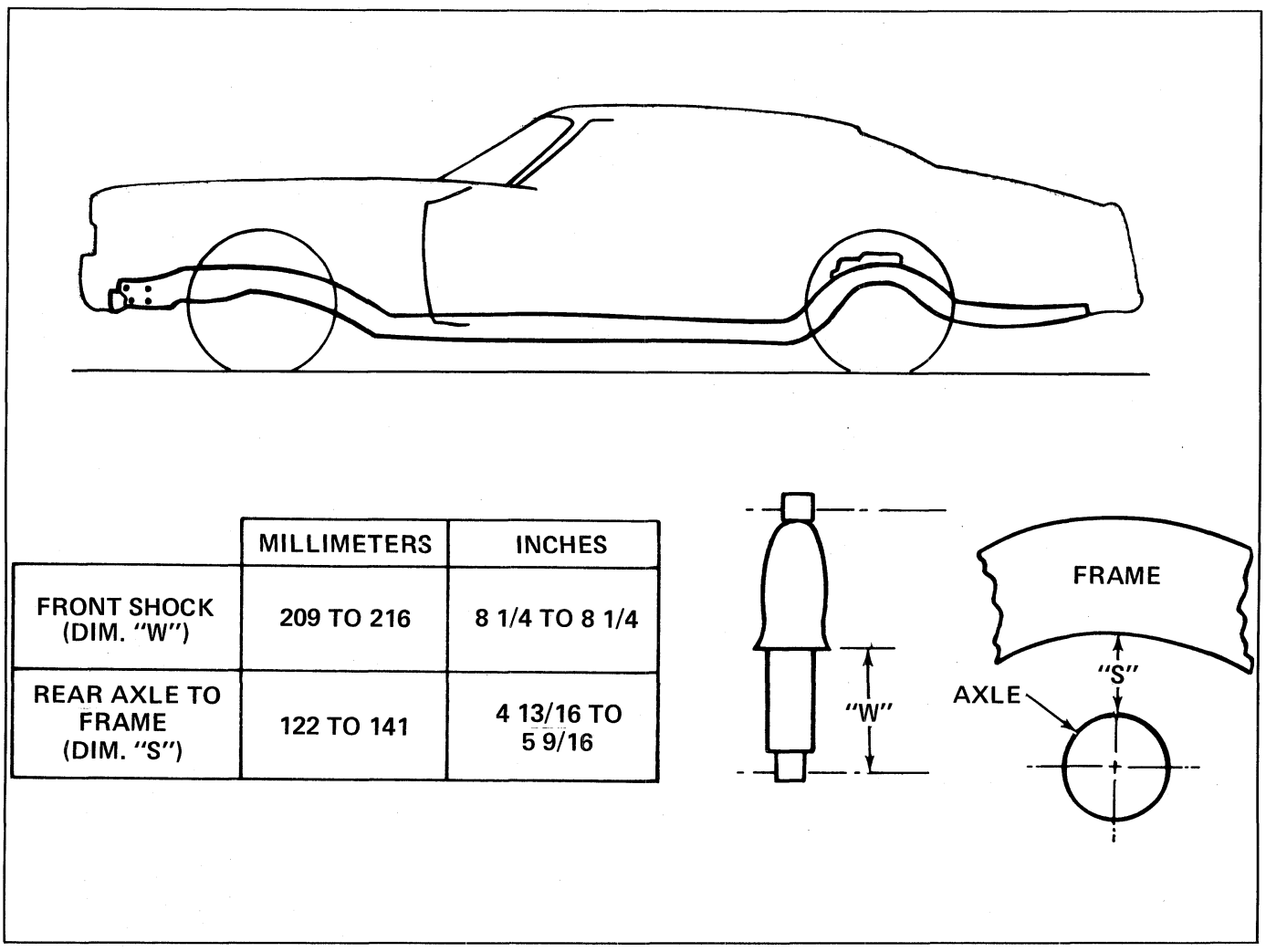


FUEL GAGE READING	AMOUNT OF WEIGHT* (BAGS OF SHOT OR EQUIVALENT)
3/4	18kg (40 LBS.)
1/2	34kg (75 LBS.)
1/4	50kg (110 LBS.)
ALMOST EMPTY	68kg (150 LBS.)

*WITH FUEL GAGE OPERATING PROPERLY AND INDICATING LESS THAN A FULL TANK OF GASOLINE.

THE PROPER OBSERVED LOAD CONDITION CAN BE SIMULATED WITH WEIGHTS IN THE LUGGAGE COMPARTMENT AS INDICATED BELOW BEING PLACED ON THE CENTERLINE OF CAR.

Fig. 3A-12 Compensating Weights (Eldorado)



	MILLIMETERS	INCHES
FRONT SHOCK (DIM. "W")	209 TO 216	8 1/4 TO 8 1/4
REAR AXLE TO FRAME (DIM. "S")	122 TO 141	4 13/16 TO 5 9/16

Fig. 3A-13 Measuring Standing Heights (Eldorado)

new warranty or for maintenance service at customer's request. These specifications provide an acceptable all-around operating range in that they prevent abnormal tire wear caused by wheel alignment.

Governmental Periodic Motor Vehicle Inspection programs usually include wheel alignment among items that are inspected. To provide useful information for such inspections, the specifications stated in column 3 of the specification chart are given and these are well within the range of safe vehicle operation.

In the event the actual settings are beyond the specifications set forth in column 2 or 3 (whichever is applicable), or whenever for other reasons the alignment is being reset, Cadillac recommends that the specifications given in column 1 of the specification chart be used.

a. Sequence of Operation

(Front wheel alignment must be checked whenever the vehicle standing height is changed.)

Front wheel alignment must be performed in the exact sequence as described in this procedure. Wheel alignment equipment manufacturers provide detailed instructions for checking wheel alignment with their alignment equipment. These instructions should be carefully followed.

In addition to the manufacturer's instructions, be sure to observe the following recommendations:

NOTE: Car must be on a level surface, gas tank full or a compensating weight added as shown in Fig. 3A-12 front seat all the way to the rear, and front and rear tires inflated to the proper pressures. Refer to Tire Pressure Chart, Fig. 3E-1. Both doors must be closed and no passengers or additional weight should be in car or trunk.

1. Drive car to determine whether steering wheel is properly centered. If correction is needed, mark the straight ahead position with tape so that the change required can be made during the toe-in adjustment.

2. Check the front standing height and adjust, if necessary. Refer to page 3A-12.

3. Check front wheel alignment and adjust as required following procedure recommended by manufacturer of alignment equipment.

4. After removing vehicle from alignment machine, check the straight ahead position of the steering wheel to determine if it is properly centered. If further correction is required, repeat the toe-in portion of the wheel alignment procedure so that the necessary changes can be made.

b. Camber and Caster (Fig. 3A-15)

These adjustments can be made either from under car or under hood, as desired. If under hood approach is used, however, be sure to recheck alignment after all operations are completed. Change in weight distribution caused by opened hood is sufficient to disturb final alignment settings.

ELDORADO WHEEL ALIGNMENT SPECIFICATIONS*

ITEM	① SPECIFICATIONS FOR RESETTING ALIGNMENT	② TOLERANCE FOR DIAGNOSIS FOR WARRANTY REPAIRS OR CUSTOMER PAID SERVICE	③ TOLERANCE FOR PERIODIC MOTOR VEHICLE INSPECTION
Camber	0° ± .40° (0° ± 3/8°)	± .80° (± 3/4°)	± 1.50° (± 1 1/2°)
Cross Camber (LH Minus RH)	0° ± .50° (0° ± 1/2°)	± 1°**	—
Caster	0° ± .50° (0° ± 1/2°)	± 1°	± 2°
Cross Caster (LH Minus RH)	0° ± .50° (0° ± 1/2°)	± 1°**	—
Toe-In Per Wheel	0° ± .06° (0° ± 1/16°)	± .12°*** (± 1/8°)***	± .38° (± 3/8°)
Sum Toe-In	0" ± 1/16"	± 1/8"	± 3/8"
Spoke Angle	0° ± 5°	± 10°	—

* Vehicle must have full lubricant, coolant and fuel levels with no passengers or luggage.

**Cross camber and cross caster not to exceed 1^{O} maximum per vehicle.

***1/8" Toe is equivalent to an angle measurement of $.12^{O}$ **Per Wheel.**

( ) Reference Data: Future specifications will be expressed only as decimal degrees.

Fig. 3A-14 Wheel Alignment Specifications (Eldorado)

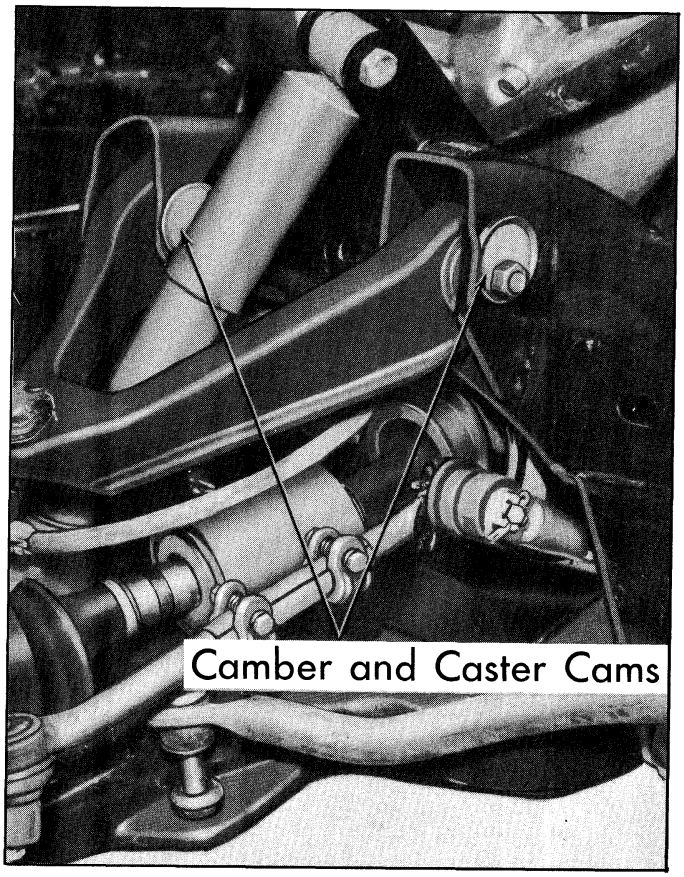


Fig. 3A-15 Camber and Caster Cam Location

1. Loosen nuts on upper suspension arm front and rear cam bolts.

2. Note camber reading and rotate front bolt to correct for 1/2 of incorrect reading or as near as possible.

3. Rotate rear cam bolt to bring camber reading to 0°.

CAUTION: *Do not use a socket to adjust rear cam bolt on left side as brake pipes could be damged. An offset box end wrench is recommended at this adjustment point.*

4. Tighten front and rear bolts and check caster.

NOTE: If caster requires adjustment, proceed with step 5; if not, move to step 8.

5. Loosen front and rear cam bolt nuts.

6. Using camber scale on alignment equipment, rotate front bolt so that the camber changes an amount equal to 1/4 of the desired caster change. (A caster change-to-camber change ratio of about 2 to 1 is inherent to the Eldorado suspension system. That is, when one cam is rotated sufficiently to change camber 1°, caster reading will change about 2°.)

NOTE: If adjusting to correct for excessive negative caster, rotate front bolt to increase positive camber. If adjusting to correct for excessive positive caster, rotate front bolt to increase negative camber.

7. Rotate the rear bolt until camber setting returns to its corrected position (Step 3).

8. Tighten upper suspension arm cam nuts to 95 foot-pounds. Hold head of bolt securely; any movement of the cam will affect final setting and will require a recheck of the camber and caster adjustments.

CAUTION: *See "CAUTION" on page 3A-2 of this section.*

c. Toe-In

Before checking toe-in, make certain that the intermediate rod height is correct. See page 3B-9 for intermediate rod height.

Toe-in is adjusted by turning the tie-rod adjuster tubes at the outer ends of each tie rod after loosening clamp bolts. The readings should be taken only when the front wheels are in a straight ahead position so that the steering gear is on its high spot.

1. Center steering wheel, raise car, and check wheel run-out.

2. Loosen tie-rod adjuster nuts and adjust tie-rods to obtain proper toe-in setting.

3. Position tie-rod adjuster clamps so that openings of clamps are facing up. Interference with front suspension components could occur while turning if clamps are facing down.

4. Tighten tie-rod adjuster nuts to 22 foot-pounds.

STEERING LINKAGE

TABLE OF CONTENTS

General Description 3B-1
Idler Arm (Exc. Eldorado) 3B-6
Idler Arm (Eldorado) 3B-9
Intermediate Rod 3B-5
Intermediate Rod Height Adjustment (Eldorado) 3B-9
Pitman Arm (Exc. Eldorado) 3B-7
Pitman Arm (Eldorado) 3B-9
Steering Linkage (Exc. Eldorado) 3B-3
Steering Linkage (Eldorado) 3B-8
Suspension and Steering Linkage Checks 3B-2
Tie Rods 3B-4
Tie Rod Adjuster Tube 3B-6
Tie Rod Pivot Seal Replacement 3B-7
Torque Specifications 3B-78

GENERAL DESCRIPTION

NOTE: Service information pertaining to steering features that are exclusive to the Eldorado steering is covered at the back of this section, beginning on page 3B-8.

A parallelogram-type steering linkage, Fig. 3B-1, is mounted forward the centerline of the front wheels and consists of a pitman arm, idler arm and bracket, two pivot assemblies, and a one-piece forged steel intermediate rod. A steering shock damper is used on all cars except DeVille. The pitman arm connects the left side of the intermediate rod to the steering gear and the idler arm and bracket assembly connect the right side of the intermediate rod to the frame. The tie rods serve as connecting links between the intermediate rod and steering arms.

All cars are fitted with serviceable pivots. They should be inspected at each engine oil change for damage or lack of enough lubricant. Enough lubricant is in the pivot if grease is expelled from the lip of the pivot seal when the seal is carefully squeezed by hand.

Damaged seal replacement and steering linkage joint lubricant are covered on page 3B-7.

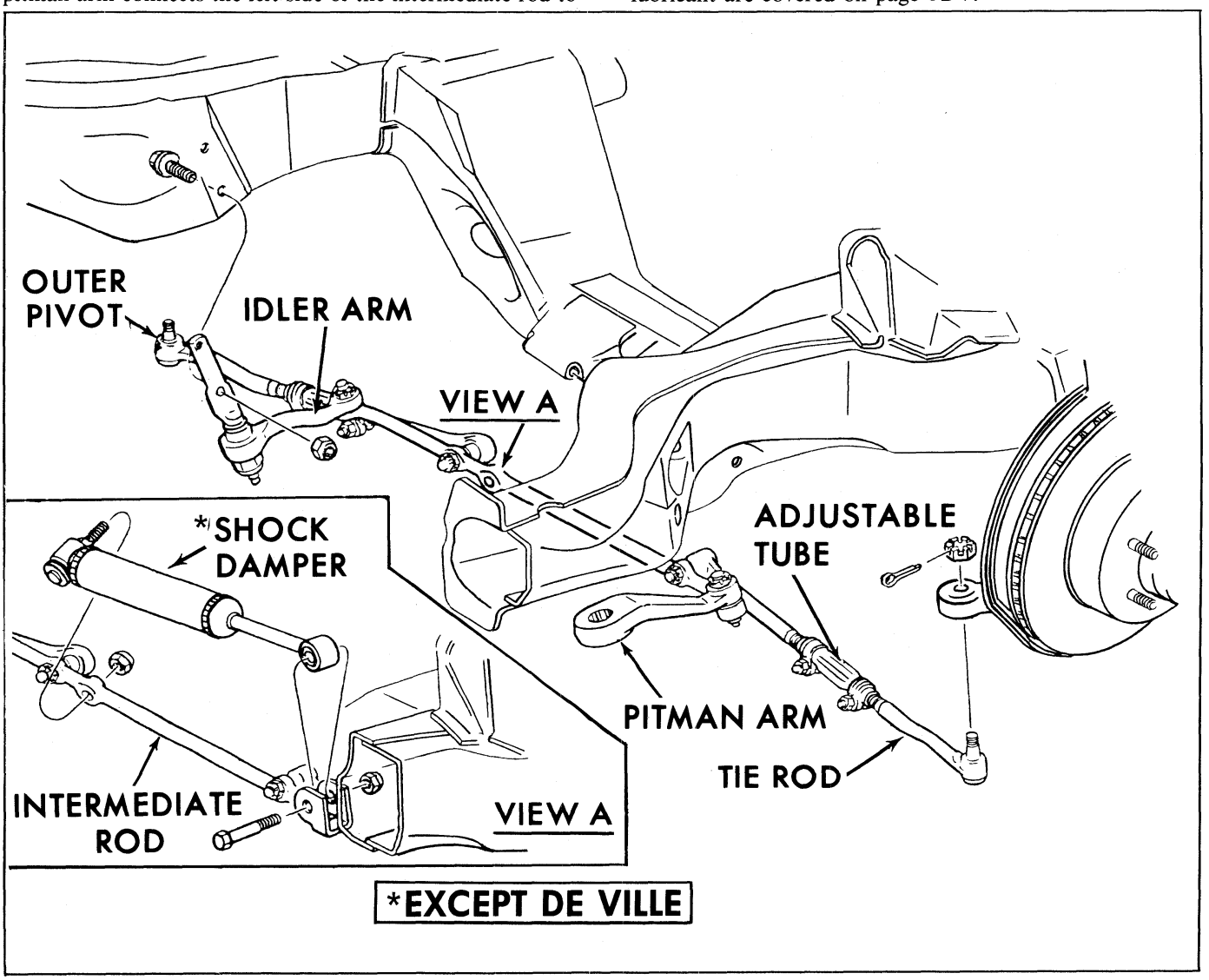


Fig. 3B-1 Steering Linkage (Exc. Eldorado)

STEERING LINKAGE DIAGNOSIS CHART

CONDITION	CAUSE	CORRECTION
Excessive play or looseness in steering system.	Front wheel bearings loosely adjusted.	Adjust bearings or replace with new parts as necessary.
	Worn couplings or steering shaft U-joints.	Replace.
	Worn upper spherical joints.	Replace.
	Steering wheel loose on shaft, loose pitman arm, tie rods, steering arms or steering linkage ball studs.	Tighten to specified torque.
	Steering gear worm bearings loosely adjusted.	Adjust preload to specification.
	Excessive pitman shaft or ball nut lash in steering gear.	Adjust preload(s) to specification.
	Worn intermediate rod or tie rod sockets.	Replace worn parts.
	Shock damper soft (except DeVille).).	Replace shock damper.
Excessive looseness in tie rod or intermediate rod pivots, or excessive vertical lash in idler support.	Seal damage and leakage resulting in loss of lubricant, corrosion and excessive wear.	Replace damaged or worn parts as necessary.
Hard Steering--Excessive effort required at steering wheel.	Low or uneven tire pressure.	Adjust to specified pressures.
	Steering linkage or spherical joints need lubrication.	Lube with specified lubricant. Check for damaged seal.
	Tight or frozen intermediate rod, tie rod or idler socket.	Lube or replace as necessary. Check for damaged seal.
	Steering gear adjusted too tightly.	Adjust preload to specification.
	Front wheel alignment incorrect.	Check alignment and correct as necessary.
	Shock damper bound up. (except DeVille)	Replace shock damper.
Poor returnability.	Steering linkage or spherical joints need lubrication.	Lube with specified lubricant.
	Steering gear adjusted too tightly.	Adjust preload to specifications.
	Front wheel alignment incorrect.	Check alignment and correct as necessary.

ON-CAR SERVICE

The following caution applies to certain steps in the assembly procedure of components in this section. The critical fasteners to which this caution applies are identified by the terminology:

CAUTION: *See "CAUTION" on page 3B-3 of this section.*

CAUTION: *This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.*

Steering Linkage Removal, Disassembly, Assembly, and Installation

a. Removal

1. (Except DeVille) Remove nut and bolt securing steering shock damper to bracket on frame.

2. Remove cotter pins from outer tie rod pivots at steering arms and remove nuts.

3. Remove outer tie rod pivots from steering knuckles using Tie Rod End Puller, J-24319, Fig. 3B-2. Be careful not to damage joint seals.

4. Remove idler arm support mounting screws and nuts from frame side member.

5. Remove pitman arm cotter pin and nut at steering linkage.

6. Remove steering linkage from pitman arm, using Puller, J-24319, Fig. 3B-3.

7. Remove intermediate rod with tie rods, idler arm, and, except DeVille, shock damper attached.

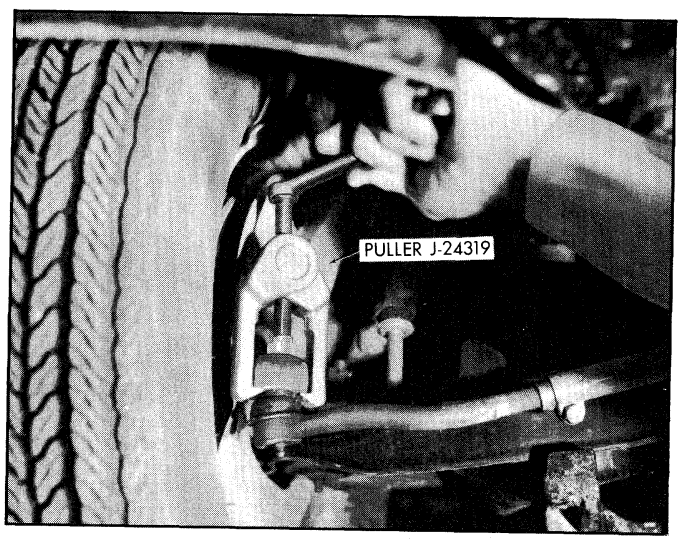


Fig. 3B-2 Removing Tie Rod End From Steering Knuckle

b. Disassembly

1. Remove cotter pins and nuts from idler arm pivot and both inner tie rod pivots.

2. Remove tie rods, using Tie Rod End Puller, J-24319, Fig. 3B-4.

3. Remove idler arm from intermediate rod, using Puller, J-24319, Fig. 3B-5.

4. Remove dust seals from pitman arm and idler arm pivot studs.

5. Remove outer tie rod pivots by loosening nuts on outer clamp bolts and unscrewing outer tie rod pivots from adjuster tubes. Be careful not to pull pivot seal off pivot housing.

6. (Except DeVille) Remove nut securing shock damper to intermediate rod and remove shock damper using Puller, J-24319.

7. If necessary, remove clamps and adjuster tubes from ends of tie rods.

c. Assembly

1. (Except DeVille) Install shock damper on intermediate rod. Secure with nut and tighten to 35 foot-pounds.

2. If previously removed, lubricate adjuster tubes with chassis lubricant. Install adjuster tubes and clamps on ends of rods.

3. Thread outer tie rod pivots into adjuster tubes, but do not tighten outer clamps.

NOTE: An equal amount of thread must be exposed on both ends of the adjuster tubes.

4. Install both tie rods on intermediate rod tightening nuts to 35 foot-pounds, and install cotter pin.

NOTE: Do not loosen nuts to install cotter pins.

CAUTION: *See "CAUTION" on page 3B-3 of this section.*

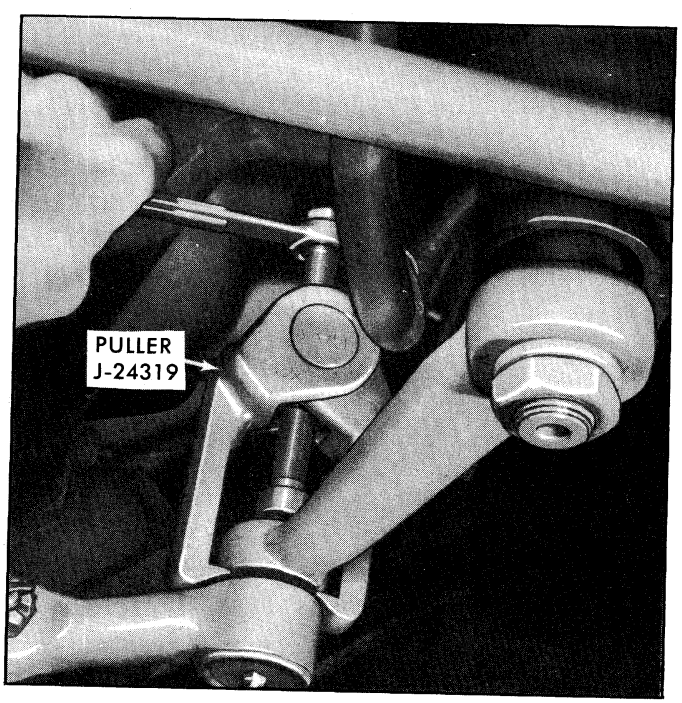


Fig. 3B-3 Disconnecting Pitman Arm

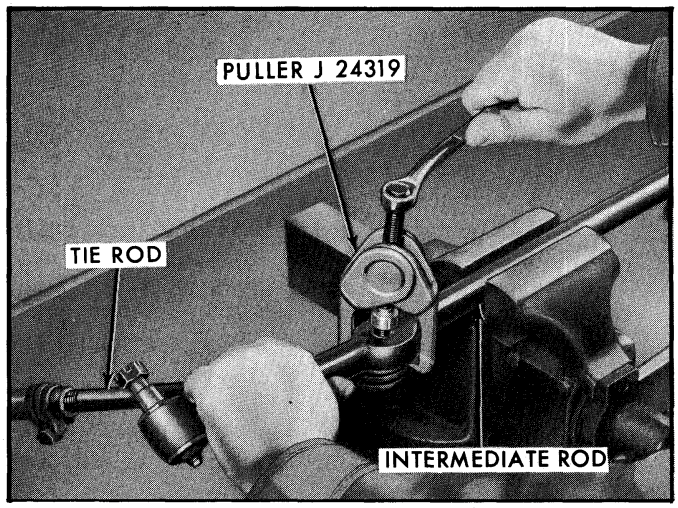


Fig. 3B-4 Removing Tie Rod From Intermediate Rod

NOTE: To assure proper rotational capability of the idler arm pivot, screw the idler arm support shaft completely into the idler arm bushing. Then, unscrew the support shaft between 90° and 270° rotationally attaining alignment of the mounting holes with the frame.

5. Install idler arm on intermediate rod. Tighten nuts to 35 foot-pounds (Seville: 40 foot-pounds) and install cotter pin.

CAUTION: *See "CAUTION" on page 3B-3 of this section.*

NOTE: If holes do not line up, continue to tighten until cotter pin can be inserted. Do not tighten nut more than 45 foot-pounds (Seville: 50 foot-pounds). Do not loosen nuts to install cotter pins.

6. Install new dust seal on pitman arm pivot stud.

7. Lubricate joints as described on page 3B-9.

d. Installation

1. Install idler arm support on frame side bar with two mounting screws and nuts. Tighten mounting screws finger tight.

CAUTION: *See "CAUTION" on page 3B-3 for Steps 2, 3, and 4.*

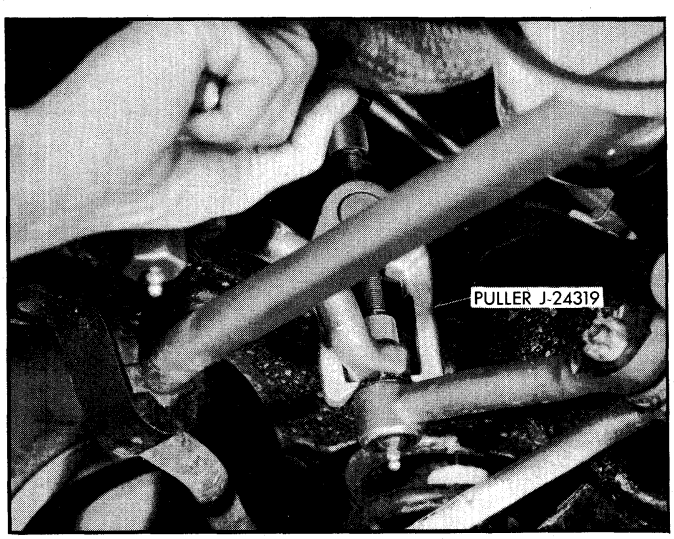


Fig. 3B-5 Removing Idler Arm From Intermediate Rod

2. Install pitman arm at intermediate rod stud. Tighten nut to 45 foot-pounds and install cotter pin.

NOTE: If holes do not line up, continue to tighten until cotter pin can be inserted. Do not tighten nut more than 55 foot-pounds.

3. Connect outer tie rod pivots to steering knuckles, tighten nuts to 35 foot-pounds and install cotter pins.

NOTE: If holes do not line up, continue to tighten until cotter pin can be inserted. Do not tighten nut more than 50 foot-pounds.

4. Turn steering wheel back and forth through the straight ahead position (without touching wheel support stops) to align linkage. Then tighten idler arm to frame attaching bolts to 50 foot-pounds (Seville: 40 foot-pounds).

5. Adjust toe-in as described on page 3A-6. (If Eldorado page 3A-15).

6. (Except DeVille) Install shock damper in frame bracket and secure with bolt and nut. Tighten nut to 35 foot-pounds.

Tie Rods

There are three linkage assemblies that use two tie rod assemblies. Each tie rod assembly is of three piece construction, consisting of an adjuster tube and an inner and outer tie rod. The tie rods are threaded into the adjuster tube and locked with clamps. Right and left hand threads are provided for toe-in adjustment and steering wheel centering.

The tie rod joints and pivots are self-adjusting for wear and require no attention in service other than periodic lubrication and inspection to see that ball studs are tight in the sockets. Replacement of tie rods should be made when excessive up and down motion is evident or if any lost motion or end play at ball end of stud exists.

a. Removal

If any tie rods are replaced, front wheel toe alignment must be checked and reset as required to meet specification.

1. Place vehicle on hoist.

2. Remove cotter pins from ball studs and remove castellated nuts.

3. Disconnect tie rod from steering knuckle by using Puller, J-24319. See Fig. 3B-2.

4. Remove inner ball stud from intermediate rod using same procedure as described in Step 2 and 3. See Fig. 3B-4.

5. To remove tie rods from the adjuster tube loosen clamp bolts and unscrew end assemblies.

NOTE: Tie rod adjuster components often become rusted in service. In such cases, it is recommended that if the torque required to remove the nut from the bolt after breakaway exceeds 10N·m (7 foot-pounds), discard the nuts and bolts.

Apply penetrating oil between the clamp and tube and rotate the clamps until they move freely. Install new bolts and nuts having the same part number to assure proper clamping at the specified nut torque.

b. Installation

1. If the tie rods were removed, lubricate the tie rod threads with EP Chassis lube and thread ends of tie rod into the adjuster tube making sure both ends are threaded and equal distance into the adjuster tube.

2. Make sure that threads on ball stud and in ball stud nuts are perfectly clean and smooth. The ball stud must have no nicks on the taper. Inspect and replace damaged seals as necessary. If seals were replaced lubricate joint as described page 3B-9.

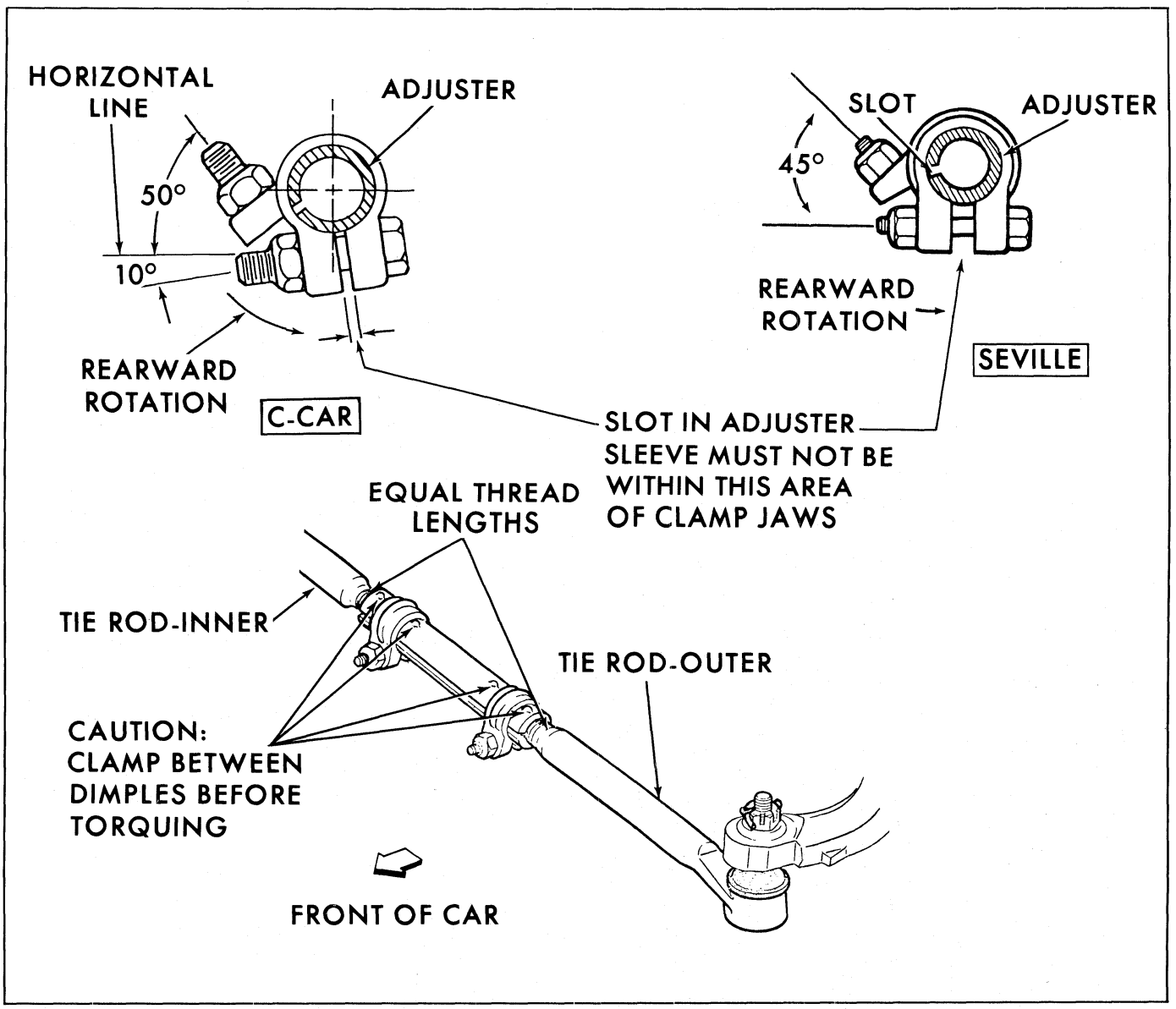


Fig. 3B-6 Position of Adjuster Tube Clamp (Exc. Eldorado)

NOTE: If threads are not clean and smooth, ball studs may turn in tie rod ends when attempting to tighten nut.

3. Install ball studs in steering knuckle and intermediate rod.

4. Install ball stud nuts and tighten to 35 foot-pounds, then tighten nuts just enough to align slot in castellated nut with hole in stud and install cotter pins.

CAUTION: *See "CAUTION" on page 3B-3 of this section.*

NOTE: Do not loosen nuts to install cotter pins.

NOTE: Before locking clamp bolts on the rods, make sure that the tie rod ends are in alignment with their ball studs by rotating both tie rods in the same direction as far as they will go and tighten adjuster tube clamps to 14 foot-pounds. Make certain that adjuster tubes and clamps are positioned as shown in Fig. 3B-6 (Fig. 3B-7 if Eldorado).

CAUTION: *See "CAUTION" on page 3B-3 of this section.*

5. Remove vehicle from hoist.

6. Adjust toe-in.

Intermediate Rod

If intermediate rod is replaced, front wheel toe alignment must be checked and reset as required to meet specification.

a. Removal

1. Place vehicle on hoist.

2. (Except DeVille) Disconnect steering shock damper from intermediate rod.

3. Remove inner tie rods from intermediate rod as described on page *3B-3*

4. Remove cotter pin and nut from intermediate rod ball stud attachment at pitman arm.

5. Disconnect intermediate rod from pitman arm by using Puller tool J-24319. See Fig. 3B-3.

6. Shift steering linkage as required to free pitman arm from intermediate rod.

7. Remove cotter pin and nut from idler arm and remove

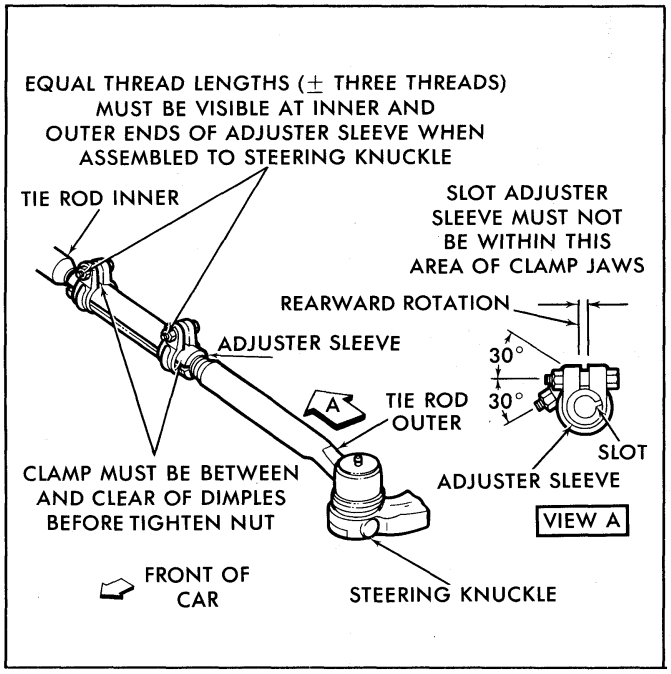


Fig. 3B-7 Position of Adjuster Tube Clamp (Eldorado)

intermediate rod from idler arm in the same manner as the intermediate rod is removed from the pitman arm in Step 4.

b. Installation

CAUTION: *See "CAUTION" on page 3B-3 of this section regarding the fasteners referred to in Steps 2, 3 and 5.*

1. Inspect and replace damaged seals as necessary. If seals are replaced, lubricate joint as described on page 3B-9.

2. Install intermediate rod to idler arm, making certain idler stud seal is in place, then install and tighten nut to 35 foot-pounds (Seville: 40 foot-pounds). Advance nut just enough to align castellation with cotter pin hole and install pin.

NOTE: Do not loosen nuts to install cotter pins.

3. Install pitman arm. Tighten nut to 45 foot-pounds, then advance nut just enough to align slot in castellated nut with hole in stud and install cotter pin.

NOTE: Do not loosen nuts to install cotter pins.

4. Install inner tie rods to intermediate rod as described on page 3B-3.

5. Install ball stud nuts and tighten to 40 foot-pounds, then advance nut just enough to align slot in castellated nut with hole in stud and install cotter pin.

NOTE: DO not loosen nuts to install cotter pins.

6. (Except DeVille) Install steering shock damper on intermediate rod. Tighten nut to 35 foot-pounds. Then advance nut to install cotter pin.

7. Remove vehicle from hoist.

8. Adjust toe-in and align steering wheel.

Tie Rod Adjuster Tube

If tie rod adjuster tube is replaced, front wheel toe alignment must be checked and reset as required to meet specifications. See page 3A-6 or, if Eldorado, 3A-15.

a. Removal

1. Place vehicle on hoist.

2. Remove cotter pins from ball studs and remove castellated nuts on outer tie rod at steering knuckle.

3. Disconnect tie rod from steering knuckle by using Puller J-24319. See Fig. 3B-2.

4. Unthread outer tie rod end from adjuster tube.

5. Unthread adjuster tube from inner tie rod still connected to intermediate rod.

NOTE: Tie rod adjuster components often become rusted in service. In such cases, it is recommended that if the torque required to remove the nut from the bolt after breakaway exceeds 7 foot-pounds, discard the nuts and bolts. Apply penetrating oil between the clamp and tube and rotate the clamps until they move freely. Install new bolts and nuts having the same part number to assure proper clamping at the specified nut torque.

b. Installation

1. Install components in reverse order of removal.

2. Lubricate the tie rod threads with EP Chassis lube and thread ends of tie rod into the adjuster tube making sure both ends are threaded and equal distance into the adjuster tube.

3. Make sure that threads on ball stud and in ball stud nuts are perfectly clean and smooth. The ball stud must have no nicks on the taper. Inspect and replace damaged seals as necessary.

NOTE: If threads are not clean and smooth, ball studs may turn in tie rod ends when attempting to tighten nut.

4. Install ball studs in steering knuckle.

5. Tighten nuts to 35 foot-pounds, then tighten nuts just enough to align slot in castellated nut with hole in stud and install cotter pins.

CAUTION: *See "CAUTION" on page 3B-3 of this section.*

NOTE: Do not loosen nuts to install cotter pins.

NOTE: Before locking clamp bolts on the rods, make sure that the tie rods are in alignment with their ball studs by rotating both inner and outer tie rods in the same direction as far as they will go and then tighten adjuster tube clamps to 22 foot-pounds. Make certain that adjuster tubes and clamps are positioned as shown in Fig. 3B-6 (Fig. 3B-7 if Eldorado).

CAUTION: *See "CAUTION" on page 3B-3 of this section.*

6. Remove vehicle from hoist.

7. Adjust toe-in.

Idler Arm

NOTE: The idler arm assembly should be replaced if when an up and down force of 110 Newtons (25 pounds) is applied at the intermediate rod end of the idler arm, the vertical lash exceeds 3.2mm (1/8 inch).

a. Removal

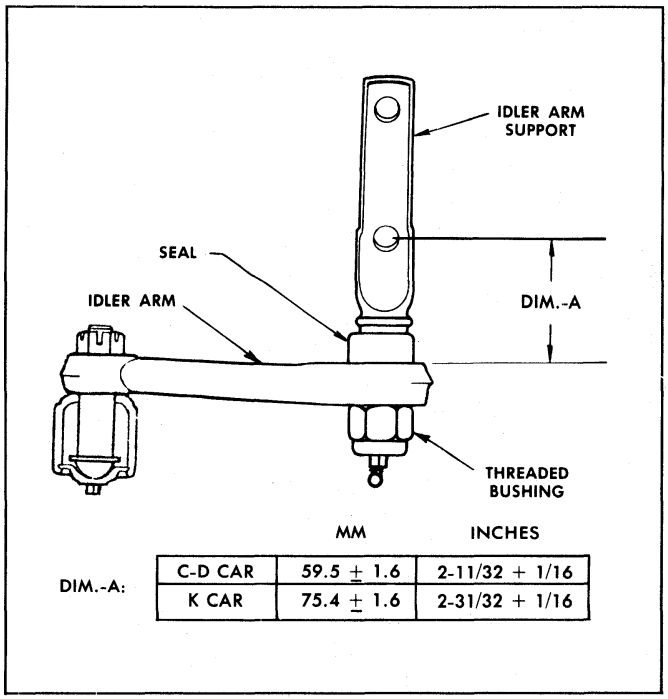
1. Place vehicle on hoist.

2. Remove idler arm support to frame nuts, washers, and bolts.

3. Remove cotter pin and nut from idler arm to intermediate rod ball stud.

4. Remove intermediate rod from idler arm by using J-24319, Fig. 3B-5.

5. Remove idler arm.



DIM.-A:	MM	INCHES
C-D CAR	59.5 ± 1.6	2-11/32 + 1/16
K CAR	75.4 ± 1.6	2-31/32 + 1/16

Fig. 3B-8 Proper Location of Idler Arm on Threaded Support Bushing (Exc. Eldorado)

b. Installation

The linkage requires proper location of the idler arm on its threaded support so that the idler arm ball socket will be level with the pitman arm ball socket. The support must be threaded into the idler arm bushing until the distance from the center of the lower mounting bolt hole to the top of the idler arm boss is as indicated in Fig. 3B-8. The position of the idler arm must be set before the idler arm assembly is installed in the vehicle.

After setting, idler arm must be free to rotate a minimum of 90 degrees in either direction from forward position.

1. Position support against frame, and secure with bolts, washers and nuts. Install and tighten nuts to 50 foot-pounds (Seville: 40 foot-pounds).

CAUTION: *See "CAUTION" on page 3B-3 of this section.*

2. Install intermediate rod to idler arm, making certain seal is on stud. Tighten nut to 35 foot-pounds (Seville: 40 foot-pounds).

CAUTION: *See "CAUTION" on page 3B-3 of this section.*

3. Advance nut just enough to align slot in castellated nut with hole in stud and install cotter pin.

NOTE: Do not loosen nut to install cotter pin.

4. Remove vehicle from hoist.

Pitman Arm

a. Removal

1. Place vehicle on hoist.
2. Remove cotter pin from pitman arm ball stud and remove nut.
3. Remove intermediate rod from pitman arm using tool J-24319. See Fig. 3B-3.
4. Remove pitman arm nut and lock washer from pitman shaft **and discard.** Mark relation of arm position to shaft.
5. Remove pitman arm with tool J-9172.

CAUTION: *Do not hammer on puller.*

b. Installation

1. Install pitman arm on pitman shaft, lining up the marks made upon removal.
2. Install **new** pitman shaft nut and lock washer, tighten to 180 foot-pounds.

CAUTION: *See "CAUTION" on page 3B-3 of this section.*

3. Position intermediate rod to pitman arm. Install nut and tighten to 45 foot-pounds. Continue to tighten nut enough to align slot in castellated nut with hole in stud and install cotter pin.

CAUTION: *See "CAUTION" on page 3B-3 of this section.*

NOTE: DO NOT loosen nut to install cotter pin.

4. Remove vehicle from hoist.

Tie Rod Pivot Seal Replacement

1. Raise car.
2. Remove cotter pin and nut from tie rod pivot.
3. Remove outer tie rod pivot from steering knuckle using Tie Rod Pivot Puller, J-24319, Fig. 3B-2. Remove inner tie rod pivot from intermediate rod using Tie Rod Pivot Puller, J-24319, Fig. 3B-4.
4. Pry old seal off pivot housing.
5. Wipe pivot and housing clean.
6. Position new seal on pivot stud. Using Seal Installer, J-21150-1, move flange of seal over seat on housing with a firm, even push.

NOTE: Make certain that seal installer is positioned squarely on seal.

7. Position tie rod to steering knuckle or intermediate rod and install nut. Tighten outer tie rod pivot nut to 35 foot-pounds. Tighten inner tie rod pivot nut to 40 foot-pounds.

CAUTION: *See "CAUTION" on page 3B-3 of this section.*

8. Secure pivot nut with cotter pin. If holes do not line up, continue to tighten nut until cotter pin can be inserted.

NOTE: Do not loosen nut to install cotter pin.

9. Lubricate joint with any lubricant meeting GM-6031M specifications.

ELDORADO STEERING

The service information that follows pertains only to the Eldorado. All other descriptions, service procedures and recommendations for the Eldorado are the same as those for other cars as given in the first part of this section.

Steering Linkage - Eldorado

The steering linkage on the Eldorado, Fig. 3B-9, consists of a pitman arm, idler arm, two tie rod assemblies, a one piece forged steel intermediate rod, and a steering shock damper. The pitman arm connects the left side of the intermediate rod to the steering gear and the idler arm connects the right side of the intermediate rod to the frame. The steering shock damper connects the intermediate rod to the frame in such a manner as to dampen vibrations in the linkage. The tie rods serve as connecting links between the intermediate rod and the steering knuckles. Tie rod ends should be checked for looseness and damaged seals. Loose tie rod ends must be replaced as a unit. Tie rod seals are replaceable and any damaged seals should be replaced. Four lubrication fittings are provided at the tie rod ends.

ON-CAR SERVICE

Steering Linkage Removal, Disassembly, Assembly, and Installation-Eldorado

a. Removal

1. Remove front wheels.
2. Remove bolt securing steering shock damper to bracket on frame.
3. Remove cotter pins and nuts from pitman arm and idler arm pivots on intermediate rod.
4. Remove idler and pitman arm pivots from intermediate rod using Puller, J-24319, Fig. 3B-10.

NOTE: It may be necessary to loosen steering gear at frame to remove intermediate rod from pitman arm.

5. Remove cotter pins and nuts from outer tie rod pivots at steering knuckles.
6. Remove tie rod pivots from steering knuckles using Tie Rod End Puller, J-24319.
7. Remove linkage from car.
8. Remove bolt and locknut securing idler arm to frame and remove idler arm from car.

b. Disassembly

1. Remove cotter pins and nuts from inner tie rod pivots.
2. Remove tie rods using Tie Rod End Puller, J-24319.
3. Remove outer tie rod pivots by loosening nuts on outer clamp bolts and unscrewing pivots from adjuster tube.
4. Loosen nuts on inner clamp bolts and unscrew tie rod inner pivots from adjuster tubes.
5. Remove bolts securing damper to bracket on intermediate rod and remove damper and spacer.

c. Assembly

1. Position steering shock damper and spacer to brackets on intermediate rod. Spacer should be positioned between damper attachment and upper part of bracket.
2. Attach damper to bracket with bolt and tighten to 40 foot-pounds.
3. Lubricate adjuster tube with chassis lubricant, install adjuster tubes and clamps on tie rod inner pivots into adjuster tubes.
4. Tread tie rod outer pivots into adjuster tubes.

NOTE: An equal amount of thread must be exposed on both ends of the adjuster tubes.

5. Install both tie rods on intermediate rod, tighten to 60 foot-pounds and install cotter pins. If cotter pin cannot be installed, tighten nut to next hole location and install cotter pin.

CAUTION: *See "CAUTION" on page 3B-3 of this section.*

NOTE: Do not loosen nuts to install cotter pins.

d. Installation

CAUTION: *See "CAUTION" on page 3B-3 when performing steps 1, 2 and 3.*

1. Install idler arm on frame with bolt and locknut. Tighten bolt to 95 foot-pounds.
2. Install intermediate rod on pitman arm and idler arm

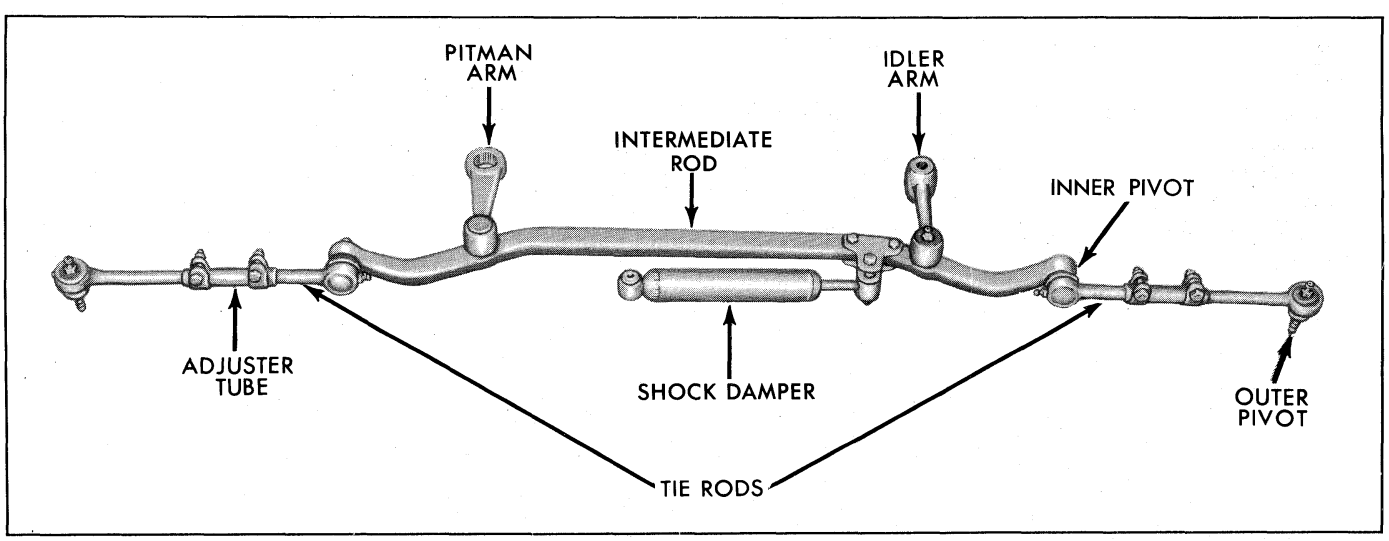


Fig. 3B-9 Steering Linkage (Eldorado)

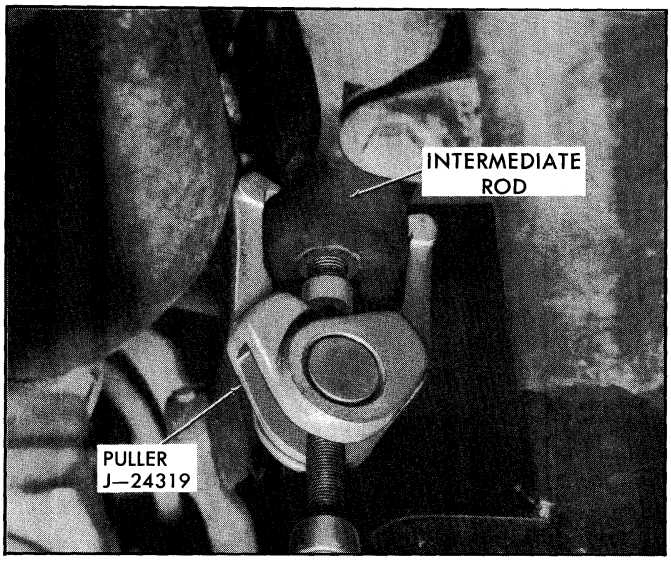


Fig. 3B-10 Disconnecting Pitman Arm (Eldorado)

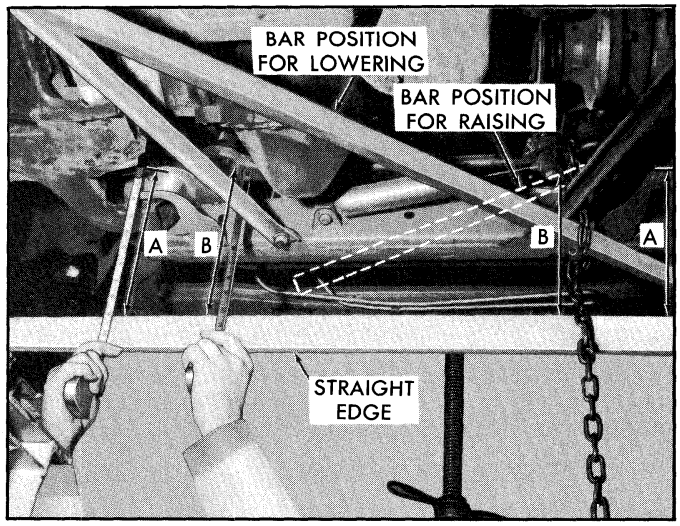


Fig. 3B-11 Steering Linkage Parallelism (Eldorado)

pivots and tighten pivot nuts to 60 foot-pounds. Install cotter pins.

NOTE: Do not loosen nuts to intall cotter pins.

3. Install outer tie rod pivots to steering knuckles and tighten nuts to 37 foot-pounds. Install cotter pins.

NOTE: Do not loosen nuts to install cotter pins. If holes do not line up, continue to tighten nut until cotter pin can be inserted. Do not tighten nut more than 50 foot-pounds.

4. Install shock damper to frame bracket, tighten bolt to 40 foot-pounds.

5. Install front wheels on car.

6. Adjust alignment as described on page 3A-2 or, if Eldorado, 3A-12.

Idler Arm - Eldorado

a. Removal

1. Raise car on hoist.

2. Remove cotter pin from idler arm stud and remove nut.

3. Remove nut and bolt securing idler arm to frame crossmember bracket.

4. Remove idler arm from intermediate rod using Puller J-24319.

b. Installation

1. Install idler arm to intermediate rod and secure with nut. Tighten to 60 foot-pounds and install cotter pin.

CAUTION: *See "CAUTION" on page 3B-3 of this section.*

2. Install idler arm in frame crossmember bracket and secure to bracket with nut and bolt. Tighten to 95 foot-pounds.

CAUTION: *See "CAUTION" on page 3B-3 of this section.*

3. Lower car.

Pitman Arm - Eldorado

a. Removal

1. Remove two plastic retainers securing flexible coupling shield to frame side rail and remove shield. Discard retainers.

2. Remove nuts and washers securing flexible coupling.

3. Raise car.

4. Remove pitman shaft nut and washer. Mark position of arm to shaft.

5. Remove cotter pin from pitman arm to intermediate rod stud and remove nut.

6. Disconnect stud from intermediate rod using Puller J-24319.

7. Remove screw securing cooler lines to front crossmember.

8. Remove the three steering gear to frame bolts and position gear forward and up far enough to attach Pitman Arm Puller J-6632. Remove pitman arm from shaft.

b. Installation

CAUTION: *See "CAUTION" on page 3B-3 of this section regarding the fasteners referred to in steps 1, 3 and 4.*

1. Install pitman arm on pitman shaft and torque nut to 185 foot-pounds. Loosely fit pivot into intermediate rod.

2. Install flexible coupling flange into steering shaft flange, loosely install nuts and washers. Check steering wheel and pitman shaft for center on gear.

3. Install steering gear to frame mounting bolts. Tighten to 70 foot-pounds.

4. Tighten pitman arm stud nut to 60 foot-pounds and install cotter pin.

NOTE: Do not loosen nut to install cotter pin.

5. Tighten flexible coupling flange nuts to 20 foot-pounds.

6. Secure cooler lines to front crossmember with screw.

7. Lower car.

8. Install flexible coupling shield and secure with new plastic retainers.

Steering Linkage Joint Lubrication

The steering linkage can be lubricated with any chassis lubricant meeting GM 7031-M specifications. Consult Section 0 for proper lubrication schedule.

Intermediate Rod Height Adjustment - Eldorado

Intermediate rod height and steering linkage parallelism should be checked and adjusted in cases where Orbital Steer is experienced. Orbital Steer is encountered when the vehicle, while traveling straight ahead, encounters a gentle swell in the road, causing the front end of the vehicle to momentarily wander slightly from its straight ahead path.

In addition to checking standing height and fron end alignment, the steering linkage paralellism should be checked

and adjusted as follows:

1. Position car on wheel alignment machine. Place a straight edge midway between intermediate rod, lower control arm and front inner pivots across a level parallel surface, see Fig. 3B-11.

2. Measure distance "A" from center line of control arm pivots to top of straight edge.

3. Measure distance "B" from intermediate rod (just inboard of inner pivots) to top of straight edge.

4. The difference between distance "B" and distance "A" should be the same, left side to right, not exceeding 1/8 of an inch.

5. If not parallel within 1/8 of an inch, loosen gear mounting bolts and rotate gear in proper direction to obtain proper height. Tighten mounting bolts to 70 foot-pounds.

CAUTION: *See "CAUTION" on page 3B-3 of this section.*

6. If proper height cannot be obtained, pry intermediate steering rod as follows:

a. If the intermediate rod needs to be lowered on the right side, install a short piece of chain around the intermediate rod between the right inner pivot and steering shock damper mounting bolt, Fig. 3B-11. Pry downward with a long bar until proper height is obtained.

CAUTION: *Correction in excess of ± 1/4 inches should not be attempted by this method as frame damage may result.*

b. If the intermediate rod needs to be raised on the right side, place the bar under the intermediate rod and pry up, Fig. 3B-11.

7. Adjust front wheel toe to specification with steering wheel and pitman arm centered, making sure that tie rod adjusters have equal thread engagement within 3 threads.

STEERING GEAR AND PUMP

TABLE OF CONTENTS

General Description 3B-11
Leakage Diagnosis 3B-13
Gear and Pump Diagnosis 3B-16
On-Car Service 3B-20
Checking Fluid Level 3B-20
Checking Pump Pressure 3B-20
Intermediate Shaft 3B-21
Cooler Tube 3B-21
Pump (Exc. Seville) 3B-23
Pump (Seville) 3B-24
Gear (Exc. Eldorado) 3B-25
Gear (Eldorado) 3B-25
Lower Steering Shaft (Eldorado) 3B-21
Unit Repair 3B-27
Intermediate Shaft 3B-27
Pump 3B-28
Pump Shaft Seal 3B-32
Gear 3B-33
Pitman Shaft Seals 3B-43
Torque Specifications 3B-78

GENERAL DESCRIPTION

A constant ratio steering gear (17.5:1) is used on Fleetwood Sedan, Limousine, and Commercial vehicles. Variable ratio power steering (15.0:1 on center, 13.0:1 at full turn) is utilized on the Brougham, DeVille, and Seville. Eldorado utilizes a variable ratio power steering (20.0:1 on center, 16.0:1 at full turn).

Variable ratio steering is accomplished by a pitman shaft sector incorporating a short tooth on either side of a long center tooth, rather than a sector with three teeth of equal

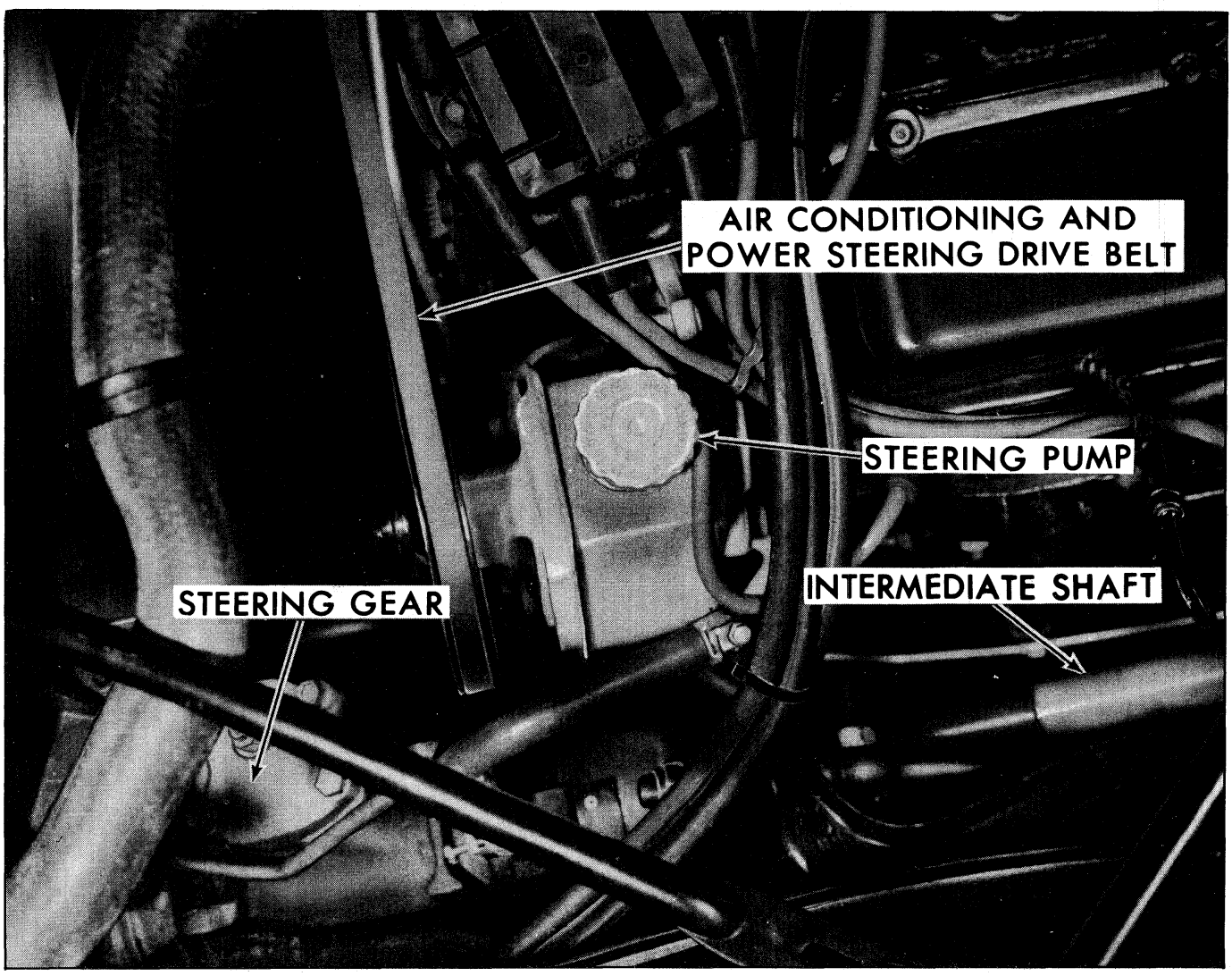


Fig. 3B-12 Steering Gear and Pump Location

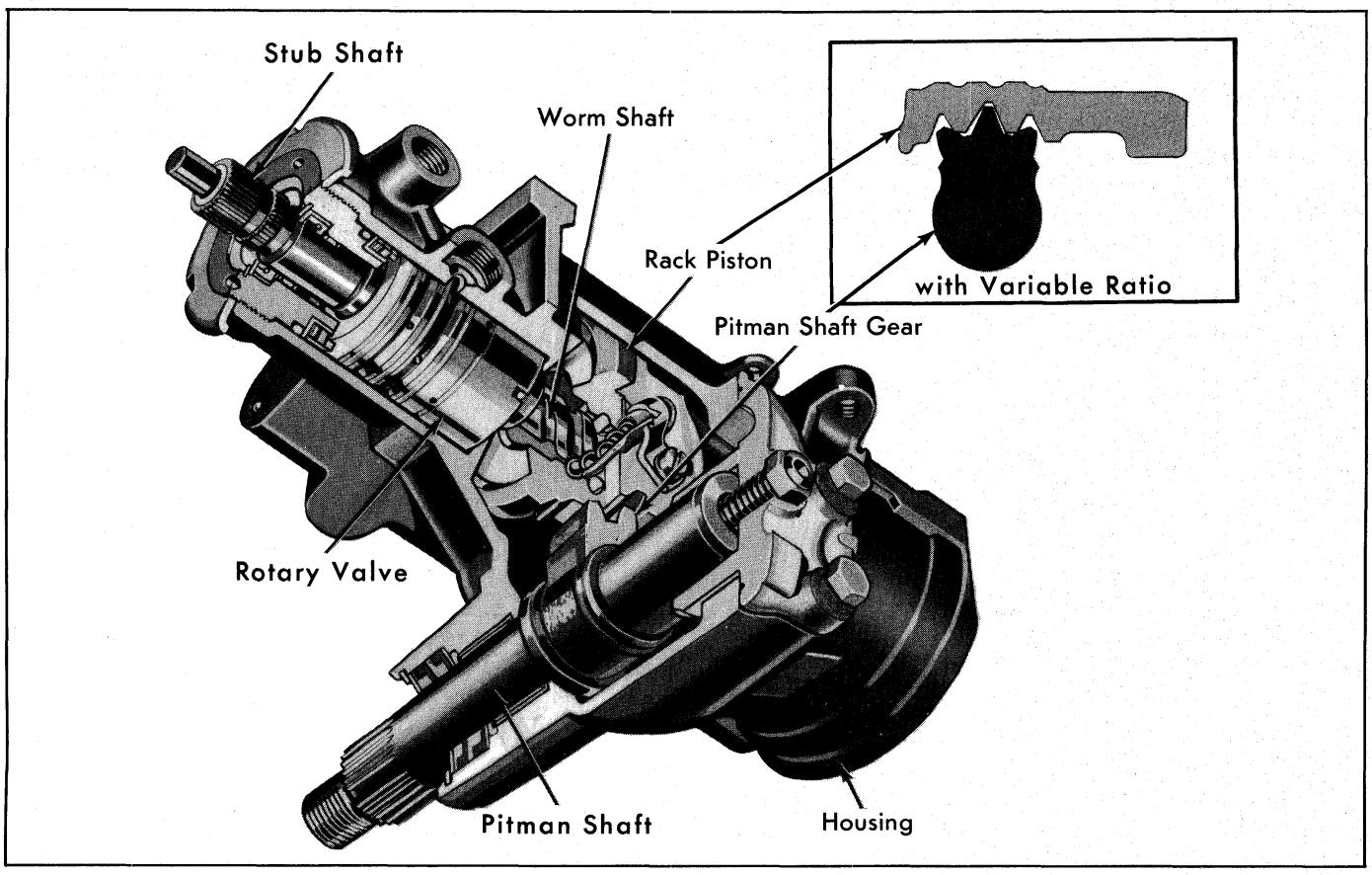


Fig. 3B-13 Steering Gear Cutaway

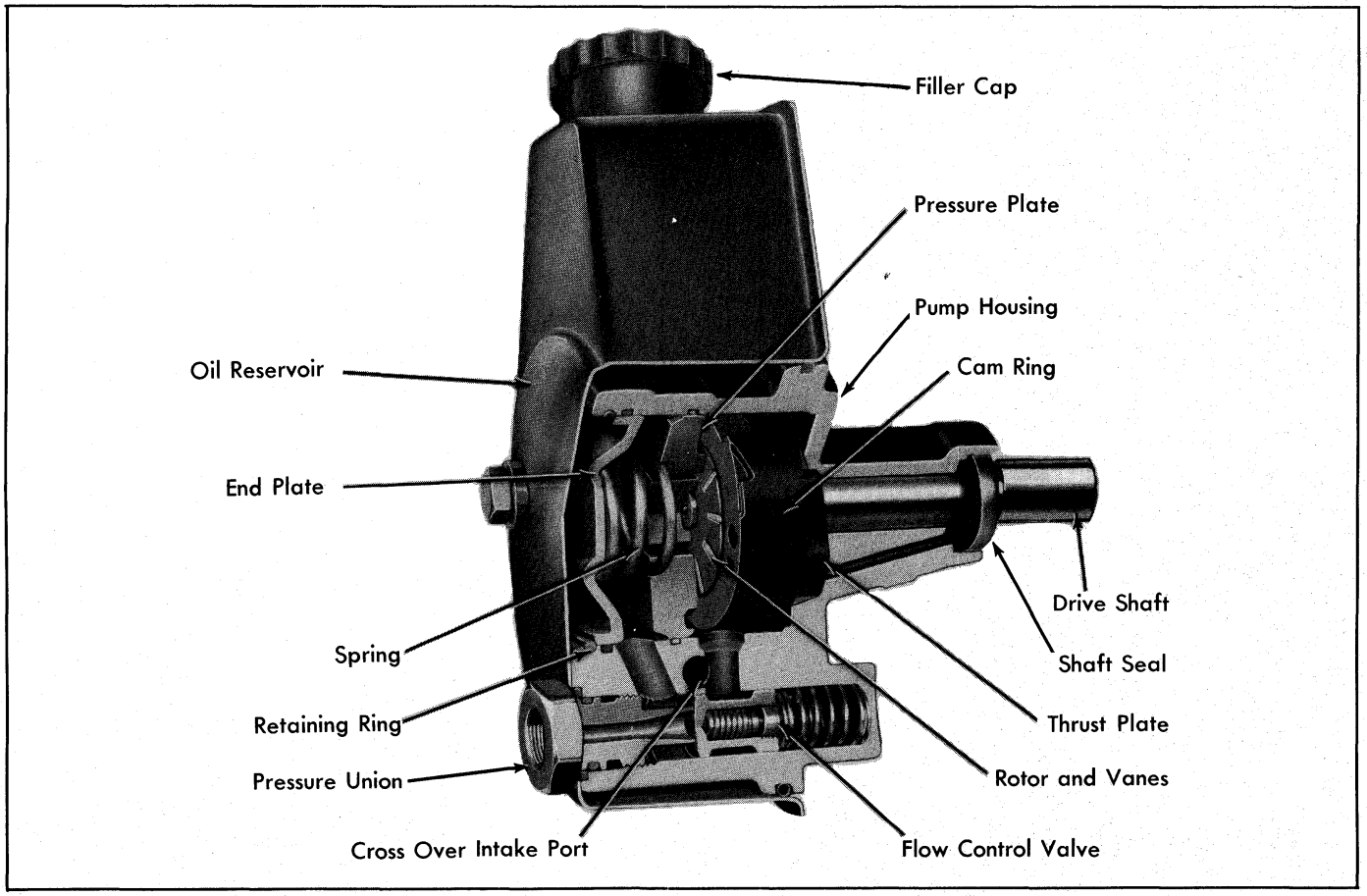


Fig. 3B-14 Steering Pump Cutaway

length as in constant ratio steering.

The steering gear is mounted on the left frame side rail and is secured by three mounting screws. The gear is joined to the intermediate shaft by a flexible coupling that helps reduce transmission noise and road shock to the car interior, Fig. 3B-12.

A constant displacement vane type pump provides hydraulic pressure for the steering system. The pump is located on the left front corner of the engine, Fig. 3B-12, and is belt driven by the engine crankshaft pulley.

Steering Gear (Fig. 3B-13)

On DeVille and Brougham only, a smaller diameter variable ratio power steering gear, not interchangeable with previous models, is used. The major internal components of the variable ratio steering gear are the rotary valve assembly, steering worm shaft, rack piston assembly, and the pitman shaft. The movement of these parts, while turning or parking, is aided by hydraulic pressure supplied by the pump. Manual steering is always available at times when the engine is not running, or in the event of pump or belt failure. Steering effort is increased under such conditions.

The steering stub shaft, rotary valve, worm shaft, and rack-piston assembly are all "in line". The rack-piston in the variable ratio steering gear is modified to accommodate the larger center tooth on the pitman shaft gear. All oil passages are internal within the gear housing, except for the pressure and return hoses between the gear and the pump.

The hydraulic rotary valve is concentric with the input shaft and is contained in the rear section of the gear housing. It contains a spool that is held in neutral position by means of a torsion bar. The spool is attached to one end of the torsion bar and the valve body to the other end. Twisting of the torsion bar allows the spool to rotate in relation to the valve body, thereby operating the valve.

Under normal driving conditions, the steering wheel effort will range from 4 to 7 Newtons (1 to 1-1/2 pounds) and parking effort will range from 9 to 11 Newtons (2 to 2-1/2 pounds).

Steering Pump (Fig. 3B-14)

On DeVille, Brougham and Seville, a smaller displacement pump is used. The major components of the power steering pump are the oil reservoir, drive shaft, pump housing, cam ring, pressure plate, thrust plate, flow control valve, the rotor and vane assembly. The pump housing and component parts are encased in the oil reservoir. The reservoir filler cap has a dipstick attached to show the oil level in the reservoir.

There are two bore openings at the rear of the pump housing. The larger of these openings contains the cam ring, pressure plate, thrust plate, rotor and vane assembly, and end plate. The smaller opening contains the pressure line union, flow control valve, and spring. The flow control orifice is part of the pressure line union. A pressure relief valve inside the flow control valve limits pump pressure to 9825-10170 kPa (1425-1475 PSI) (for Seville, 9308-9998 kPa or 1350-1450 PSI).

Eldorado, which incorporates the hydro-boost brake system, has two return ports, one of which connects to the hydraulic booster. See Fig. 3B-19.

A steering pump return line filter is used on the Eldorado hydro-boost brake system. The filter is clamped to a bracket which is secured to the face of the steering pump with one screw. This filter should be replaced each time service is done that indicates contaminates have been introduced into the system.

For further information on the hydro-boost brake system, see Section 5, page 5-56.

STEERING LEAKAGE DIAGNOSIS

Complaints of faulty steering are frequently the result of problems other than the steering gear or pump. Those areas of the steering system which can be easily checked and quickly corrected without disassembly and overhaul of any major components should be attempted first.

Conditions such as hard or loose steering, road shock or vibrations are not always due to the steering gear or pump, but are often related instead to such factors as tire pressure and front end alignment. These factors should be checked and corrected before any adjustment or disassembly of the power steering gear or pump is attempted.

Many factors affect proper operation of the steering system, of which the most common are:

1. Fluid level.
2. Drive belt tension.
3. Loose component mountings.
4. Coupling alignment, axial and lateral.
5. Loose pump pulley.

These factors must be checked and corrected before making any further diagnosis of the steering system. **The need for proper diagnosis cannot be over-emphasized.**

Determine the Cause

After the source of the problem has been found, determine the cause. For example, if the oil level in the reservoir is found to be low, refill and check the entire hydraulic system for oil leaks. Refilling the reservoir will not necessarily correct problem.

External Leakage Diagnosis

General Procedure

1. Wipe suspected area dry.
2. Check for overfilled reservoir.
3. Check for oil aeration and overflow.
4. Check hose connections - tighten if necessary.
5. Verify exact point of leakage.

Example: Torsion bar, stub shaft and adjuster seals are close together; exact leakage point could be difficult to locate.

Example: The point oil drips from is not necessarily the leakage point - oil overflowing from reservoir for instance.

6. When service is required:

A. Clean leakage area upon disassembly.

B. Check component sealing surfaces for damage.

C. Replace leaking seal or seals.

D. Reset bolt torque to specification where required.

Some of the problems associated with the power steering systems may be described as:

1. Oil leakage on garage floor.
2. Oil leaks visible on steering gear, pump, or anywhere else on the left side of engine compartment.
3. Growling noise especially when parking or when engine is cold.
4. Loss of power when parking.
5. Heavy steering effort.

For the purpose of trouble shooting problems of this nature, assume that there is an external leak in the power steering system, and follow the steps given in this procedure.

This procedure is a guide, which will enable you to locate, identify, and repair leaks in the power steering system. It contains:

A. Diagram of the complete power steering system with the areas of potential leakage identified.

B. Recommended procedure for locating external leakage in the vehicle.

C. Areas of leakage to be checked, which can be serviced at once.

D. Part replacement recommendations.

E. Diagram of the actual areas where leakage will be observed and the action recommended to repair this leakage.

External Leakage Check

The purpose of the diagnostic procedure is to pinpoint the location of the leak. The method outlined in this procedure can be followed to locate the leak and repair it.

In some cases you will be able to locate the leak easily. However, seepage type leaks may be more difficult to isolate. For seepage leaks, the following method is recommended.

A. With the vehicle's engine off, wipe the complete power steering system dry (gear, pump, hoses, and connections).

B. Check oil level in pump's reservoir and bring to proper level.

C. Start engine and turn steering wheel from stop to stop several times. Do not hold for any length of time as this can damage the power steering pump. It is easier if someone else operates the steering wheel while you check for seepage.

D. Find the exact area of leakage.

E. Refer to the diagnostic chart to find the recommended method of repair.

Quick Fixes

The purpose of this section is to acquaint you with the types of leakage which can be repaired very easily. It contains information on reservoir oil level, the hoses and the hose connections.

An overfilled pump reservoir can be a cause for leakage complaint. The oil in the steering system expands as heated during normal usage. If overfilled the excess is forced through the breather cap vent and may be sprayed over the engine by air blast. Operate the engine and steering system until normal operating temperature is obtained. Remove the reservoir cap and check the graduated level on the dipstick. Add or remove fluid to bring oil to proper level.

Seepage at the hose connections can be a cause for leakage complaint and can be due to loose hose connections. If leakage is observed at the hose connections, and the fitting is not cross treaded, tighten the fitting at the gear (and at hydraulic booster on Eldorados) to 35 foot-pounds maximum (30 foot-pounds maximum on Seville).

The fitting at the power steering pump should be tightened to 45 foot-pounds maximum (40 foot-pounds maximum on Seville). If tightening to this torque does not stop the leak, refer to the diagnostic chart.

If either the return hose or the pressure hose leaks, replace the hose.

Component Replacement Recommendations

Lip seals, which seal rotating shafts, require special treatment. This type of seal is used on the steering gear at the pitman shaft, at the stub shaft, and on the drive shaft of the pump. When leakage occurs in one of these areas, always replace the seal or seals after inspecting and thoroughly cleaning the sealing surfaces. Replace the shaft only if very severe pitting is found. If the corrosion in the lip seal contact zone is slight, clean the surface of the shaft with crocus cloth. Replace the shaft only if the leakage cannot be stopped by smoothing with crocus cloth first.

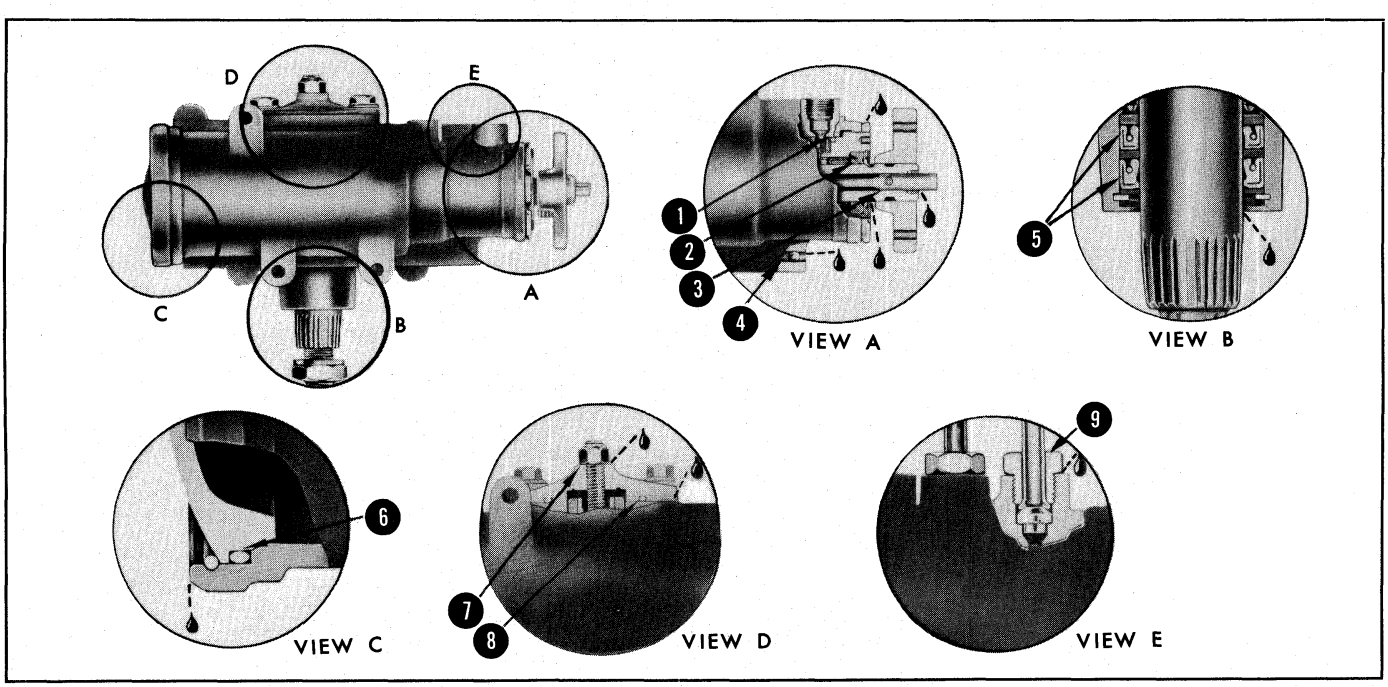


Fig. 3B-15 Steering Gear Leakage Areas

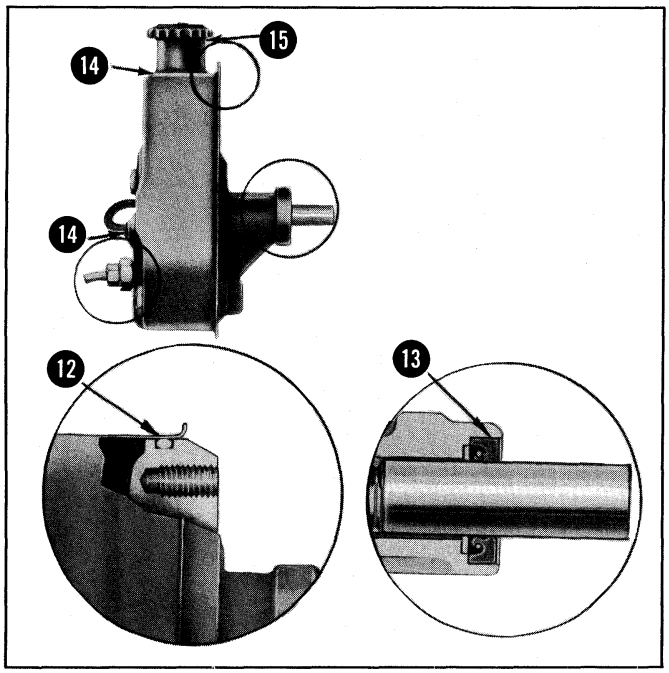


Fig. 3B-16 Steering Pump Leakage Areas

Housing or Cover Seepage

Both the power steering gear and pump assemblies are leakage checked before shipment. However, occasionally oil seepage may occur from the gear or pump other than from the seal areas. If this type of leakage is found, replace the leaking part.

Individual Leakage Breakdown

The following diagrams have been prepared to show the potential areas of leakage. If leakage occurs in the areas shown, replace the part listed.

Gear (Fig. 3B-15)

Pay particular attention to the exact source of leakage in this area. Due to the closeness of the various seals, the wrong diagnosis will result in an ineffective repair.

Action to be taken

1. Replace adjuster plug "O" ring seal. (Fig. 3B-15 View A-1)
2. Replace dust and stub shaft seals. (Fig. 3B-15 View A-2)
3. Replace rotary valve assembly. (Fig. 3B-15 View A)
4. Seat ball flush with punch and restake. If seepage persists, replace housing. (Fig. 3B-15 View A-4)
5. Replace both pitman shaft seals. (Fig. 3B-15 View B)
6. Replace end plug "O" ring seal. (Fig. 3B-15 View C)
7. Tighten nut to 35 foot-pounds. Replace nut if leakage persists.

Hydraulic Brake Booster Leakage: See page 5-57. Hydro-Boost Leak Diagnosis. (Fig. 3B-15 View D-1)

8. Tighten side cover screws to 45 foot-pounds. Replace side cover seal if leakage persists. (Fig. 3B-15 View D-8)
9. If leakage persists upon tightening the fitting nut to specified torque replace brass connector and reface hose tube flare. If leakage is due to damaged threads (cross threaded), replace brass connector. Repair fitting nut or replace hose as required. If housing threads are badly stripped, replace housing. (Fig. 3B-15 View E)

Pump (Fig. 3B-16)

Action to be taken

10. Tighten hose fitting nut to specified torque. If leakage persists, replace discharge fitting and reface hose tube flare or replace hose as required.
11. Tighten fitting to specified torque. If leakage persists, replace both "O" ring seals.
12. Replace reservoir "O" ring.
13. Replace pump shaft seal.
14. Bent or cracked reservoir, replace reservoir.
15. Check oil level. If leakage persists with the correct fluid level and the cap tight, replace the cap.

STEERING GEAR AND PUMP DIAGNOSIS CHART

CONDITION	CAUSE	CORRECTION
Hissing noise in steering gear. (On the Eldorado hydraulic brake booster, a hiss noise will be noticed whenever the brake pedal is depressed heavily. This is normal and in no way affects steering.)	There is some noise in all power steering systems. One of the most common is a hissing sound most evident at standstill parking. There is no relationship between this noise and performance of the steering. "Hiss" may be expected when steering wheel is at end of travel or when slowly turning at standstill.	Slight "hiss" is normal and in no way affects steering. Do not replace valve unless "hiss" is extremely objectionable. A replacement valve will also exhibit slight noise and is not always a cure for the objection. Investigate clearance around flexible coupling rivets. Be sure steering shaft and gear are aligned so flexible coupling rotates in a flat plane and is not distorted as shaft rotates. Any metal-to-metal contacts through flexible coupling will transmit valve "hiss" into passenger compartment through the steering column.
Rattle or chuckle noise in steering gear.	Gear loose on frame. Steering linkage looseness. Loose pitman shaft over center adjustment. Pressure hose touching other parts of car. NOTE: A slight rattle may occur on turns because of increased clearance off the "high point." This is normal and clearance must not be reduced below specified limits to eliminate this slight rattle. Loose pitman arm.	Check gear-to-frame mounting screws. Tighten screws to specified torque. Check linkage pivot points for wear. Replace if necessary. Adjust to specifications. Adjust hose position. Tighten pitman arm to specifications.
Squawk noise in steering gear when turning or recovering from a turn.	Dampener "O" ring on gear valve spool cut or hardened.	Replace dampener "O" ring.
Chirp noise in steering pump. Belt squeal (Particularly noticeable at full wheel travel and stand still parking). Growl noise in steering pump.	Loose belt. Loose belt. Excessive back pressure in hoses or steering gear caused by restriction.	Adjust belt tension to specification. Adjust belt tension to specification. Locate restriction and correct. Replace part if necessary.
Growl noise in steering pump (Particularly noticeable at standstill parking).	Scored pressure plates, thrust plate or rotor. Extreme wear of cam ring.	Replace parts, disassemble gear and clean. Flush hoses. Replace parts, disassemble gear and clean. Flush Hoses.
Groan noise in steering pump.	Low fluid level. Air in the fluid. Poor pressure hose connection.	Fill reservoir to proper level. Tighten connector to specified torque. Bleed system by operating steering from right to left -- full turn.

STEERING GEAR AND PUMP DIAGNOSIS CHART (Cont'd.)

CONDITION	CAUSE	CORRECTION
Rattle noise in steering pump.	Vanes not installed properly.	Install properly.
	Vanes sticking in rotor slots.	Free up by removing burrs, varnish or dirt.
Swish noise in steering pump.	Malfunctioning flow control valve.	Replace part.
Whine noise in steering pump.	Pump shaft bearing scored.	Replace housing and shaft. Disassemble gear and clean. Flush hoses.
Poor return of steering wheel to center.	Lack of lubrication in linkage and spherical joints.	Lube linkage and spherical joints. Check seals for damage and replace if necessary.
	Lower coupling flange rubbing against steering gear adjuster plug.	Loosen pinch bolt and assemble properly.
	Steering gear to column misalignment. (Eldorado & Seville only)	Align steering column.
	Tires not properly inflated.	Inflate to specified pressure.
	Improper front wheel alignment.	Check and adjust as necessary.
		With front wheels still on alignment pads of front-end machine, disconnect pitman arm of linkage from pitman shaft of gear. Turn front wheels by hand. If wheels will not turn or turn with considerable effort, determine if linkage or spherical joints are binding.
	Steering linkage binding.	Replace pivots.
	Upper coupling binding.	Replace upper coupling.
	(Turn steering wheel and listen for internal rubbing in column - check causes listed and correct as directed.)	
	Steering wheel rubbing against directional signal housing.	Adjust steering jacket.
	Tight or frozen steering shaft bearings.	Replace bearings.
	Rubber spacer binding in shift tube.	Make certain spacer is properly seated. Lubricate inside diameter with silicone.
	Sticky or plugged spool valve.	Remove and clean or replace valve.
	Steering gear adjustments over specifications.	Check adjustment with gear out of vehicle. Adjust as required.
	Tight or frozen U-joint or upper coupling in steering shaft.	Replace U-joint or upper coupling.
(Keep in mind road condition and wind. Test car on flat road going in both directions)	Front end misaligned. Radial tire lateral force (conicity)	Adjust to specifications. (Usually excess cross-caster) Rotate tires to equalize conicity force (see section 3E).
	Unbalanced steering gear valve. NOTE: If this is cause, steering effort will be very light in direction of lead and heavy in opposite direction.	Replace valve.

STEERING GEAR AND PUMP DIAGNOSIS CHART (Cont'd.)

CONDITION	CAUSE	CORRECTION
Momentary increase in effort when turning wheel fast to right or left.	Low fluid level in pump.	Add power steering fluid as required.
	Pump belt slipping.	Tighten or replace belt.
	High internal leakage.	Check pump pressure. (See pump pressure test).
	Insufficient pump flow to gear.	Replace discharge fitting, check for restriction in hose or gear inlet.
Steering wheel surges or jerks when turning with engine running especially during parking.	Low fluid level.	Fill as required.
	Loose pump belt.	Adjust tension to specification.
	Steering linkage hitting engine oil pan at full turn.	Correct clearance.
	Insufficient pump pressure.	Check pump pressure. (See pump pressure test). Replace relief valve if necessary.
	Sticky flow control valve.	Inspect for varnish or damage, replace if necessary.
Excessive wheel kickback or loose steering.	Air in system.	Add power steering fluid to pump reservoir and bleed by operating steering. Check hose connectors for proper torque and adjust as required.
	Steering gear loose on frame.	Tighten attaching screws to specified torque.
	Steering gear flexible coupling loose on shaft or rubber disc mounting screws loose.	Tighten flange pinch bolts to specified torque, if serrations are not damaged. Tighten upper flange to coupling nuts to specified torque.
	Steering linkage joints worn enough to be loose.	Replace loose pivots.
	Front wheel bearings incorrectly adjusted or worn.	Adjust bearings or replace with new parts as necessary.
	Worn poppet valve (Gear).	Replace poppet valve.
	Loose thrust bearing preload adjustment. (Gear)	Adjust to specification with gear out of vehicle.
	Excessive "over-center" lash.	Adjust to specification with gear out of vehicle.
Hard steering or lack of assist. NOTE: If previous checks do not reveal cause of hard steering, follow the procedure below to determine fault.	Loose pump belt.	Adjust belt tension to specification.
	Low fluid level in reservoir. NOTE: Low fluid level will also result in excessive pump noise.	Fill to proper level. If excessively low, check all lines and joints for evidence of external leakage. Tighten loose connectors to specified torque.
	Steering gear to column misalignment.	Align steering column.
	Lower coupling flange rubbing against steering gear adjuster plug.	Loosen pinch bolt and assemble properly.
	Tires not properly inflated.	Inflate to recommended pressure.
	Further possible causes could be: Sticky flow control valve. Insufficient pump pressure out Excessive internal pump leakage. Excessive internal gear leakage.	In order to diagnose conditions listed below, a test of the entire power steering system is required.

STEERING GEAR AND PUMP DIAGNOSIS CHART (Cont'd.)

CONDITION	CAUSE	CORRECTION
Foaming milky power steering fluid, low fluid level, and possible low pressure.	Air in the fluid, and loss of fluid due to internal pump leakage causing overflow.	Check for leak and correct. Bleed system. Extremely cold temperatures will cause system aeration should the oil level be low. If oil level is correct and pump still foams, remove pump from vehicle and separate reservoir from housing. Check welsh plug and housing for cracks. If plug is loose or housing is cracked, replace housing.
Low pressure due to steering pump.	Flow control valve stuck or inoperative.	Remove burrs or dirt or replace.
	Pressure plate not flat against cam ring.	Correct.
	Extreme wear of cam ring.	Replace parts. Disassemble gear and clean. Flush hoses.
	Scored pressure plate, thrust plate or rotor.	Replace parts (If rotor, replace with rotating group kit), disassemble gear and clean.
	Vanes not installed properly.	Install properly.
	Vanes sticking in rotor slots.	Free-up by removing burrs, varnish or dirt.
	Cracked or broken thrust or pressure plate.	Replace part.
Low pressure due to steering gear.	Pressure loss in cylinder due to worn piston ring or scored housing bore.	Remove gear from car for disassembly and inspection of ring and housing bore.
	Leakage at valve rings, valve body to worm seal.	Remove gear from car for disassembly and replace seals.

ON CAR SERVICE

The following caution applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology:

CAUTION: *See "CAUTION" on page 3B-20 of this section.*

CAUTION: *This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to asure proper retention of this part.*

Checking Fluid Level

When making a complete fluid change, use GM Part No. 1050017 special power steering fluid or equivalent.

CAUTION: *Power steering fluid and brake fluid cannot be mixed. If brake seals contact steering fluid or steering seals contact brake fluid, seal damage may result.*

1. Run engine and turn gear from lock to lock three or four times, then shut engine off with gear in left turn position. Remove reservoir filler cap and check oil in reservoir. If the fluid appears milky, air is present. Continue to turn gear from lock to lock until fluid is clear. Check oil level on dip stick. Level should be half-way between "hot" and "cold" marks when fluid is approximately 70°C (150°F) (reservoir is hot to touch).

2. If oil level when hot (approximately 21°C-70°F) is below "cold" mark add special power steering fluid until level is half-way between the "hot" and "cold" marks on dipstick and reinstall filler cap.

NOTE: At room temperature (approximately 21°C-70°F) or before starting the engine, the fluid level should be between the "cold" and "add" marks on the dipstick. After high speed driving under high ambient conditions, fluid will be at the "hot" mark at approximately 121°C (250°F) fluid temperature.

3. When checking fluid level after making a complete fluid change, air must be bled from the system. Proceed as follows:

a. Install steering fluid in system. Fluid level in the pump must be at base of reservoir neck.

b. Raise front of car and with engine off, turn wheels all the way to the left.

c. Add power steering fluid to "Add" mark on dipstick.

d. Crank engine for one second or less without starting engine.

e. Add fluid if necessary to "Add" mark on dipstick.

f. Start engine and recheck fluid level. Add fluid if necessary to "Add" mark on dipstick.

g. Bleed system by turning wheels from side to side without hitting stops. Maintain fluid level just above internal pump casting. Fluid with air in it will have a light tan appearance. This air must be eliminated from fluid before normal steering action can be obtained. On Eldorado, depress the brake pedal several times to clear air from the booster.

h. Return wheels to center position and continue to run engine for two or three minutes, then shut engine off.

i. Road test car to make sure steering functions normally and is free from noise.

j. Recheck fluid level as described in step 1 making sure fluid is at the specified level.

Checking Pump Pressure

1. Disconnect pressure hose at union of pump, use a small container to catch any fluid which might leak.

2. Connect a spare pressure hose to pump union.

3. Using pressure gage, J-5176-1, adapter fitting, J-22326, connect gage to both hoses.

4. Open hand valve on gage.

5. Start engine, allow system to reach operating temperatures and check fluid level adding any fluid if required. When engine is at normal operating temperature, the initial pressure read on the gage (valve open) should be in the 552-862 kPa (80-125 PSI) range. Should this pressure be in excess of 1379 kPa (200 PSI), check the hoses for restrictions and the poppet valve for proper assembly.

6. Close gate valve fully three times. Record the highest pressures attained each time.

CAUTION: *Do not leave valve fully closed for more than five seconds as the pump could be damaged internally.*

7. If the pressures recorded are between 9825-10170 kPa (1425-1475 PSI) (on Seville, 9308-9998 kPa or 1350-1450 PSI) and the range of readings are within 207 kPa (30 PSI), the pump is functioning within specifications.

8. If the pressures recorded are high, but do not repeat within 207 kPa (30 PSI), the flow controlling valve is sticking. Remove the valve, clean it and remove any burrs using crocus cloth or a fine hone. If the system contains some dirt, flush it. If it is exceptionally dirty, both the pump and the gear must be completely disassembled, cleaned and reassembled before further usage.

9. If the pressures recorded are constant, but below the low listed specification, replace the flow control valve and recheck. If the pressures are still low, replace the rotating group.

10. If the pump checks to specification, leave the valve open and turn (or have turned) the steering wheel into both corners. Record the highest pressures and compare with the maximum pump pressure recorded. If this pressure cannot be built in either (or one) side of the gear, and is below specification, the gear is leaking internally and must be disassembled and repaired.

11. Shut off engine, remove testing gage, spare hose, reconnect pressure hose, check fluid level or make needed repairs. Run engine and recheck fluid level as outlined in column 1 on this page.

WARNING: WHEN HOSES ARE RECONNECTED BE SURE HOSES DO NOT TOUCH OTHER ENGINE COMPARTMENT COMPONENTS.

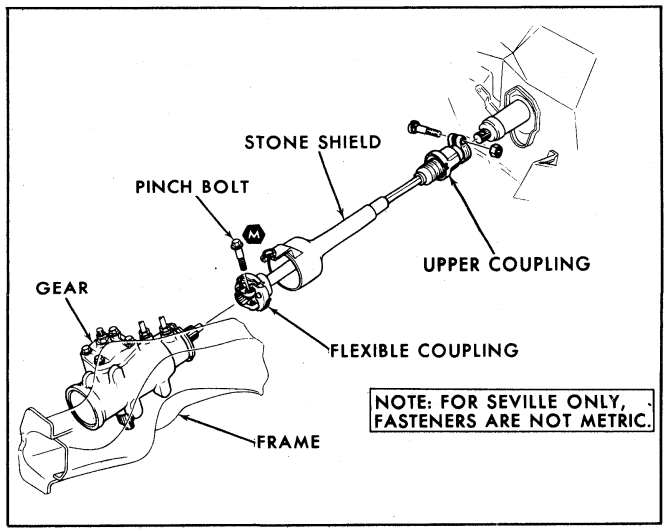


Fig. 3B-17 Intermediate Shaft Assembly

Intermediate Shaft - Exc. Eldorado (Fig. 3B-17)

a. Removal

1. Disengage stone shield from steering gear return hose nut.
2. Remove pinch bolt from flexible coupling.
3. Remove bolt and nut securing upper coupling to steering shaft.
4. Pull up on intermediate shaft to remove from steering gear stub shaft, then push down until coupling is removed from steering shaft.
5. Remove intermediate shaft.

b. Installation

1. Install intermediate shaft on steering shaft and install bolt and nut securing upper coupling to steering shaft and tighten to 60 N·m (45 foot-pounds).
2. Push down on intermediate shaft to install on steering gear stub shaft. Coupling must be fully seated so splines are not visible between coupling and gear.
3. Install pinch bolt in flexible coupling and torque to 40 N·m (30 foot-pounds).
4. Engage stone shield on steering gear return hose nut.

Lower Steering Shaft (Fig. 3B-18)

a. Removal

1. Remove two plastic retainers securing flexible coupling shield and remove shield.
2. Remove two nuts and lockwashers and bolts holding flexible coupling together.
3. Remove screw holding flexible coupling to steering gear and shift portion of flexible coupling on gear away from flange on shaft.
4. Disengage flange on shaft from flexible coupling.
5. Remove screw securing universal joint to lower steering shaft and remove shaft from universal joint.

b. Installation

CAUTION: *See "CAUTION" on page 3B-20 when performing Steps 1, 2, 5 and 6.*

1. Insert lower steering shaft into universal joint aligning split in universal joint with flat on shaft. Secure with screw, tightened to 80 foot-pounds.
2. Engage flange on shaft to flexible coupling on gear and secure with two bolts, lockwashers and nuts. Tighten nuts to 20 foot-pounds.
3. Install screw securing flexible coupling to steering gear. There should be at least .040 inch clearance between coupling and adjuster plug. Tighten screw to 30 foot-pounds.
4. Install flexible coupling shield and secure with two plastic retainers.

Steering Pump Fluid Cooler Tube (Fig. 3B-19)

a. Removal

1. Position container under fluid cooler to catch fluid that will escape when hose and clamp are removed.
2. Remove clamp securing return hose to fluid cooler tube and position hose to prevent further leakage of fluid.

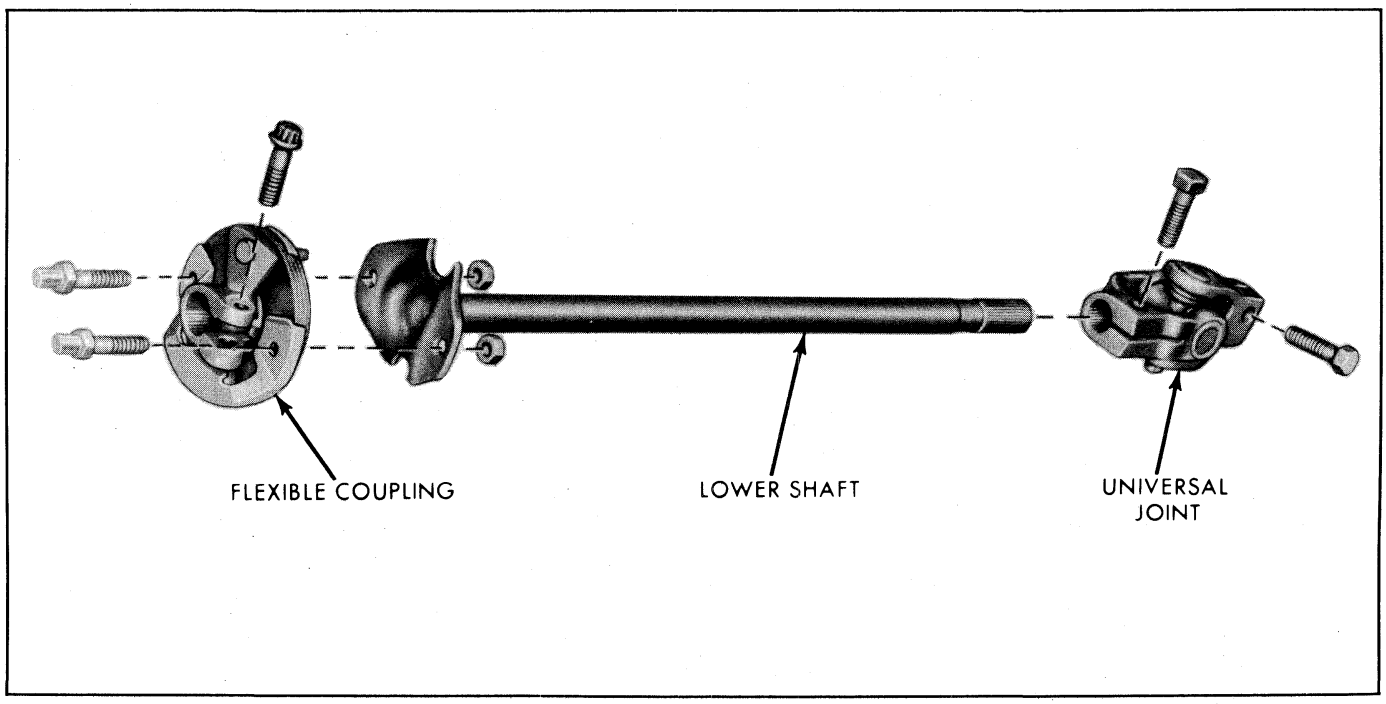


Fig. 3B-18 Lower Steering Shaft (Eldorado)

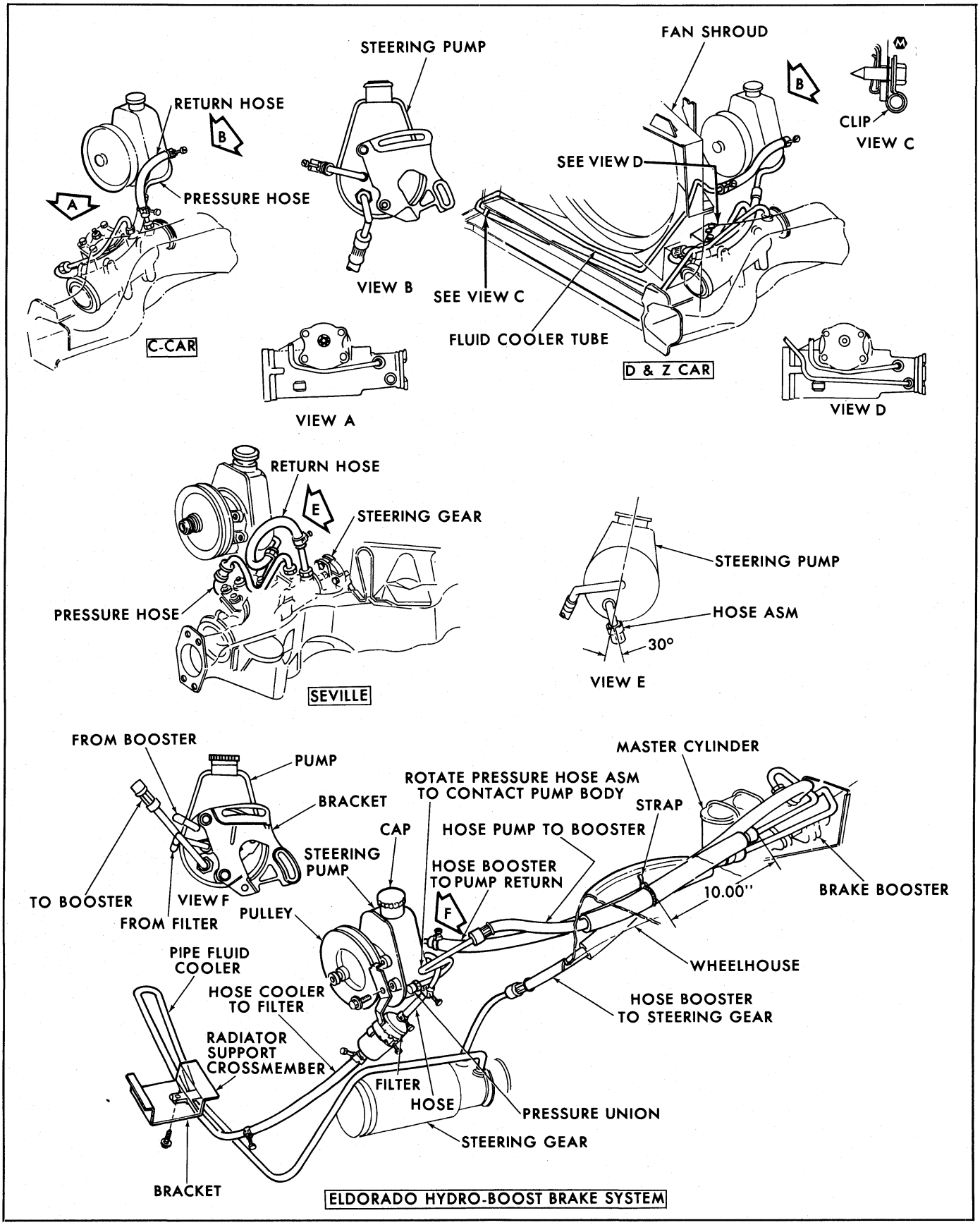


Fig. 3B-19 Power Steering Hose Routings

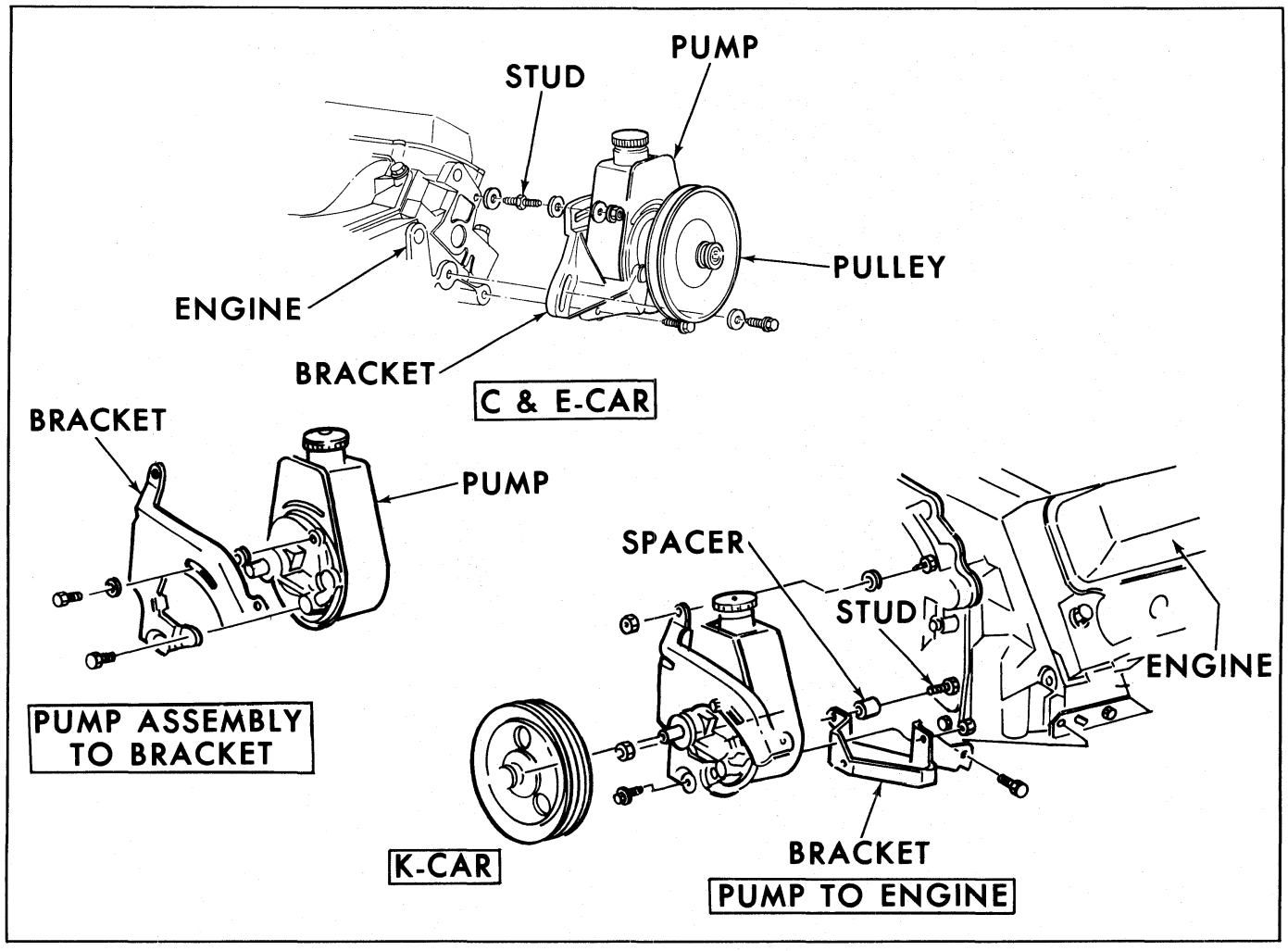


Fig. 3B-20 Steering Pump Mounting

3. Separate return line from gear and plug opening at gear to prevent loss of fluid and entrance of dirt into system.

4. Remove one screw securing cooler tube to bottom of radiator support crossmember and remove cooler tube.

b. Installation

1. Position new cooler tube, remove plug in gear and connect new cooler. Tighten nut finger tight.

2. Secure cooler to bottom of radiator support crossmember and install one screw. Tighten to 10 N·m (60 inch-pounds).

3. Tighten nut to gear to 40 N·m (30 foot-pounds).

4. Install hose on return line and on longest end of "trombone" and secure each end with clamp. Tighten to 2 N·m (20 inch-pounds).

5. Bleed and refill steering system with power steering fluid.

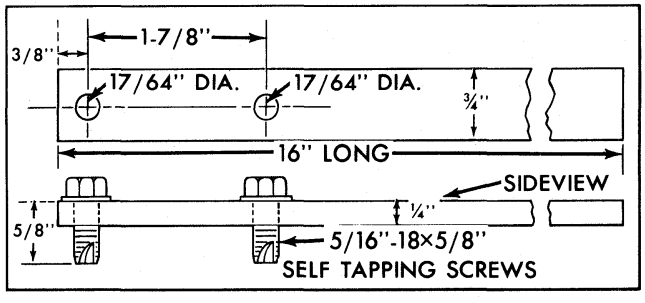


Fig. 3B-21 Belt Tensioning Tool

Steering Pump C-Car and Eldorado (Fig. 3B-20)

a. Removal

1. Disconnect pressure and return lines from pump and filter inlet. Plug all openings to prevent loss of fluid and entrance of dirt into system.

2. Remove nut securing pump mounting bracket to cylinder head stud.

3. Remove adjusting screw securing mounting bracket to front of cylinder block.

4. Remove drive belts from pulley.

5. Remove bottom pivot screw and steering pump with bracket and filter attached.

b. Installation

1. Position steering pump, with bracket and filter attached, to engine and loosely install bottom pivot screw securing pump and bracket to front of cylinder block.

2. Position drive belts on pulley. Do not tension belts at this time.

3. Loosely install adjusting screw securing mounting bracket to front of cylinder block.

4. Loosely install nut securing pump mounting bracket

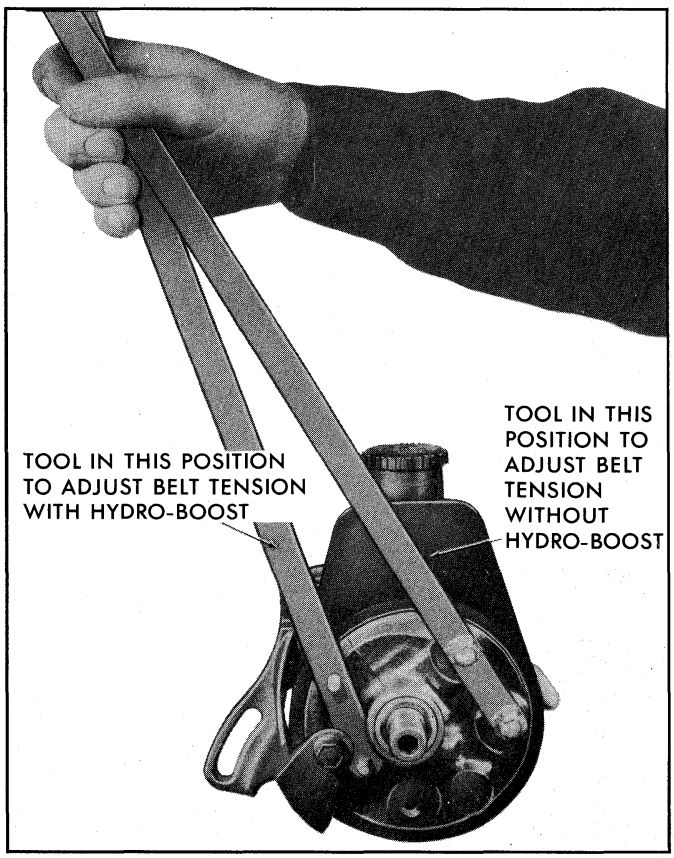


Fig. 3B-22 Belt Tensioning Tool Location

to cylinder head stud.

5. Adjust belt tension as follows:

a. Place Belt Tension Gage, J-23600, on drive belt midway between pulleys at location B, shown in Section 6B, Fig. 6B-15.

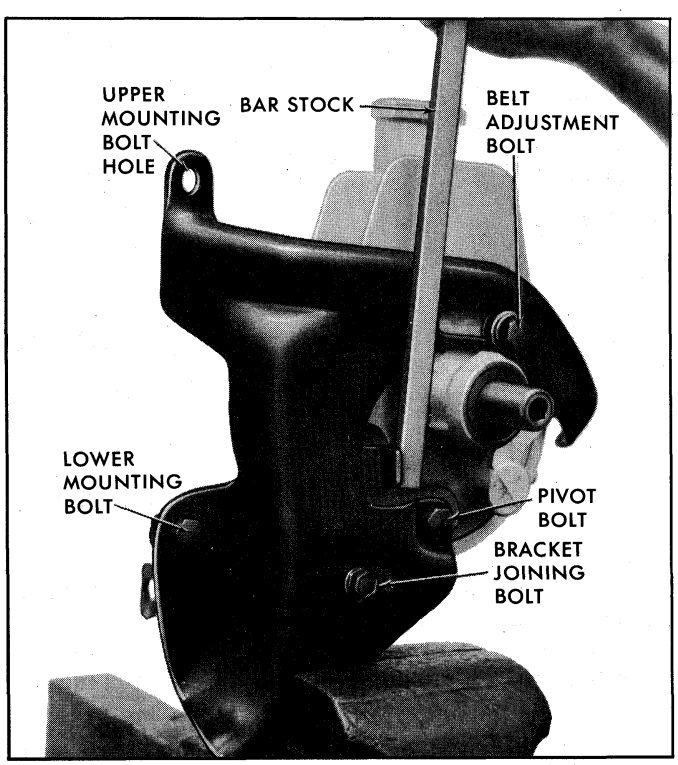


Fig. 3B-23 Belt Tightening Tool (Seville)

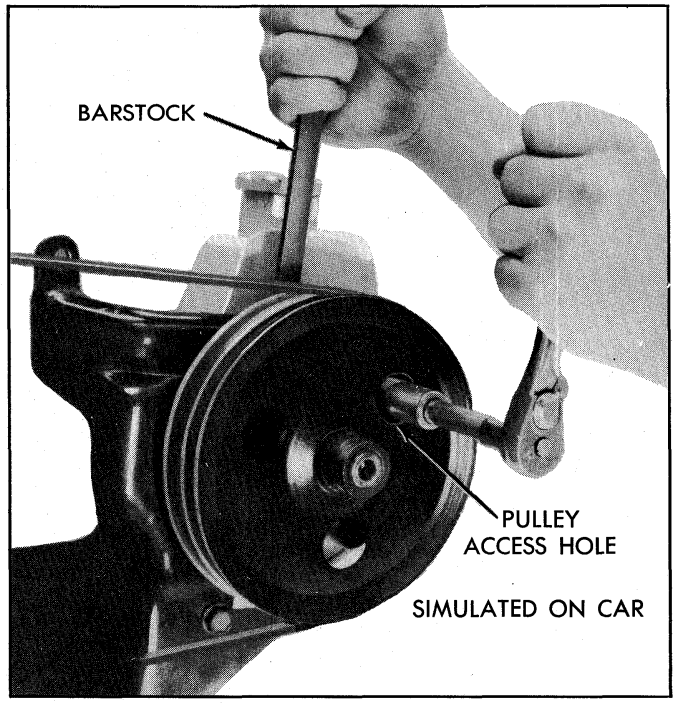


Fig. 3B-24 Tightening Steering Pump Belt (Seville)

b. Pull pump toward outside of car until correct belt tension is reached on belt tension gage, using the tool illustrated in Fig. 3B-21 which can be made from bar steel stock and self-tapping screws. This tool fits into the accommodating holes in the front face of the pump casting behind the pulley, Fig. 3B-22.

CAUTION: *Do not pry on reservoir or pull on filler neck.*

NOTE: Proper tension for a new belt is 125 pounds, and 90 pounds for a belt that has been previously tensioned.

c. Tighten all mounting and adjusting bolts and nuts to 25 foot-pounds.

6. Unplug fittings and connect high pressure line at rear of pump. Tighten fitting to 40 foot-pounds.

7. Unplug fittings and install return hose(s) on fitting at side of pump or, if Eldorado, to filter inlet and secure with clamp. Tighten clamp to 20 foot-pounds.

8. Eldorado only: Secure filter bracket to face of pump with one screw.

9. Check fluid level as described on page 3B-20.

10. Bleed steering gear as described on page 3B-20.

Steering Pump - Seville (Fig. 3B-20)

a. Removal

1. Remove generator as described in Section 6D.

2. Remove generator adjusting bracket.

3. Disconnect pressure and return lines from pump. Plug all openings to prevent loss of fluid and entrance of dirt into system.

4. Loosen pump adjusting bolt, pivot bolt and pivot nut. Remove belt from pulley, Fig. 3B-23.

5. Remove two nuts and spacer securing pump mounting bracket to water pump and timing chain cover. Remove bracket joining bolt and remove pump with bracket attached, Fig. 3B-23.

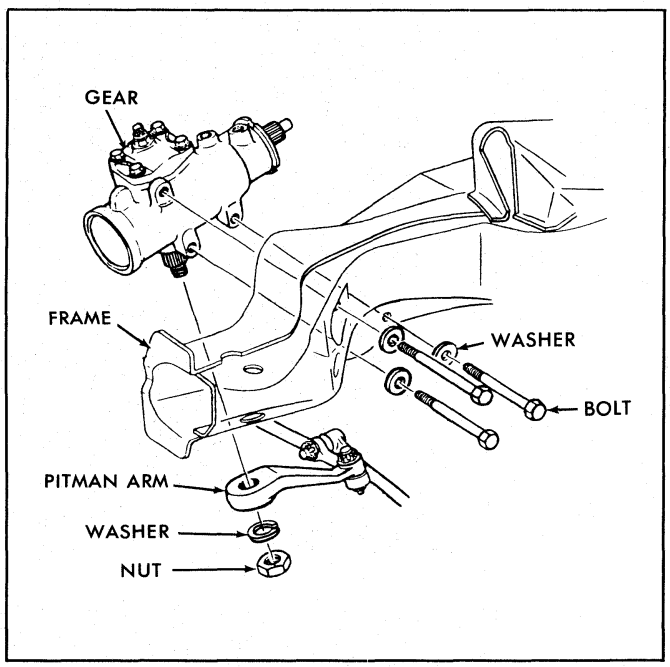


Fig. 3B-25 Steering Gear Installation

b. Installation

1. Position steering pump, with bracket attached, on water pump and timing chain cover.

2. Install spacer between timing chain cover and mounting bracket. Install the three nuts securing pump. Tighten lower nut at spacer to 30 foot-pounds. Tighten upper nut and joining bolt to 20 foot-pounds, Fig. 3B-23.

3. Install generator adjusting bracket.

4. Position drive belts on pulley.

5. Adjust steering pump belt tension as follows:

a. Place Belt Tension Gage, J-23600, on drive belt midway between pulleys at location "B", shown in Section 6B, Fig. 6B-15.

b. Pull pump toward outside of car until correct belt tension is reached on Belt Tension Gage, using the tool illustrated in Fig. 3B-23, which can be made from bar steel stock 1/4" x 1/2" x 24".

CAUTION: *Do not pull or pry on pump reservoir.*

NOTE: Proper tension for a new belt is 125 pounds, and 90 pounds for a belt that has been previously tensioned.

6. Tighten steering pump adjustment bolt through pulley access hole, to 30 foot-pounds, Fig. 3B-24.

7. Tighten rear pivot nut from underside of car to 30 foot-pounds.

NOTE: Front pivot bolt should be tightened to approximately 30 foot-pounds using a 9/16" 12 pt. box end wrench.

8. Unplug fitting and connect high pressure line at rear of pump. Tighten fitting to 40 foot-pounds.

9. Unplug fitting and install return hose on fitting at side of pump and secure with clamp. Tighten clamp to 17 inch-pounds.

10. Install generator as described in Section 6D.

11. Tighten generator belt tension as described in Section 6B.

12. Check fluid level as described on page 3B-20.

13. Bleed steering gear as described on page 3B-20.

Steering Gear Removal (Fig. 3B-25)

a. Removal

1. Position container under gear to catch dripping fluid.

2. Disconnect pressure and return lines at steering gear. Plug all openings to prevent loss of fluid and entrance of dirt into system.

3. From underhood, disconnect stone shield from return pipe.

4. Remove pinch bolt and disconnect flex coupling from gear.

5. Raise car.

6. Remove one nut and lockwasher, break pitman arm loose from pitman shaft using pitman arm puller, J-9172, and remove pitman arm from steering gear.

NOTE: Residual torque on nut after driving may range from 10-200 foot-pounds.

7. Remove three screws and flat washers that hold gear to side rail, and lower gear assembly down and out of car.

b. Installation

CAUTION: *See "CAUTION" on page 3B-20 of this section for steps 1, 2, and 5.*

1. Position steering gear to frame side rail so that gear aligns with intermediate shaft and three frame holes. Secure gear to side rail with three mounting bolts. Tighten to 70 foot-pounds.

NOTE: If mounting threads are stripped, do not repair. Replace housing.

2. Position pitman arm on pitman shaft and install lockwasher and nut. Tighten nut to 185 foot-pounds to seat arm on shaft.

3. Lower car.

4. Unplug openings and connect pressure and return lines to steering gear. Tighten fittings to 30 foot-pounds.

5. Install flex coupling on gear stub shaft, aligning the shaft. Install pinch bolt and when properly seated, tighten to 40 N·m (30 foot-pounds).

Steering Gear–Eldorado (Fig. 3B-26)

a. Removal

1. Disconnect pressure and return lines from gear. Cap or tape line fittings.

2. Raise car.

3. Remove cotter pin and nut at pitman arm.

4. Disconnect pitman arm from intermediate rod using puller, J-24319, Fig. 3B-10.

5. Remove two plastic retainers securing flexible coupling shield to frame side rail and remove shield. Discard retainers.

6. Remove two nuts and lockwashers holding flexible coupling together.

7. Remove three screws that hold steering gear to frame side rail, move steering gear forward and downward out of car.

8. Working on bench, remove pitman shaft nut and lockwasher and remove pitman arm from pitman shaft using pitman arm puller, J-6632.

NOTE: If mounting threads are stripped, do not repair. Replace housing.

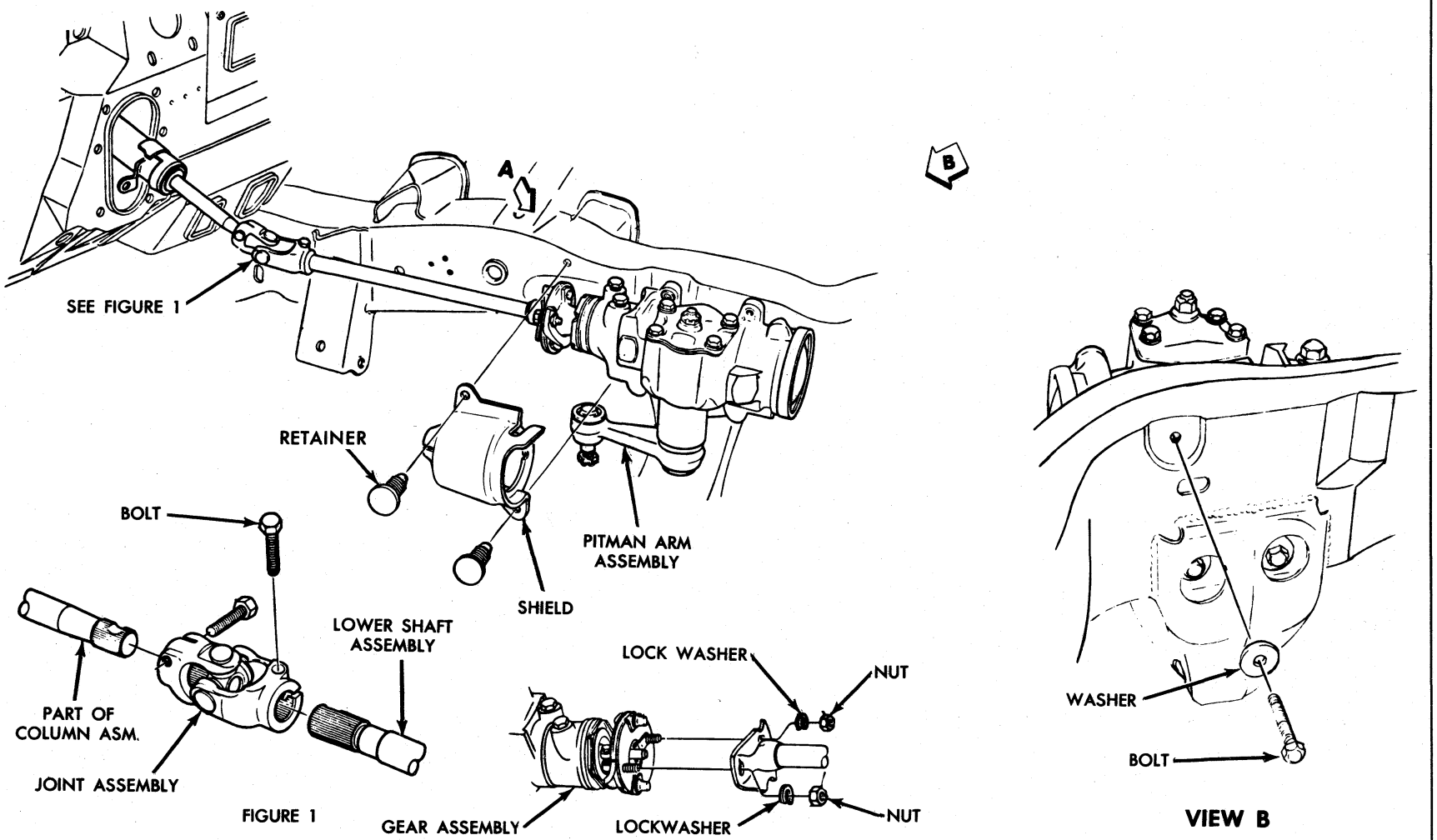


Fig. 3B-26 Steering Gear Installation (Eldorado)

b. Installation

CAUTION: *See "CAUTION" on page 3B-20 when performing Steps 1, 2, and 4.*

1. place pitman arm on pitman shaft and install lockwasher and nut on pitman shaft. Tighten nut to 185 foot-pounds.

2. Position steering gear on car and secure to frame side rail with three screws and flat washers. Tighten screws to 70 foot-pounds.

3. Install nuts and lockwashers that hold flexible coupling together. Tighten nuts to 20 foot-pounds.

4. Install flexible coupling shield to frame side rail and secure with two new plastic retainers.

5. Install intermediate rod to pitman arm and secure with nut and cotter pin. Tighten nut to 60 foot-pounds and install cotter pin.

NOTE: If cotter pin cannot be installed, tighten nut to next hole location and install cotter pin.

6. Uncap pressure and return line hoses and connect to steering gear. Tighten nuts to 30 foot-pounds.

7. Check fluid as outlined on page 3B-20.

WARNING: WHEN HOSES ARE RECONNECTED, BE SURE HOSES DO NOT TOUCH WHEELHOUSING OR HOSES MAY BECOME CHAFED AND RUPTURE.

UNIT REPAIR

Intermediate Shaft and/or Stone Shield Replacement (Exc. Eldorado) Fig. 3B-27

1. Remove intermediate shaft as described on page 3B-21.

2. Extend shaft to full length by pulling out on both couplings. Mark both couplings on one side to aid reassemble.

NOTE: This step is only useful when neither shaft needs replacing.

3. Separate shaft assembly by pressing through flexible coupling using 3/8" diameter rod, 15" long. Support back of coupling during disassembly (Fig. 3B-28).

4. Remove stone shield.

5. Remove preload spring.

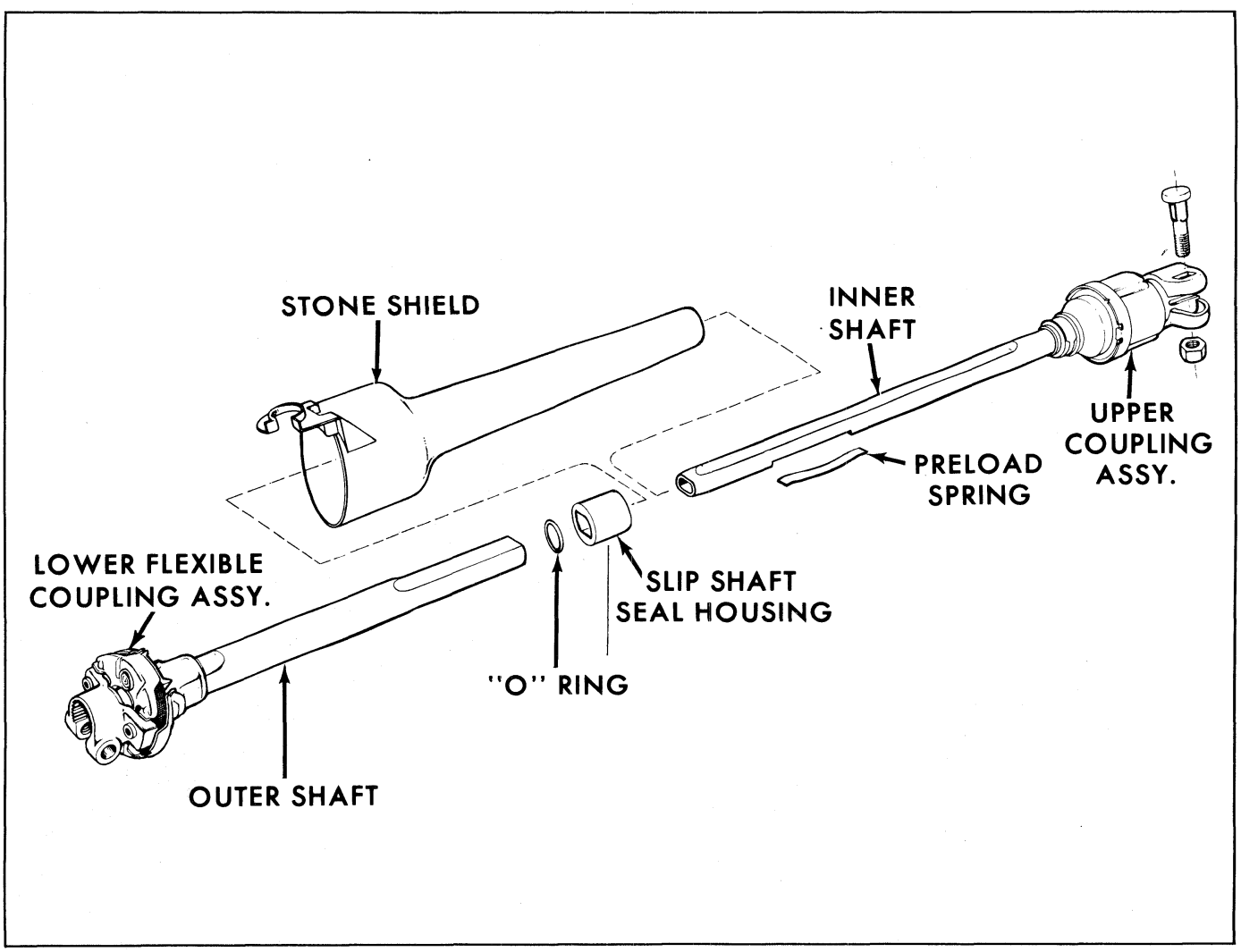


Fig. 3B-27 Intermediate Shaft Disassembly

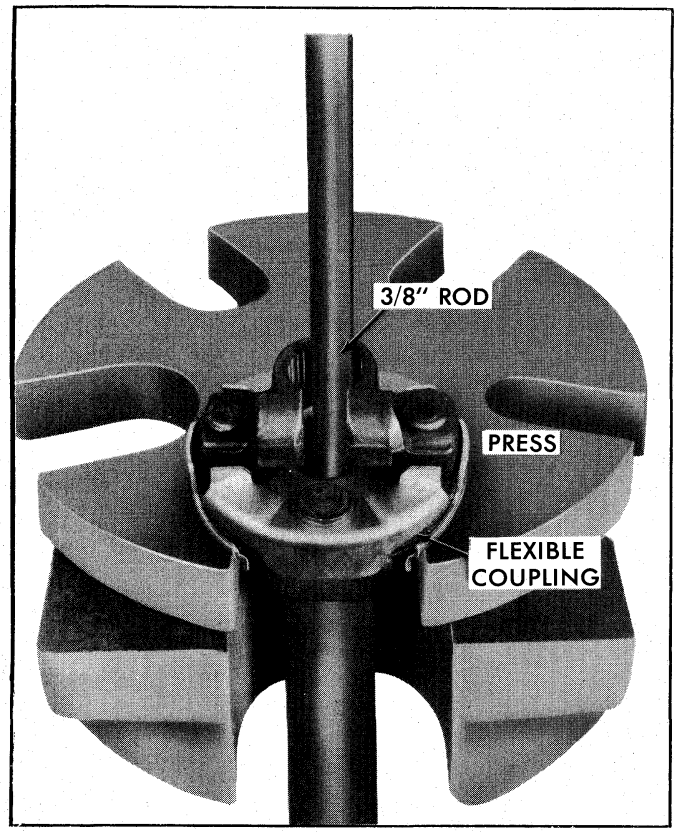


Fig. 3B-28 Separate Shaft Assembly

6. If slip shaft seal housing must be replaced, remove housing and "O" ring by lightly tapping to remove from outer shaft, Fig. 3B-29.

7. If replacing, install new slip shaft seal housing and "O" ring by lightly tapping with plastic hammer until seal housing is seated on outer shaft.

8. Peen end of inner shaft to remove stake marks (Fig. 3B-30).

9. Install preload spring and apply chassis lube to preload spring and shaft (Fig. 3B-31).

10. Install stone shield on outer shaft.

11. While aligning marks on both couplings, install inner shaft into outer shaft. If replacing inner or outer shaft, couplings must be aligned as shown in Fig. 3B-32.

12. Install intermediate shaft as described on page 3B-21.

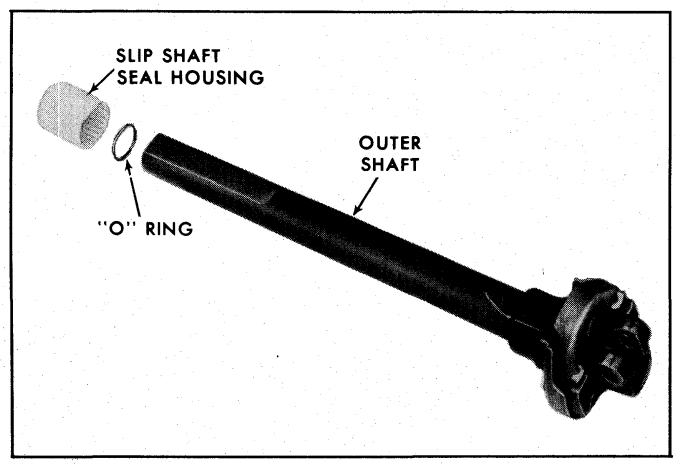


Fig. 3B-29 Slip Shaft Seal Housing

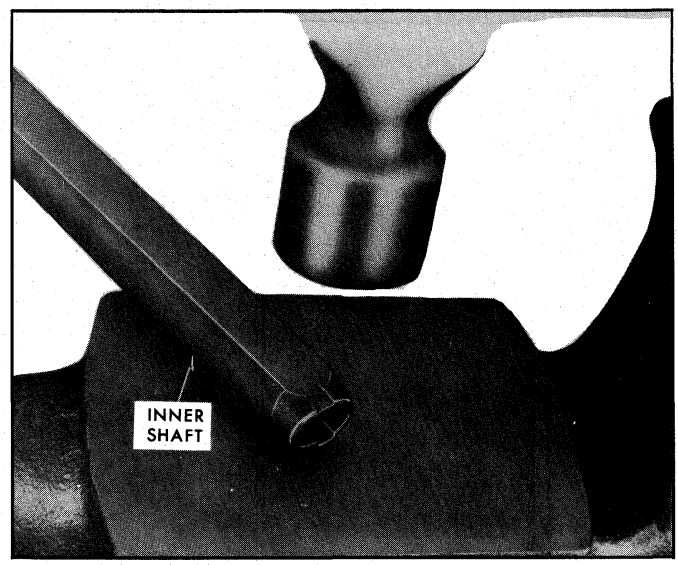


Fig. 3B-30 Remove Stake Marks

Steering Pump Disassembly, Cleaning, Inspection, and Assembly

Disassembly of the major components within the pump must be performed on a clean workbench. The work area, tools, and parts must be kept clean at all times. Refer to Fig. 3B-33 for parts nomenclature and location.

a. Disassembly

1. Remove steering pump and bracket assembly from engine (with filter attached if Eldorado) as described on page 3B-23 (page 3B-24 for Seville).

2a. Eldorado only: loosen clamps holding filter to bracket and short hose to return port. Remove and discard filter.

b. Remove clamp holding short hose to return port and remove hose.

c. Remove single bolt holding filter bracket to front face of pump and remove filter bracket.

5. Clamp mounting bracket in vise.

6. Remove steering pump pulley from shaft using J-25034 steering pump pulley remover, Fig. 3B-34.

CAUTION: *Never remove pulley by pounding it off*

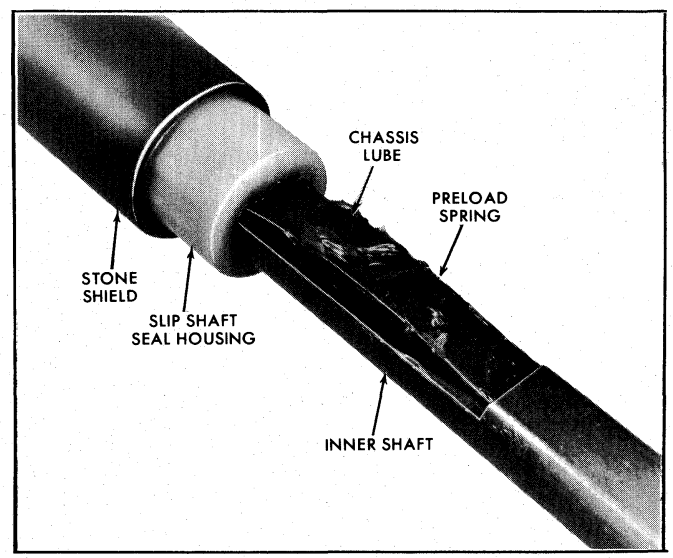


Fig. 3B-31 Assemble Shaft

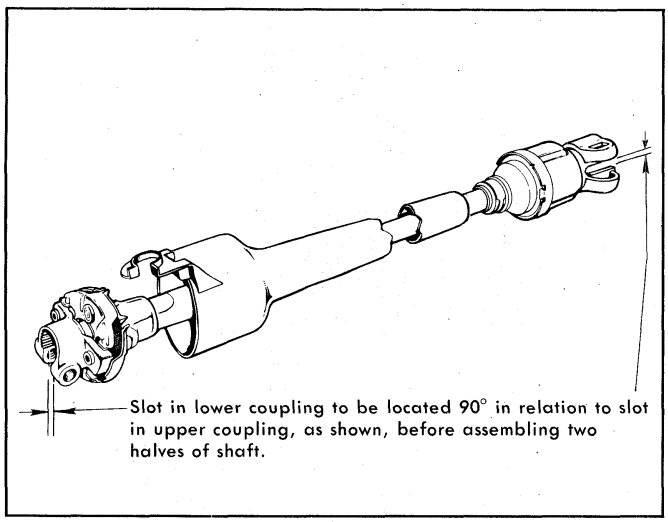


Fig. 3B-32 Coupling Alignment

with a hammer. This could damage pulley as well as snap ring at inner end of the shaft. If pounding pulley inward, pressure plate will be broken; outward, thrust plate will be broken. Complete disassembly of the pump is required for replacement of these parts.

7. Remove bracket from pump.

8. Place pump assembly in vise, shaft down, using flat on housing for one clamping surface. Do not exert excessive force, as this may distort bearing.

9. Remove pressure union and O-ring seal from rear of pump assembly. Discard O-ring seal.

CAUTION: *Spring loaded flow control valve tends to "pop" out when pressure union is removed.*

10. Lift reservoir from pump housing by rocking reservoir up and away from housing.

11. Remove and discard outer pump housing O-ring seal, mounting bolt O-ring seals, and flow control valve opening O-ring seal.

12. Remove magnet from pump housing, Fig. 3B-40.

13. Rotate end plate retaining ring so that one end of ring is over hole in housing. Spring one end of ring with punch to allow screwdriver to be inserted to lift ring out, Fig. 3B-35.

NOTE: Hold hand over retaining ring as end plate is spring loaded and may pop-out.

14. Remove end plate and end plate "O" ring. End plate is spring loaded and will generally raise above the housing, making removal easy. However, if end plate should stick a slight rocking action on top surface will free the plate, Fig. 3B-36.

15. Remove pressure plate spring.

16. Remove pump from vise and invert. Flow control valve and spring will fall free, Fig. 3B-37. Flow control valve is serviced as a unit and should not be disassembled.

NOTE: Clean shaft with crocus cloth if necessary to remove rust and corrosion before removing shaft.

17. Tap very lightly on end of shaft, only until pressure plate falls free, Fig. 3B-38.

18. Remove pressure plate, shaft with rotor and vanes, and thrust plate attached.

19. Remove vanes from rotor, then remove retaining ring from splined end of shaft and remove rotor and thrust plate from shaft. Discard retaining ring.

NOTE: To remove retaining ring, clamp shaft in soft jawed vise, and using a pair of long nose pliers or a screwdriver, pry retaining ring off shaft. Be careful not to damage shaft with vise jaws.

20. Remove pressure plate O-ring seal and end plate O-ring seal from bore of housing and discard.

21. Remove shaft seal by prying out with screwdriver and discard seal.

NOTE: Take care not to damage housing bore.

b. Cleaning and Inspection

Carefully clean all pump parts in non-toxic cleaning

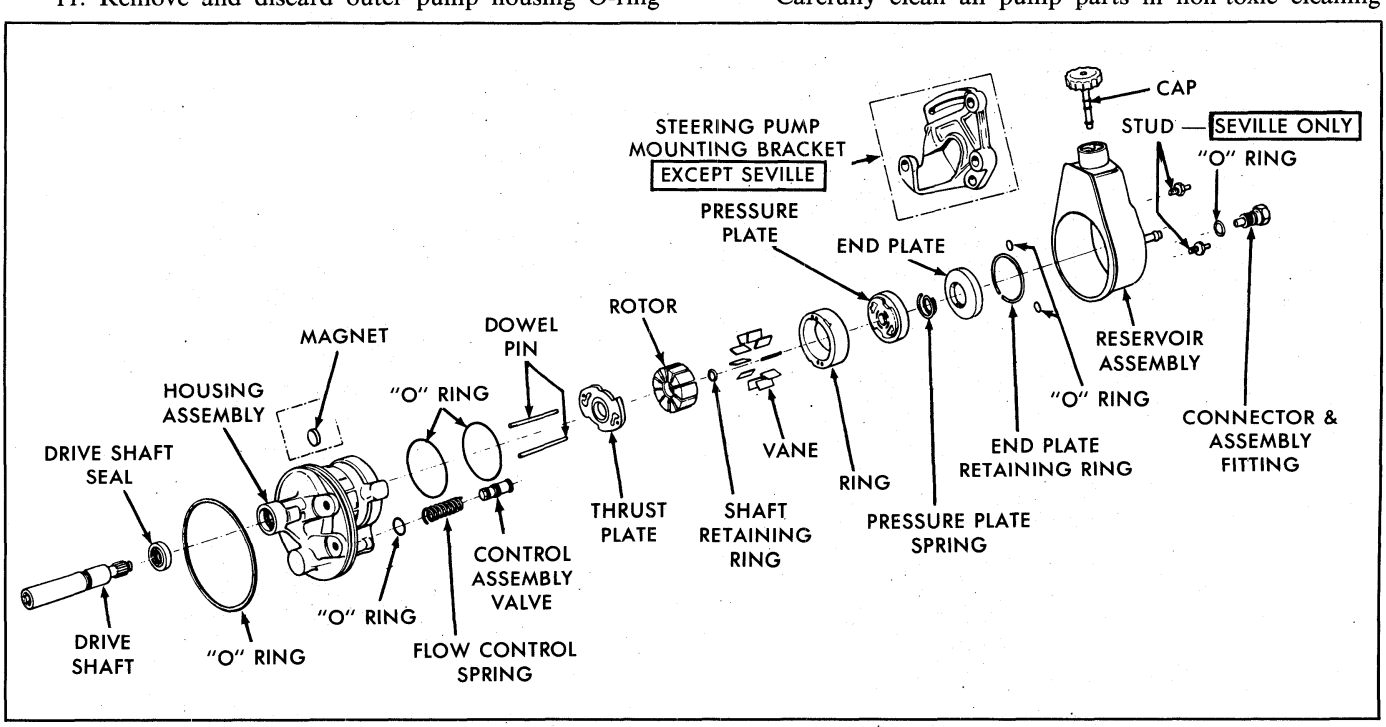


Fig. 3B-33 Steering Pump Disassembled

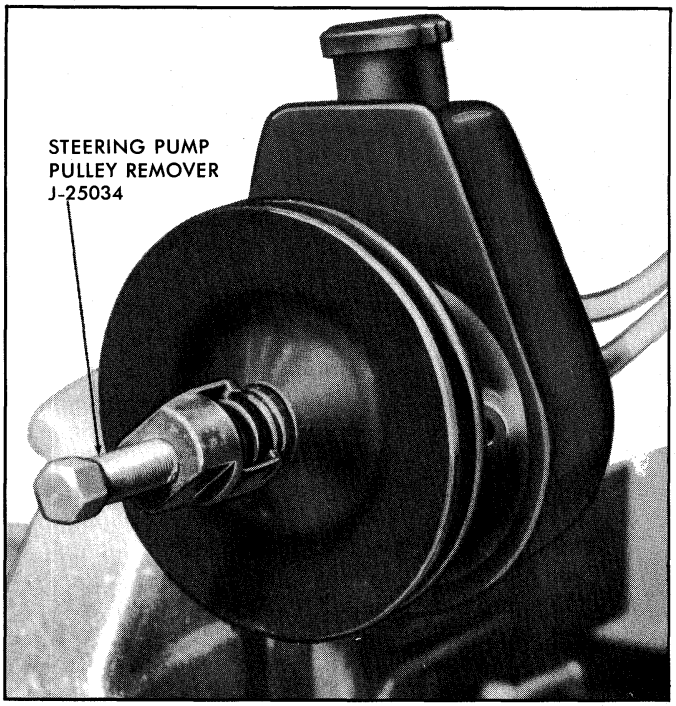


Fig. 3B-34 Pulley Remover

solvent. Remove ferrous material adhering to magnet. Replace any damaged or worn parts.

1. Inspect flow control valve assembly for score marks, wear, burrs, or other damage.

2. Inspect castings for cracks or other visual evidence of damage. Check machined surfaces, especially mating surfaces on O-ring seats, for scratches or butts that might permit leaks. Examine the V-shaped notches at edges of discharge ports on pressure plate. These notches must be clean and undamaged if pump noise is to be avoided, as they cushion the hydraulic shock when each vane passes the port.

3. Inspect cam ring end surfaces for score marks.

NOTE: Cam ring is especially treated which leaves a dull gray-black finish on wear surface. Wavy grain appearance inside cam ring is normal.

4. Inspect pump shaft for score marks, excessive wear, or damage - particularly at splines and at bearing and seal surfaces. Separate rotor and vanes and inspect for wear and

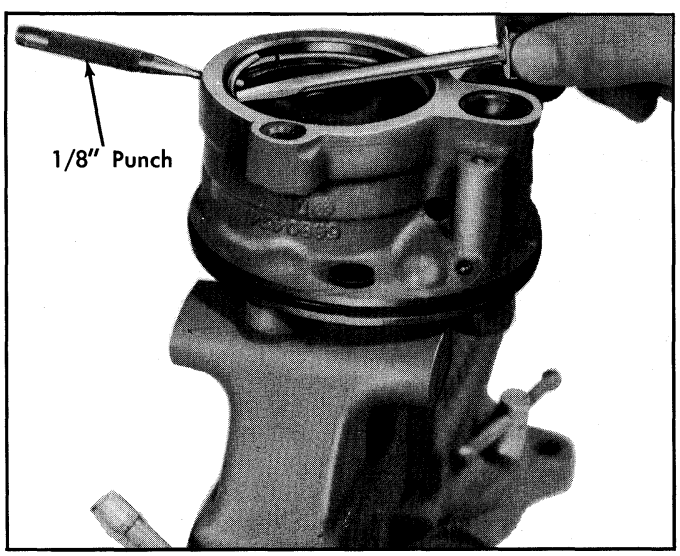


Fig. 3B-35 Removing End Plate Retaining Ring

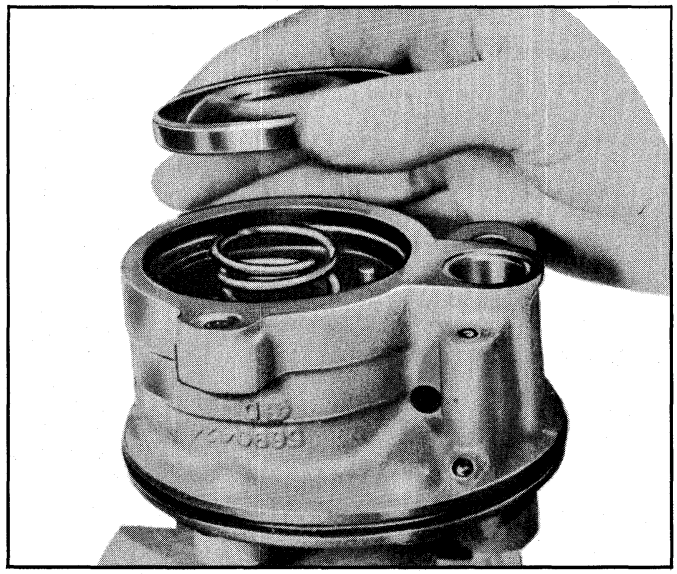


Fig. 3B-36 Removing of End Plate Exposing Spring

general condition.

5. Inspect shaft bushing in pump housing, and replace pump housing if bushing is scored or excessively worn.

6. If any internal parts are found to be worn or damaged, disassemble gear and clean internal parts.

c. Assembly

1. Lubricate new O-ring seals and seat areas with power steering fluid.

2. Lubricate new shaft seal with power steering fluid and install in housing with metal backing up. Use Seal Installer, J-7728, Fig. 3B-39.

3. Install new pressure plate and end plate O-ring seals in proper grooves in pump housing.

4. Install thrust plate on drive shaft with ported face toward splined end of shaft.

5. Install rotor on shaft with counterbored end toward thrust plate.

6. Clamp shaft in soft jawed vise and install new retaining ring on splined end of shaft by prying ring open and

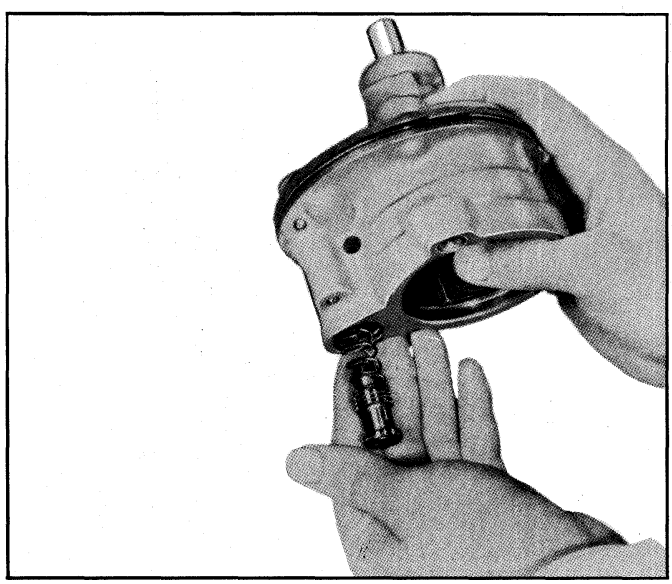


Fig. 3B-37 Removal of Flow Control Valve and Spring

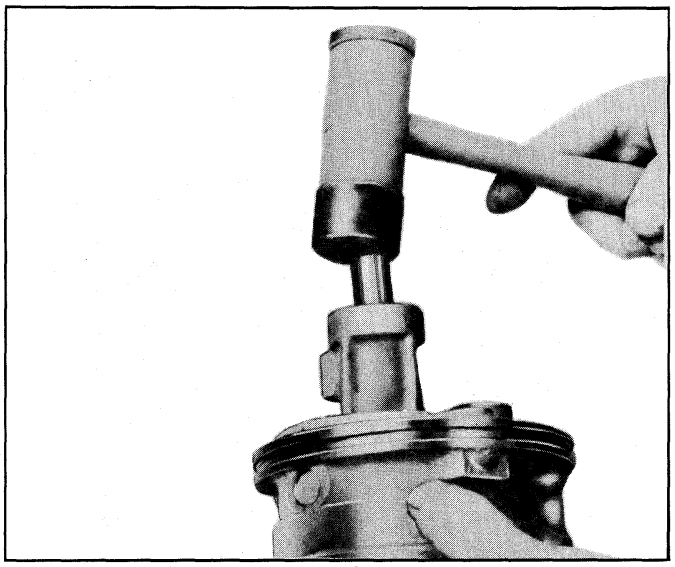


Fig. 3B-38 Tapping Shaft to Unseat Pressure Plate

sliding it down over shaft until it seats itself in ring groove. Be careful not to damage shaft.

7. Insert drive shaft with thrust plate and rotor into housing, Fig. 3B-40. Make sure that shaft is properly seated.

8. Place pump housing in vise, hub down, using flat on hub for one clamping surface.

9. Install dowel pins through thrust plate into pump housing.

10. Install cam ring on dowel pins with rotation arrow toward rear of pump housing and pointing in direction of pump rotation, Fig. 3B-41. Direction of rotation is counterclockwise when viewed from rear of pump.

11. Install vanes in slots in rotor, with radius edges toward outside of rotor, so they ride on cam ring.

12. Lubricate outside diameter of pressure plate with petrolatum or equivalent to prevent damage to O-ring and install pressure plate on dowel pins with ported face toward cam ring. Install plate so that narrow slots in plate engage dowel pins. Make sure that pressure plate is properly seated by tapping lightly around outer circumference with a wooden hammer handle.

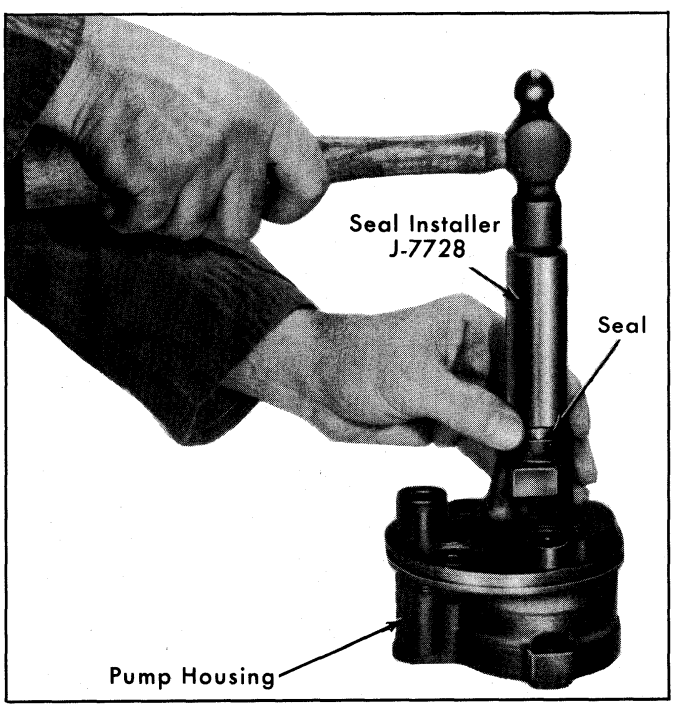


Fig. 3B-39 Installing Pump Shaft Seal

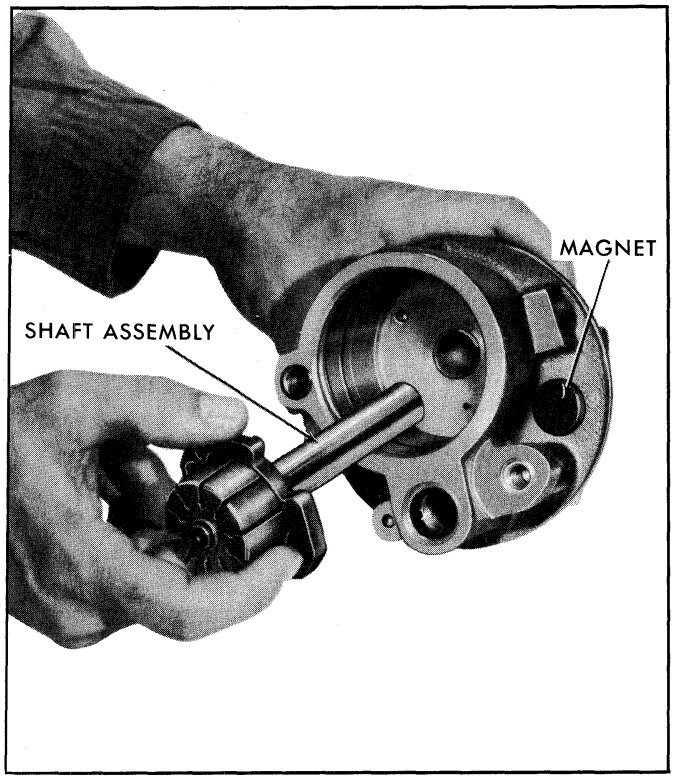


Fig. 3B-40 Installing Pump Shaft Assembly

13. Install pressure plate spring.

14. Lubricate outside diameter of end plate with petrolatum or equivalent and install end plate in pump housing.

15. Place pump housing in arbor press, depress end plate below retaining ring groove, and install end plate retaining ring, Fig. 3B-42. Make certain that ring is completely seated in groove of housing.

16. Place cleaned magnet flat against pump housing adjacent to pump inlet port, Fig. 3B-39.

17. Install new outer pump housing O-ring seal, flow control valve opening O-ring seal, and mounting bolt O-ring seals in pump housing.

18. Install reservoir on pump housing. Do not hammer on housing.

19. Install flow control valve spring.

20. Install flow control valve (hex head screw goes into bore first), Fig. 3B-43.

21. Install pressure union using a new O-ring seal in rearmost groove. Tighten to 40 foot-pounds.

22. Install mounting bracket on pump and secure with three screws. Tighten screws to 30 foot-pounds.

23. Clamp mounting bracket in vise with pump attached.

24. Position steering pump pulley on shaft and screw steering pump pulley installer J-25033, Fig. 3B-44 into shaft as far as it will go.

25. Make certain that the pulley is started evenly and that the steering pump pulley installer fits flush with the hub

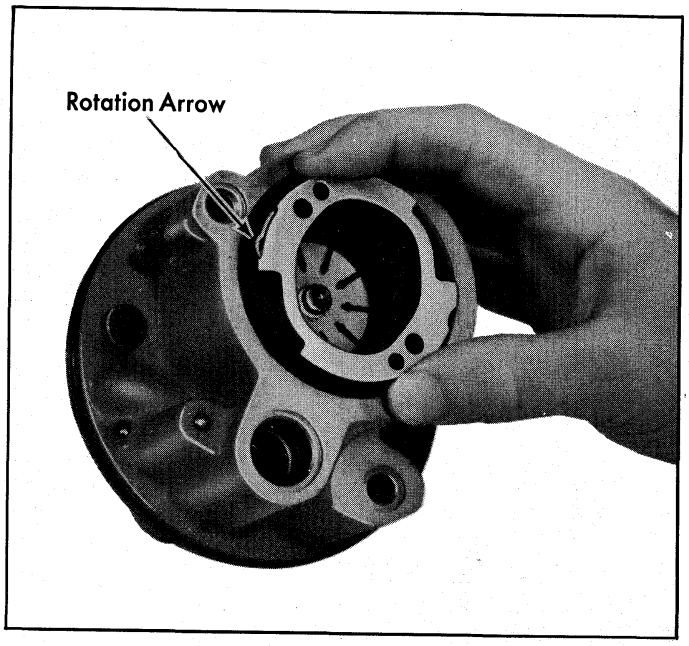


Fig. 3B-41 Installing Cam Ring

of the pulley.

26. Press the pulley onto the shaft until the hub is flush with the end of the shaft Fig. 3B-44.

CAUTION: *Never install pulley by pounding with a hammer as pressure plate will be broken, and possibly damage snap ring requiring complete disassembly of pump to replace parts.*

NOTE: Large nut on tool has left hand threads.

27. (Eldorado only) Install filter bracket to front face of pump with one bolt. Torque to 30 foot-pounds.

28. Install new filter to pump with short hose and two clamps. Clamp to bracket with large clamp. Note direction of flow crimp end of filter to pump. Torque clamps to 20 inch-pounds.

29. Install pump on car as described on page 3B-23 (page 3B-25 if Seville).

Steering Pump Shaft Seal Replacement-Off Car

Steering pump shaft seal cannot be replaced with pump on car as there is insufficient clearance for application of tools

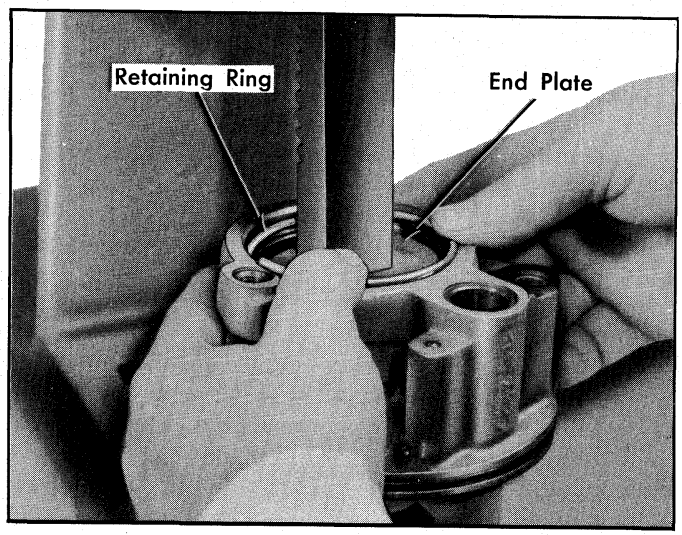


Fig. 3B-42 Installing End Plate Retaining Ring

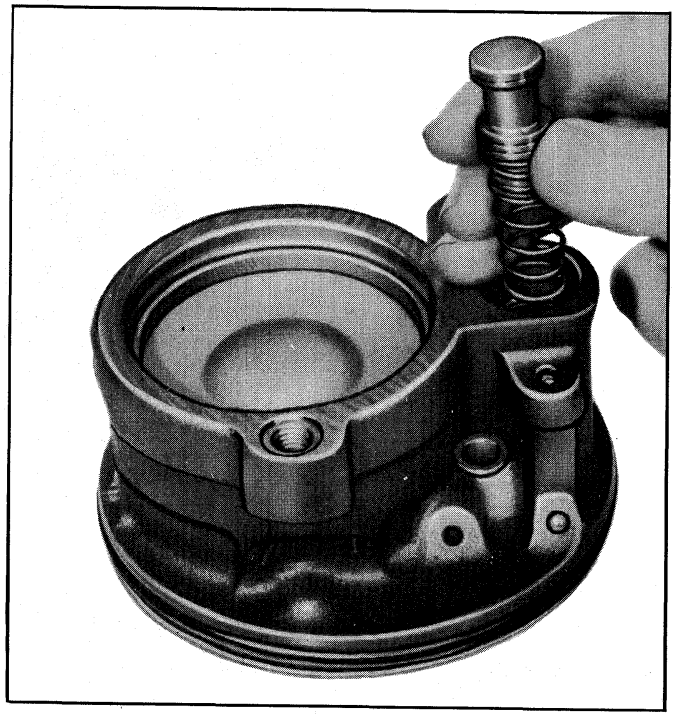


Fig. 3B-43 Installing Flow Control Valve

for removing pulley and installing seal. For replacing seal only, proceed as follows:

1. Remove pump from car as described on page 3B-23 (page 3B-24 if Seville).

2. Clamp mounting bracket in vise with pump attached and remove pulley from shaft using pulley puller, J-25034, Fig. 3B-34.

CAUTION: *Never remove pulley by pounding it off with a hammer as this could damage pulley as well as snap ring at inner end of shaft. If pounding pulley outward, thrust plate will be broken, requiring complete disassembly of pump for replacement of parts.*

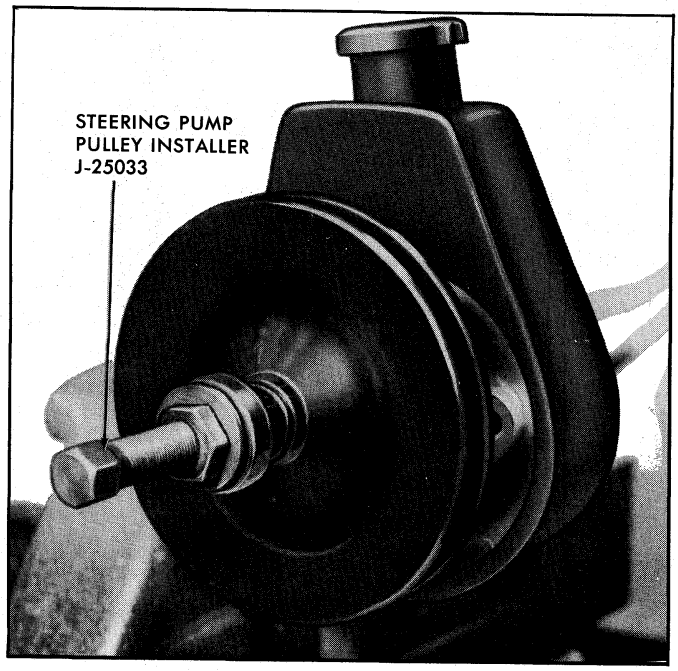


Fig. 3B-44 Pulley Installer



Fig. 3B-45 Installing Pump Shaft Seal (Off Car)

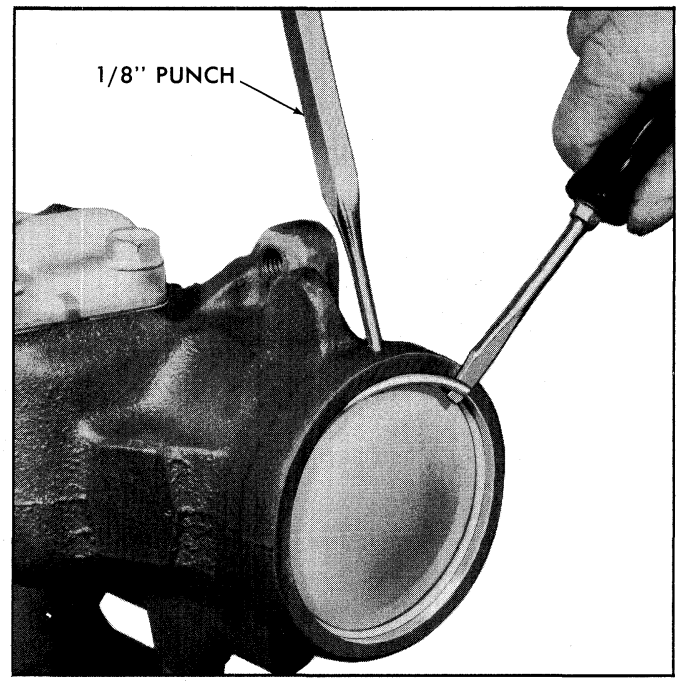


Fig. 3B-46 Removing End Cover Retaining Ring

3. Remove shaft seal by prying out with sharp tool.

CAUTION: *Insert sharp tool between seal and pump housing. Do not pry against pump shaft.*

4. Remove pump and mounting bracket from vise and lay flat on bench, allowing return pipe(s) to hang over side of bench, Fig. 3B-45, so it will not be damaged when installing new shaft seal.

CAUTION: *Pump mounting bracket may be damaged if clamped in vise while installing new shaft seal.*

5. Position new shaft seal on drive shaft with metal backing facing pulley end of shaft.

NOTE: Clean shaft with crocus cloth if necessary to remove rust and corrosion before removing shaft.

6. Install seal, using Pump Shaft Seal Installer, J-7728, Fig. 3B-39. Tap tool **lightly** with small hammer until seal is properly seated in shaft hub.

7. Clamp mounting bracket in vise with pump attached.

8. Position steering pump pulley on shaft and screw steering pump pulley installer J-25033, Fig. 3B-44 into shaft as far as it will go.

9. Make certain that the pulley is started evenly and that the steering pump pulley installer fits flush with the hub of the pulley.

10. Press the pulley onto the shaft until the hub is flush with the end of the shaft.

CAUTION: *Never install pulley by pounding with a hammer as pressure plate will be broken, and possibly damage snap ring requiring complete disassembly of pump to replace parts.*

NOTE: Large nut on tool has left hand threads.

11. Install pump on car as described on page 3B-23 (page 3B-25 if Seville).

Steering Gear, Removal Of Major Components

1. Clamp lower tab in vise with end cover tilted upward about 20°.

2. Rotate gear housing end cover retaining ring so that one end of ring is over hole in housing. Spring one end of ring with punch to allow screw driver to be inserted to lift ring out, Fig. 3B-46.

3. Rotate stub shaft counterclockwise until rack-piston loosens end cover in housing. Remove end cover and O-ring from housing.

CAUTION: *Do not rotate any further than necessary or balls will fall out of their circuit making disassembly more difficult, or pitman shaft and rack-piston teeth could become disengaged.*

4. Remove rack-piston end plug in the following manner:

a. Strike end plug with a hammer to unseat threads.

NOTE: This is important, as end plug is tightened to 80 foot-pounds during assembly and the hex could be rounded off during removal.

b. Rotate stub shaft until pitman shaft teeth are centered in housing.

c. Use a breaker bar and a 1″ socket to remove end plug, Fig. 3B-47.

5. Remove four side cover-to-housing retaining screws.

6. Tap end of pitman shaft with a soft mallet and slide

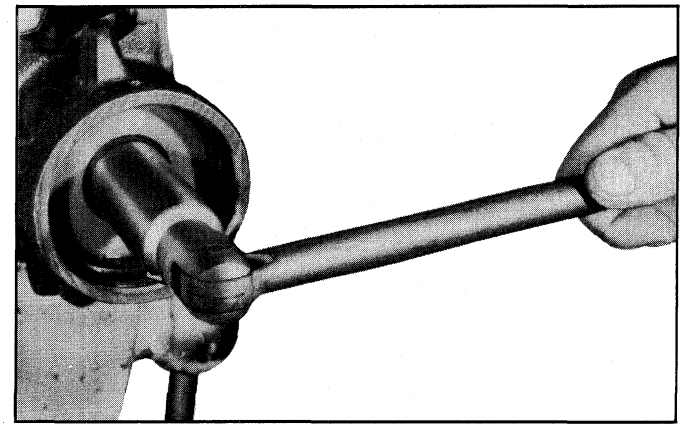


Fig. 3B-47 Removing Rack-Piston End Plug

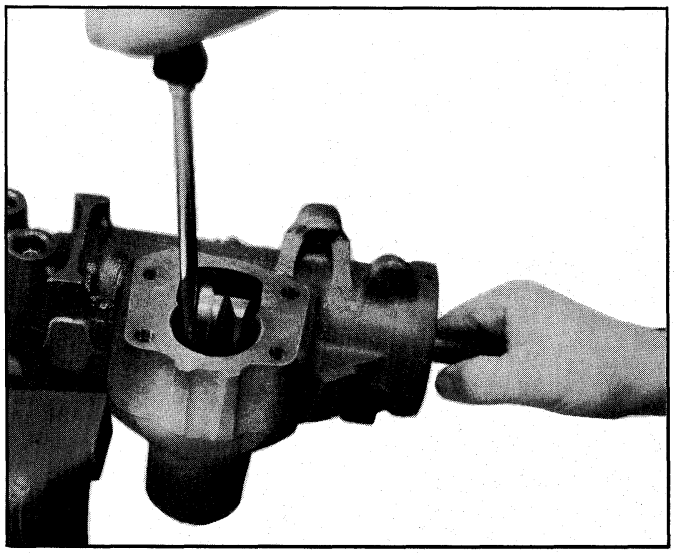


Fig. 3B-48 Installing Rack Piston Arbor

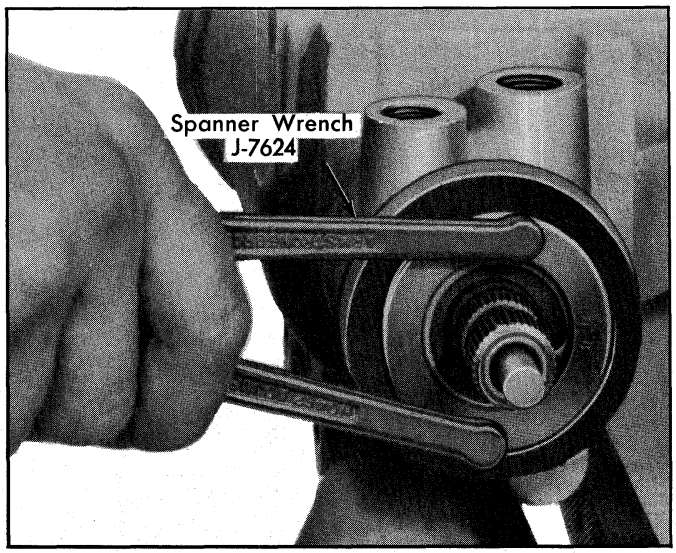


Fig. 3B-49 Removing Adjuster Plug

pitman shaft out of housing. Remove slowly as oil will drain from the housing.

7. Insert rack-piston arbor, J-21552, into rack-piston against end of worm. Turn stub shaft counterclockwise, while holding tool tightly against worm, to force rack-piston on arbor. Hold tool and using a screwdriver, force rack piston farther onto tool to prevent end circuit balls from falling out, and remove rack piston from gear housing, Fig. 3B-48. Do not remove rack-piston arbor from rack-piston until ready to remove balls from rack-piston.

WARNING: DO NOT INSERT FINGERS IN GEAR HOUSING IN AN ATTEMPT TO FORCE RACK-PISTON FROM GEAR AS THIS COULD RESULT IN PERSONAL INJURY.

8. Remove adjuster plug locknut by breaking it loose with hammer and punch, and remove locknut from housing.

9. Loosen adjuster plug assembly, using spanner wrench J-7624, Fig. 3B-49, and remove from housing. Remove and discard adjuster plug O-ring.

10. Remove valve assembly by grasping stub shaft and pulling out. Separate worm and shaft, and remove and discard lower shaft cap O-ring.

11. Remove worm, lower thrust bearing, and races from upper end of housing.

Steering Gear, Disassembly, Inspection, and Assembly of Major Components

Disassembly of the major components within the gear must be performed on a clean workbench. The work area, tools, and parts must be kept clean at all times. Refer to Fig. 3B-51 for parts nomenclature and location.

a. Gear Housing, Pitman Shaft Needle Bearing, and Seals

Disassembly

1. Remove pitman shaft seal retaining ring from gear housing, using Snap Ring Pliers, J-4245 (#3), and, then remove outer back-up washer.

2. Drive needle bearing, outer seal, inner backup washer, and inner seal from gear housing bore with Pitman Shaft Bearing Remover, J-6657. Discard seals.

Inspection

1. Inspect pitman shaft and needle bearing for broken or pitted rollers.

2. Inspect housing bore. If badly scored or worn, replace housing.

NOTE: A laser-beam hardening manufacturing process may have been used on the bore surface of the steering gear housing, to reduce wear, Fig. 3B-50. The laser process produces longitudinal "tracks", Fig. 3B-50, on the inside of the gear housing bore. These tracks are normal and may also leave corresponding polish areas on the rack piston, Fig. 3B-50.

These bore tracks and piston rack polished areas should not be misconstrued as scored or worn surfaces but should be expected to be encountered during gear inspection. Polished surfaces are generally considered acceptable and normal in such cases. The housing should be replaced only if score marks or a wear pattern can be felt with a fingernail.

3. Inspect high pressure line hose connector seat in gear housing. If badly scored, replace as described on page 3B-43. Inspect poppet and seat and replace if deformed or scored.

4. Inspect low pressure line hose connector seat in gear housing. If badly scored, replace as described on page 3B-43.

5. Inspect ball plug in valve body end of housing. If it is leaking or raised above the surface, it may be driven in flush or 2mm (1/16 inch) below surface. Ball can be tightened by staking housing.

6. Inspect all retaining ring grooves and seal surfaces for damage or failure.

Assembly

1. Thoroughly clean the parts and lubricate them with power steering fluid.

2. Install pitman shaft needle bearing on Bearing Installer, J-22407, with bearing shoulder against tool. Position bearing and tool in housing from bottom of gear. Press bearing into housing until bearing is bottomed out against hub of housing, Fig. 3B-52.

3. Lubricate pitman shaft bore and single lip pitman

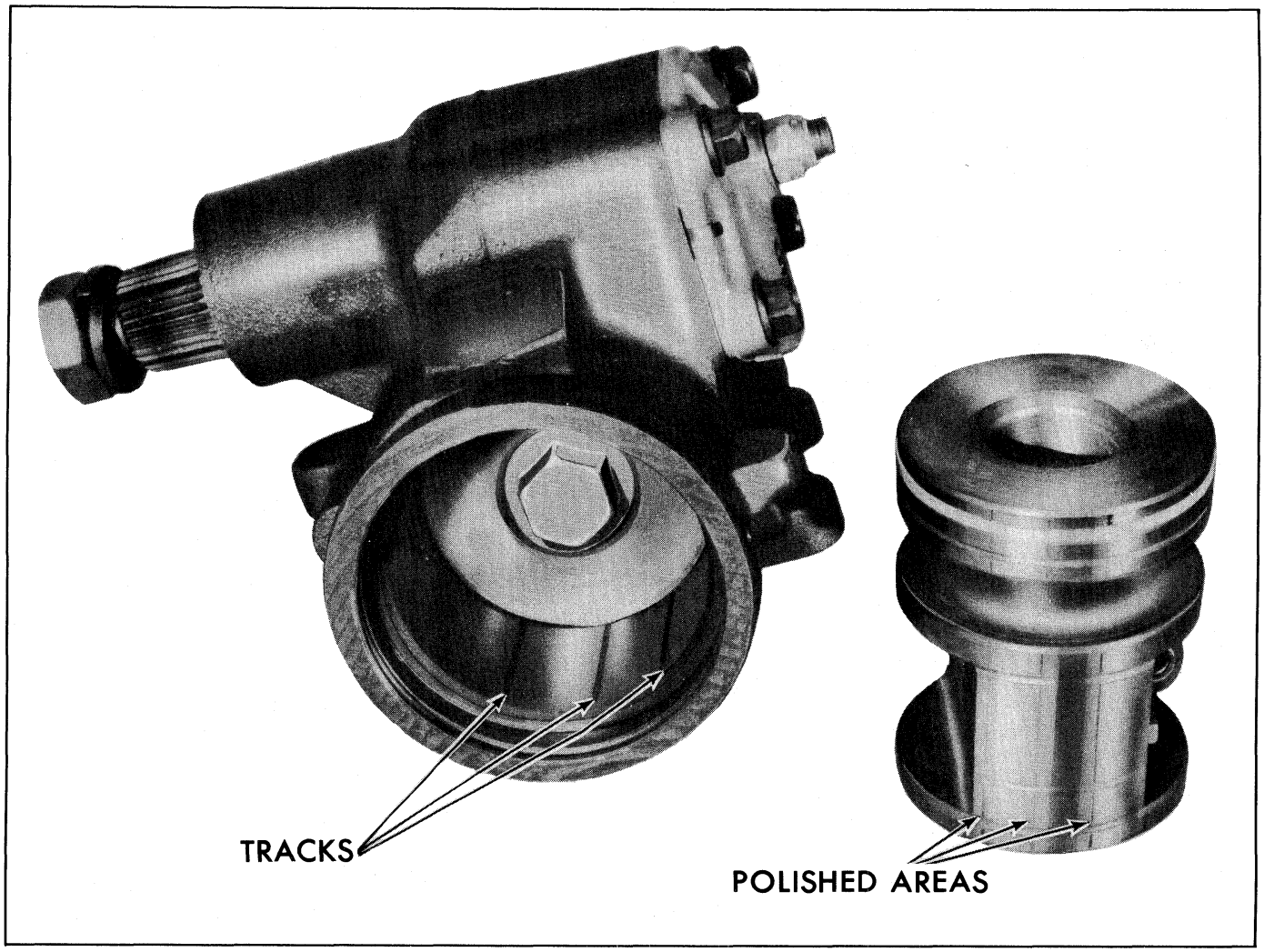


Fig. 3B-50 Steering Gear Laser Tracks

shaft seal with power steering fluid and install seal, lip down, into bore, using Seal Installer, J-6219, Fig. 3B-53. Do not drive seal more than 1/8 inch below lip of bore.

4. Remove tool and place steel washer on top of seal. Using tool J-6219, drive seal approximately 13mm (1/2 inch) further into bore.

5. Lubricate double lip seal with power steering fluid and install seal with lip of oil seal down into housing bore. Using Seal Installer, J-6219, drive seal down into bore until top edge of seal is flush with bottom edge of retaining ring groove.

6. Remove tool and place steel washer and retaining ring over seal. Using tool J-6219, drive both seals down into bore until retaining ring falls into retaining ring groove.

NOTE: In order to avoid possible damage to sealing surface of lower seal, it is important that seals and washers be driven down only far enough so that retaining ring falls into ring groove.

b. Adjuster Plug Assembly

NOTE: If replacing oil seal only, install adjuster plug loosely in the gear housing. Remove retaining ring with Snap Ring Pliers, J-4245. Pry out dust seal and oil seal from bore of adjuster plug, being careful not to score the needle bearing bore. To install, follow Steps 2, 3, and 4 under Assembly.

Disassembly

1. Remove thrust bearing retainer with a screwdriver, Fig. 3B-54. Pry alternately on dimples so as not to score needle bearing bore, and discard. Remove thrust bearing spacer, thrust bearing, and thrust bearing races.

2. Remove adjuster plug O-ring seal and discard.

3. Remove stub shaft retaining ring, using Snap Ring Pliers, J-4245 (#3).

4. Remove combination washer and dust seal and discard.

5. Remove stub shaft oil seal by prying out with screwdriver and discard.

Inspection

1. Inspect needle bearing in adjuster plug. If rollers are broken or pitted, remove needle bearing by pressing out from thrust bearing end, using Adjuster Plug Bearing Remover and Installer, J-6221, Fig. 3B-55.

2. Inspect thrust bearing spacer for cracks.

3. Inspect thrust bearing rollers for wear, pitting, scoring, or cracking. If any of these conditions are found, replace bearing and both thrust bearing races.

4. Inspect thrust bearing races for wear, pitting, scoring,

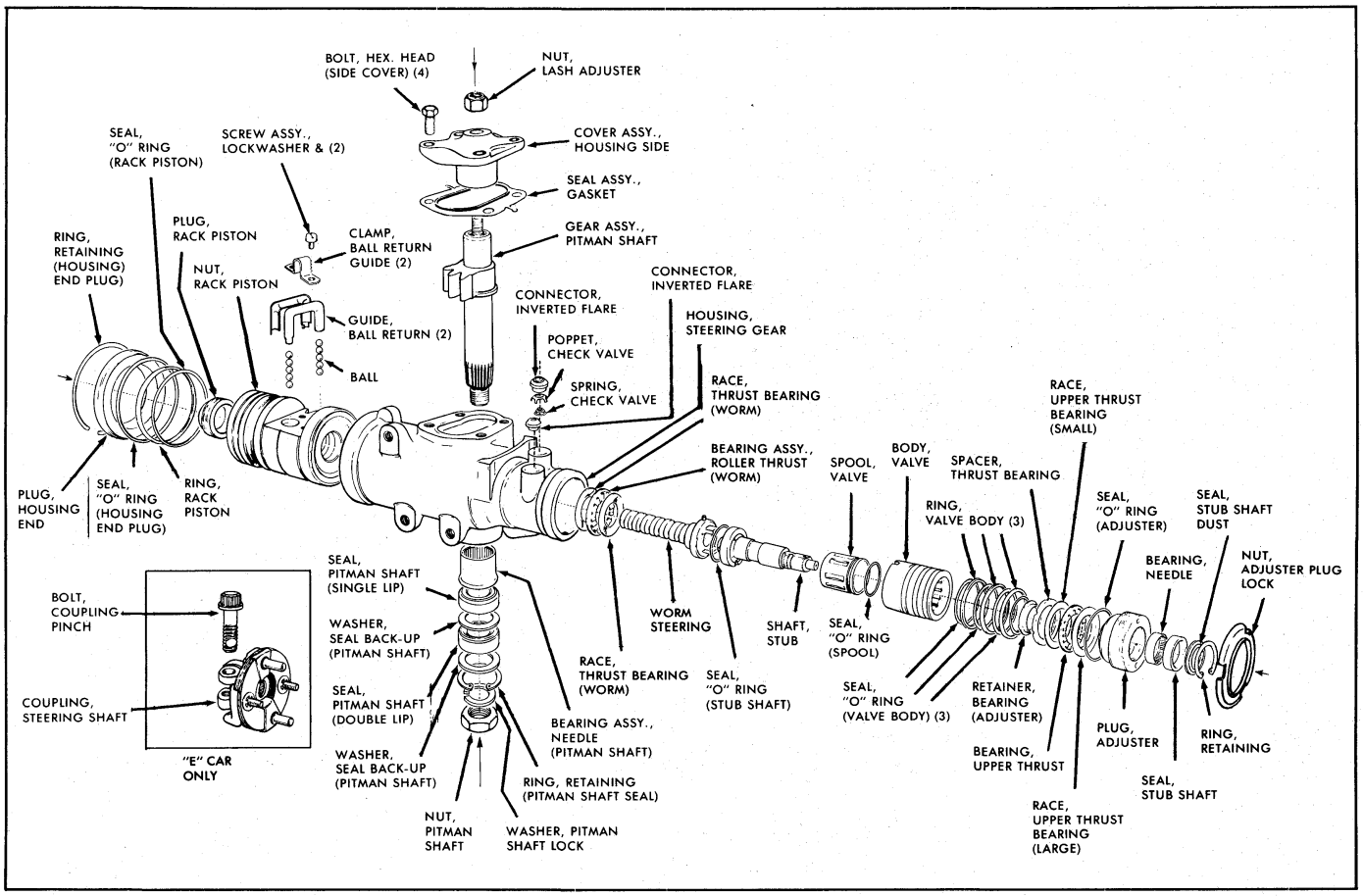


Fig. 3B-51 Steering Gear Disassembled

cracking, or brinelling. If any of these conditions are found, replace races and check thrust bearing and thrust bearing spacer.

Assembly

1. If adjuster plug needle bearing was previously removed, install new needle bearing on Tool J-6221, with letters on bearings against tool. Position bearing and tool over thrust bearing end of plug and drive bearing into plug, Figure 3B-55. End of bearing must be flush with bottom surface of stub shaft seal bore.

2. Lubricate new stub shaft oil seal with power steering fluid and, using Adjuster Plug Seal Installer, J-5188, Fig. 3B-56, install seal far enough to provide clearance for dust seal and retaining ring.

3. Lubricate new dust seal with power steering fluid and install in plug with rubber face outward.

4. Install retaining ring with Snap Ring Pliers, J-4245

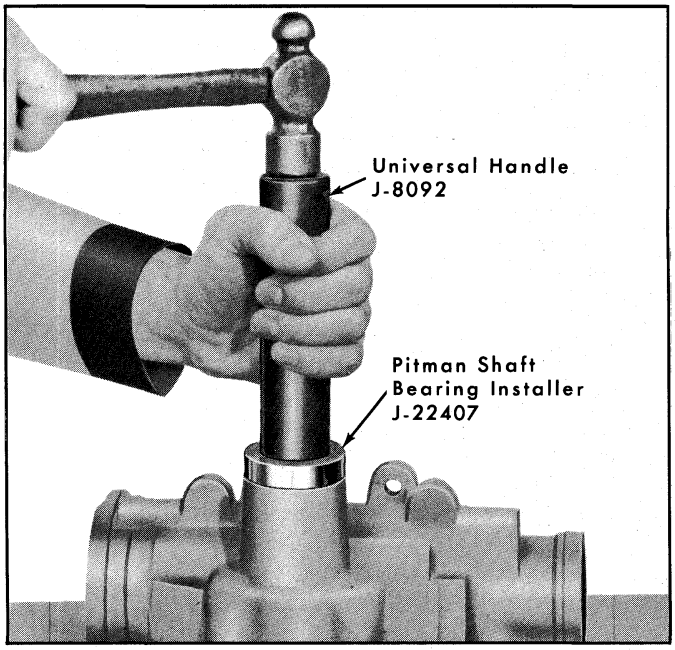


Fig. 3B-52 Installing Pitman Shaft Bearing

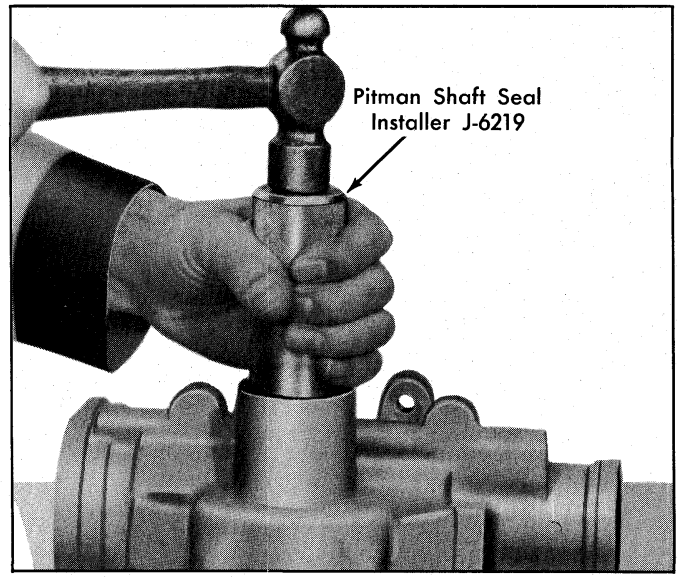


Fig. 3B-53 Installing Pitman Shaft Seal

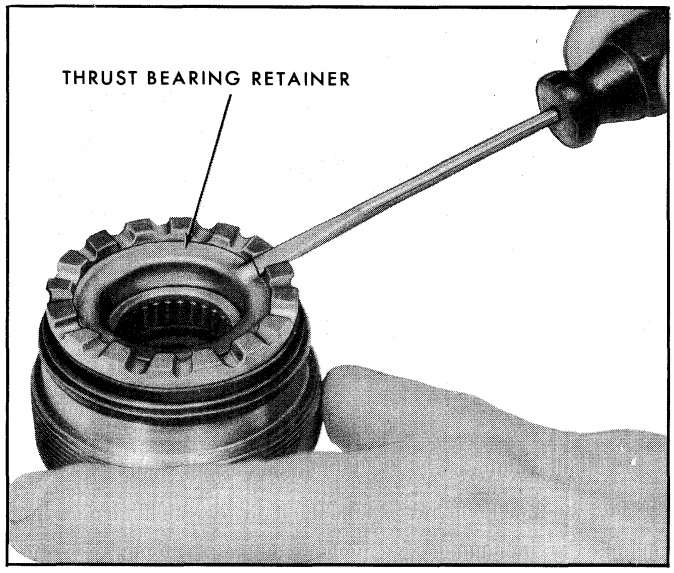


Fig. 3B-54 Removing Thrust Bearing Retainer

(#3), making certain that ring is properly seated.

5. Lubricate new O-ring seal with power steering fluid and install in groove on adjuster plug. Assemble flanged thrust bearing race, and thrust bearing, small thrust bearing race, and thrust bearing spacer on adjuster plug. Press bearing retainer into needle bearing bore, using a brass or wooden dowel. Radial location of dimples is not important.

NOTE: Dowel used to install thrust bearing retainer should be notched to clear retainer dimples. Dimples will distort if used as installation surface.

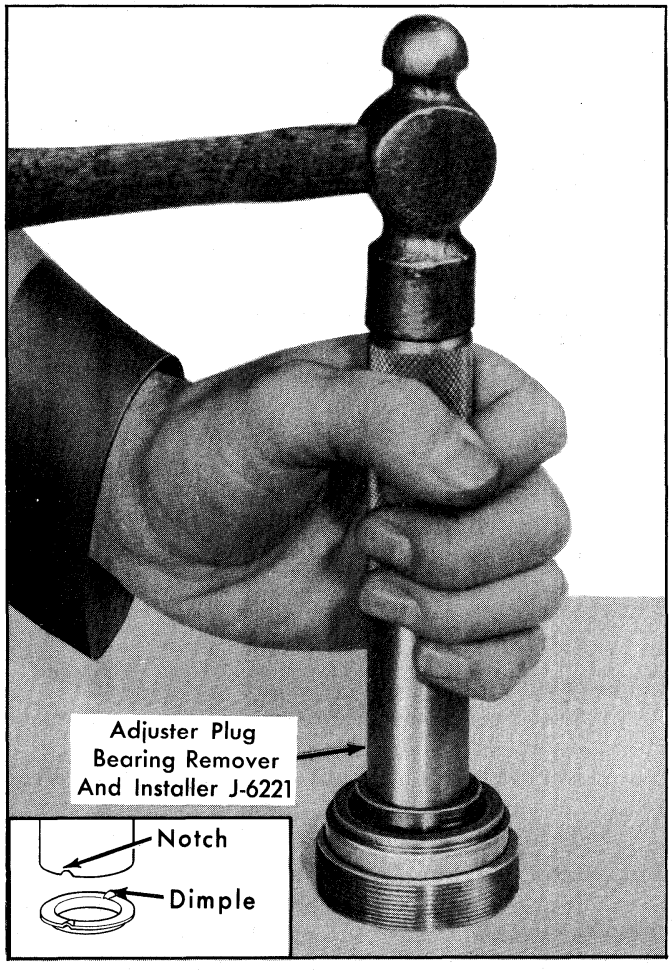


Fig. 3B-55 Removing and Installing Adjuster Plug Bearing



Fig. 3B-56 Installing Oil Seal

c. Stub Shaft and Valve Assembly

The complete valve assembly is a precision unit with selectively fitted parts hydraulically balanced during assembly. If replacement of any valve part other than rings or seals is necessary, the complete rotary valve assembly must be replaced.

Do not disassemble valve unless absolutely necessary, to avoid possibility of damage to the assembly. If valve spool dampener O-ring requires replacement, remove valve spool as outlined below, replace O-ring and reinstall spool.

Disassembly of Valve Spool Dampener O-ring

1. Remove cap to worm O-ring seal and discard.

2. Remove stub shaft, torsion bar, and valve cap assembly by holding valve assembly in both hands, with thumbs on valve body. Tap torsion bar lightly against workbench. This will dislodge cap from valve body-to-cap pin. Move the assembly forward far enough for the cap to clear the valve body and disconnect the stub shaft pin from the valve spool. Then remove the stub shaft assembly leaving the spool in the valve body.

CAUTION: *Clearance between valve body and spool is .0004-.0006 inch. Slightest cocking of spool*

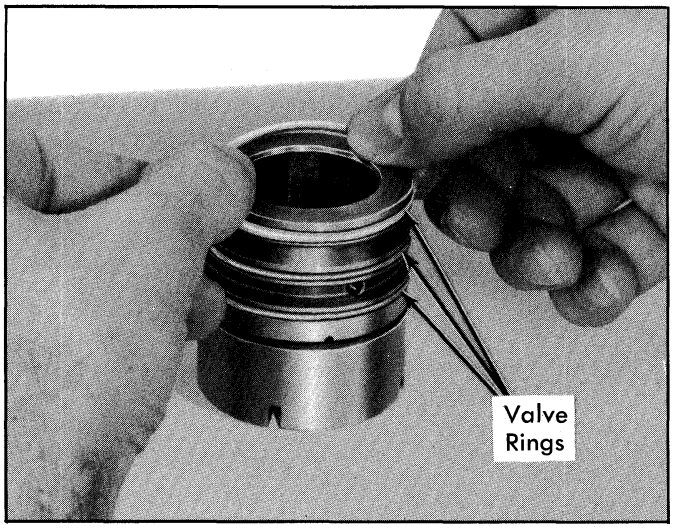


Fig. 3B-57 Installing Valve Rings

may cause it to stick in the valve body.

3. Remove valve spool from valve body by withdrawing spool from the flat end of the valve body with a steady twisting pull to prevent jamming. If slight sticking occurs, carefully work spool back into valve body. If this does not free spool, it has become cocked in the valve body bore. Do not attempt to force the spool in or out if it becomes cocked. Visual inspection on a flat surface will show in which direction spool is cocked. A few very light taps with a light, soft plastic or rawhide mallet should align spool in bore and free it.

CAUTION: *Do not tap with anything metallic. If spool can be rotated, it can be removed.*

Inspection

1. If there is evidence that torsion bar O-ring seal inside stub shaft has been leaking, entire valve assembly should be replaced.

2. Check pin in valve body that engages cap. If it is severely worn, cracked, or broken, the entire valve assembly should be replaced.

3. Check smaller of the two worm pin grooves in valve body. If it is severely worn, entire valve assembly should be replaced.

4. Check spool drive pin on stub shaft. If it is severely worn, cracked, or broken, entire valve assembly should be replaced.

5. Examine spool O.D. for nicks, burrs, or bad wear spots. If any are found, entire valve assembly should be replaced. A slight polishing is normal on valving surfaces.

6. Examine valve body I.D. for nicks, burrs, or bad wear spots. If any are found, entire valve assembly should be replaced. A slight polishing is normal on valving surfaces.

7. Check fit of spool in valve body before installing valve spool dampener O-ring seal.

When lubricated with power steering fluid, spool should rotate smoothly without binding or catching. If either occurs, entire valve assembly should be replaced.

8. Examine needle bearing diameter of stub shaft. If it is badly worn, or scored, entire valve assembly should be replaced.

9. Visually inspect valve body rings. If damaged, carefully cut valve rings and O-ring back-up seals. Remove and discard.

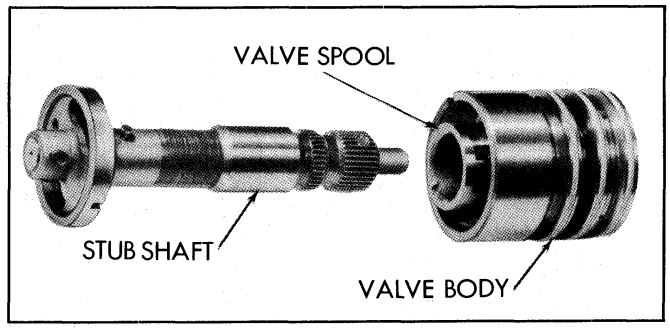


Fig. 3B-58 Installing Spool in Body

Assembly

1. If new valve body back-up O-ring seals are necessary, lubricate them with power steering fluid. Assemble in ring grooves on valve body. Do not allow seals to become twisted. If new valve rings are necessary, lubricate them with power steering fluid and assemble valve rings in ring grooves over back-up O-ring seals by carefully slipping rings over valve body, Fig. 3B-57. Rings may appear to be loose in grooves, but the heat of the oil after assembly will cause them to tighten.

2. Lubricate new valve spool dampener O-ring seal with power steering fluid and install seal in valve spool groove.

3. Install spool into valve body, Fig. 3B-58, sliding it partially through toward notched end.

CAUTION: *Because clearance between spool and valve body is .0004-.0006 inch extreme care must be taken when assembling these parts.*

4. Insert stub shaft through spool to engage locking pin in spool.

5. Pull spool and stub shaft into valve body aligning stub shaft notch with valve body pin, Fig. 3B-59.

6. Lubricate new cap-to-worm O-ring seal with power steering fluid and install in valve body.

NOTE: Do not install upper thrust bearing assembly on valve assembly at this time.

d. Pitman Gear Shaft and Side Cover

Inspection

1. Inspect pitman shaft bearing surface in side cover for excessive wear or scoring. If badly worn or scored, replace side cover.

NOTE: The bearing may extend from the side cover. It is not necessary to reposition the bearing or replace the side cover if this condition occurs.

2. Visually inspect pitman shaft sector teeth, bearing and seal surface. If abnormally worn, pitted, or scored, replace pitman shaft.

e. Rack-Piston and Worm Assembly

Disassembly

1. Place assembly on a clean cloth. Remove return guide clamp screws and remove clamp.

2. Remove ball return guides and Arbor, J-21552. Make sure all 24 balls are caught on the cloth.

NOTE: Rack-piston ring seldom needs to be replaced.

Inspection

1. Inspect worm and rack-piston grooves and all of the balls for excessive wear or scoring. If either worm or rack-piston needs replacing, both must be replaced as a matched assembly.

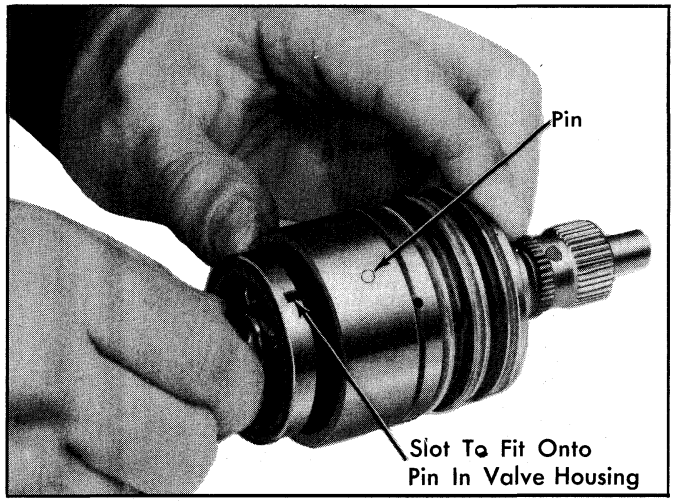


Fig. 3B-59 Installing Stub Shaft

2. Inspect ball return guides, making sure that the ends where balls enter and leave the guides are not damaged.

3. Inspect lower thrust bearing and races for wear, pitting, scoring, or cracking. If any of these conditions are found, replace thrust bearing and races, and check worm.

4. Inspect rack-piston and end plug to be sure threads are not damaged.

5. Inspect rack-piston teeth for abnormal wear or scoring. Inspect rack-piston O.D. for abnormal wear, scoring, or burrs. If any of these conditions exist and are excessive, both the rack-piston and worm must be replaced.

6. Visually inspect piston ring; if damaged, remove ring and back-up O-ring seal and discard.

Assembly

1. Thoroughly clean the parts and lubricate them with power steering fluid.

2. Lubricate new back-up O-ring seal, if necessary, with power steering fluid and install in piston ring groove on rack-piston. Do not allow seal to become twisted.

3. Install new piston ring, if necessary, in groove over O-ring seal.

4. Insert worm into end of rack-piston, from end opposite piston ring, until worm is against rack-piston shoulder.

5. Load 19 balls into guide hole nearest piston ring while slowly rotating worm counterclockwise to feed balls through circuit. Alternate black balls with white balls throughout the circuit.

NOTE: Balls should be measured with a micrometer if mixed or color identification is questioned. The measured difference between the black and white balls is .0005 inch.

6. Apply a liberal amount of petrolatum or equivalent to one ball return guide and install the remaining 5 balls into guide. Place the other guide over the balls and ball guide, and insert guides into guide holes of rack-piston. Make sure black ball in guide is installed next to white ball in rack-piston or vice versa. Guides should fit loosely. It is essential that all balls be positioned so that they are alternate in color. No two balls of the same color are to be side by side.

7. Place return guide clamp over guides and secure with two screws and lockwashers. Tighten screws to 5 foot-pounds.

8. Worm groove is ground with a high point in the center. When rack-piston passes over this high point, a preload of 1 to 4 inch-pounds should be obtained. To measure preload of worm and rack-piston ball assembly, proceed as follows:

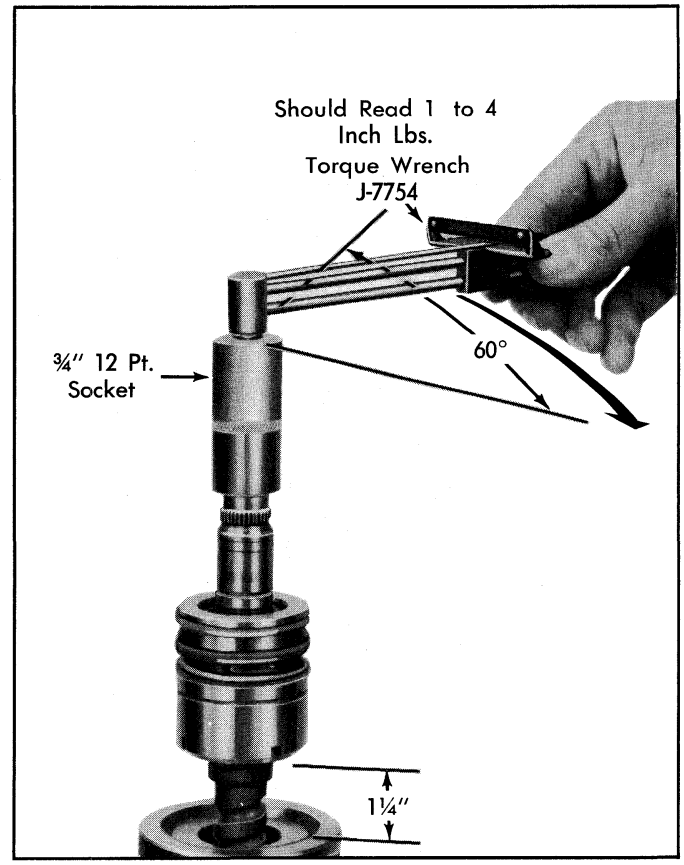


Fig. 3B-60 Check Worm and Rack-Piston Preload

a. Clamp rack-piston in a bench vise with soft jaws with worm shaft pointing up. Do not distort rack-piston by over-tightening vise.

b. Place valve assembly on worm engaging worm drive pin.

c. Rotate worm until it extends 32mm (1-1/4 inches) from rack-piston to thrust bearing face. This is center position.

d. Place Torque Wrench, J-7754, with a 3/4 inch 12-point socket on stub shaft, Fig. 3B-60, and rotate wrench through an arc of approximately 60° in both directions several times, then take a torque reading. Highest average reading obtained with worm rotating should be between 1 and 4 inch-pounds.

9. If reading is below 1 inch-pound, a new set of balls must be installed upon reassembly. Final preload on replacement balls should be 2 or 3 inch-pounds.

10. Remove valve assembly from worm.

11. Remove rack-piston from vise.

12. Insert Worm Gear Ball Arbor, J-21552, into worm and turn rack-piston onto arbor. Do not allow arbor to separate from worm until rack-piston is fully on arbor.

Steering Gear, Installation of Major Components

1. Position gear housing horizontally in vise and clamp lower tab at valve end of gear as shown in Fig. 3B-77.

2. Lubricate worm shaft, lower thrust bearing, and races with power steering fluid, then position thrust bearing and races on worm.

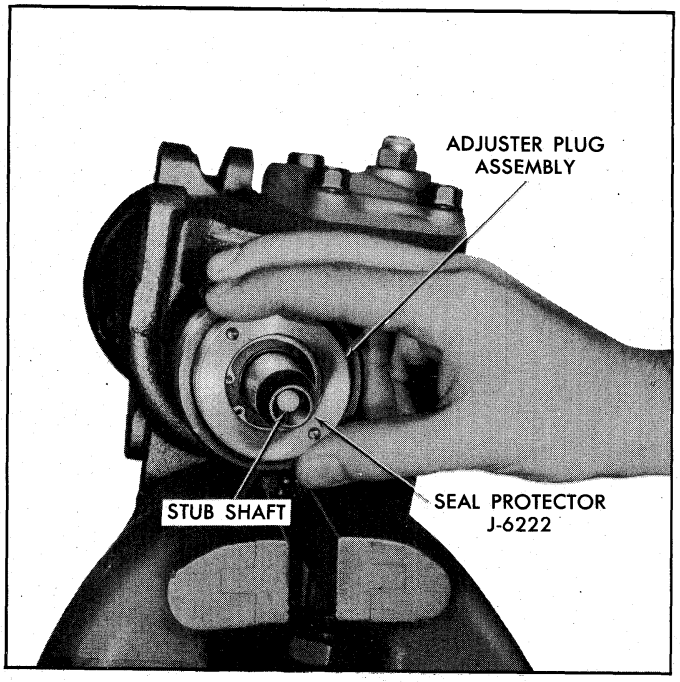


Fig. 3B-61 Installing Adjuster Plug

NOTE: Races must be positioned in same direction with cupped side towards worm shaft and curved side towards gear housing, Fig. 3B-63.

3. Align valve body drive pin on worm with narrow pin slot on valve body. Be sure O-ring seal between valve body and worm head is installed.

4. Position valve assembly and worm shaft in housing as an integral unit.

CAUTION: *Do not push against stub shaft, as this might cause stub shaft and cap to pull out of valve body, allowing spool seal to slip into valve body oil grooves. Valve assembly can be installed by pushing on the outer diameter of the valve body housing with the fingers of both hands. Make certain that white plastic rings are not binding on inside of housing. Valve assembly is properly seated when oil return hole in gear housing is fully visible.*

5. Place Adjuster Plug Seal Protector, J-6222, over end of stub shaft.

6. Lubricate new adjuster plug O-ring seal with power steering fluid and install in groove on adjuster plug.

7. Install adjuster plug assembly over end of stub shaft, Fig. 3B-61, and tighten just enough to make certain that all parts are properly seated in gear housing. Remove Seal Protector, J-6222.

NOTE: If Seal Protector, J-6222 is removed too soon, stub shaft seal will be damaged by the shaft splines.

8. Install adjuster plug locknut loosely on adjuster plug.

9. Adjust thrust bearing preload as described on page 3B-41.

10. Install Rack-Piston Seal Compressor, J-8947, in gear housing, Fig. 3B-62, holding it tightly against shoulder in housing.

11. Insert rack-piston into housing until arbor engages worm. Turn stub shaft clockwise, using a 3/4 inch twelve-point socket or box end wrench, to draw rack-piston into housing. When piston-ring is in housing piston bore, Arbor J-21552, and Seal Compressor, J-8947, can be removed.

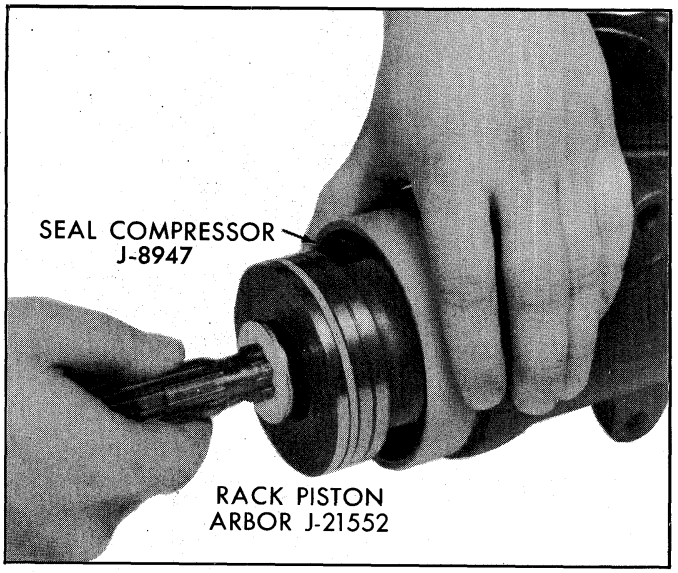


Fig. 3B-62 Installing Rack-Piston

12. Turn stub shaft as necessary until middle rack groove in rack-piston is aligned with center of pitman shaft needle bearing.

13. Lubricate new side cover O-ring and install in face of side cover.

14. Assemble side cover on pitman shaft by screwing cover onto pitman shaft adjuster screw until side cover bottoms on pitman shaft, and back off 1/2 turn.

15. Install pitman shaft so that center tooth in sector meshes with center groove of rack-piston. Make sure side cover O-ring is in place before pushing side cover down on gear housing.

16. Install side cover screws and tighten to 45 foot-pounds.

17. Hold adjuster screw with Allen wrench and install new adjuster lock nut half way on adjuster screw.

18. Install rack-piston end plug in rack-piston.

NOTE: Rack-piston end plug is tightened as follows: Steel end plug 100 foot-pounds. Aluminum end plug 75 foot-pounds.

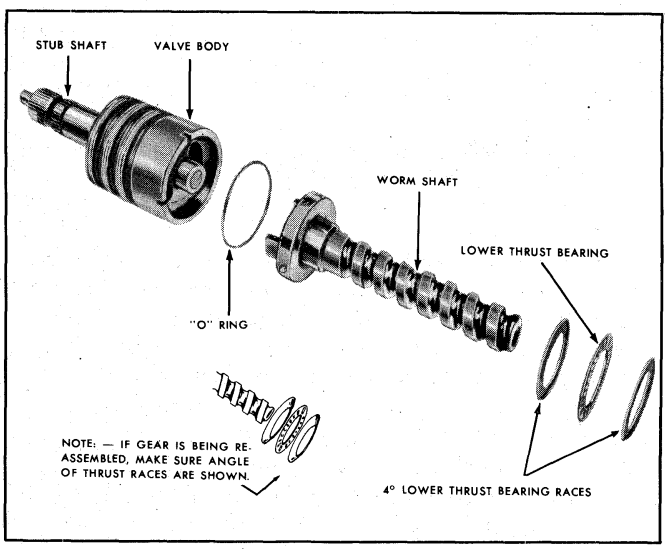


Fig. 3B-63 Lower Thrust Bearing Assembly

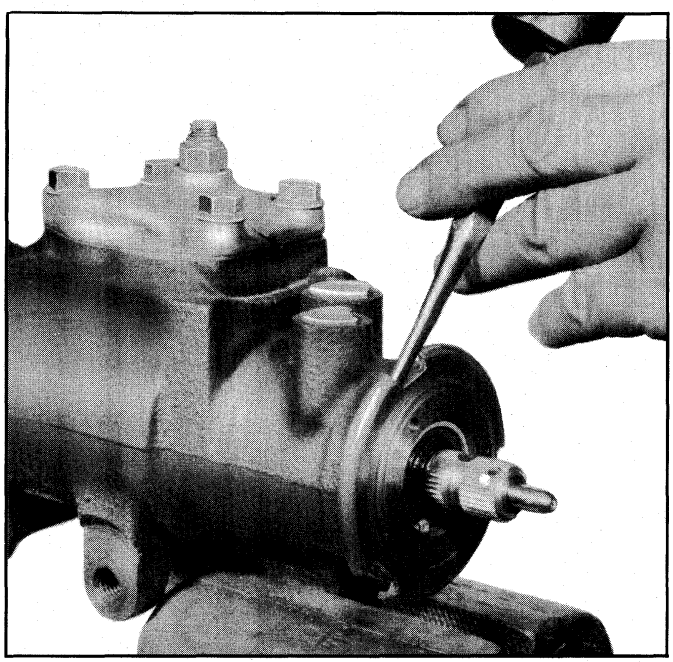


Fig. 3B-64 Loosening Adjuster Plug Lock Nut

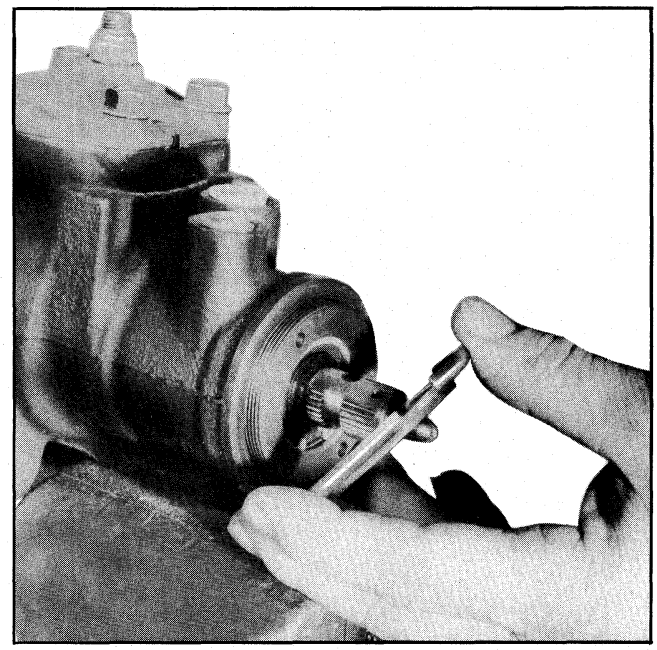


Fig. 3B-65 Removing Adjuster Plug Lock Nut

CAUTION: *Aluminum end plug may strip its threads if tightened over 75 foot-pounds.*

19. Lubricate new housing end cover O-ring seal with power steering fluid and install in gear housing.

20. Insert end cover into gear housing and seat against O-ring seal. Slight tapping with a mallet may be necessary to seat end plug properly.

21. Snap end cover retainer ring into place with fingers. Slight tapping may be required to bottom retainer ring in the gear housing securely.

22. Adjust pitman shaft end play as described on page 3B-42.

23. Install flexible coupling on stub shaft with .040 inch clearance between the adjuster plug and the coupling. Install flange screw in coupling. Tighten screw to 30 foot-pounds.

Thrust Bearing Adjustment

If a gear is known to contain the new thrust bearing parts, thrust bearing adjustment in service is simplified. Recommended procedure:

1. Drain power steering fluid from gear by rotating the stub shaft full travel in both directions several times.

2. Loosen and remove adjuster plug lock nut, Fig. 3B-64 and 3B-65.

3. Turn the adjuster plug in (clockwise) until the plug and thrust bearing are firmly bottomed - approximately 20 foot-pounds. Fig. 3B-66.

4. Mark the housing even with one of the holes in the adjuster plug, Fig. 3B-67.

5. Measure back (counterclockwise direction) 3/16 to 1/4 inch and remark housing, Fig. 3B-68.

6. Rotate adjuster (counterclockwise) until hole in adjuster is in line with second mark, Fig. 3B-69.

7. Tighten lock nut securely. Hold (or have held) adjuster plug to maintain alignment of hole with mark, Fig. 3B-70.

8. Turn the stub shaft to the right stop and then back 1/4 turn. Using an inch-pound torque wrench, measure the torque. Reading should be taken with beam of torque wrench near vertical while turning counterclockwise at an even rate. Fig. 3B-71. If reading is less than 4, or more than 10 inch-pounds, use alternate adjustment procedure below.

Alternate Thrust Bearing Adjustment Procedure

1. Drain gear by rotating stub shaft from stop to stop several times.

2. Loosen pitman shaft preload adjuster screw lock nut and turn the preload adjuster screw 1-1/2 turns counterclockwise. Retighten the lock nut, Fig. 3B-72. If when turning the preload screw counterclockwise, it bottoms, turn back clockwise one-half turn.

3. Loosen but, do not remove the adjuster plug lock nut, Fig. 3B-64.

4. Loosen the adjuster plug one turn counterclockwise, Fig. 3B-73.

5. Turn the stub shaft to the right stop and then back

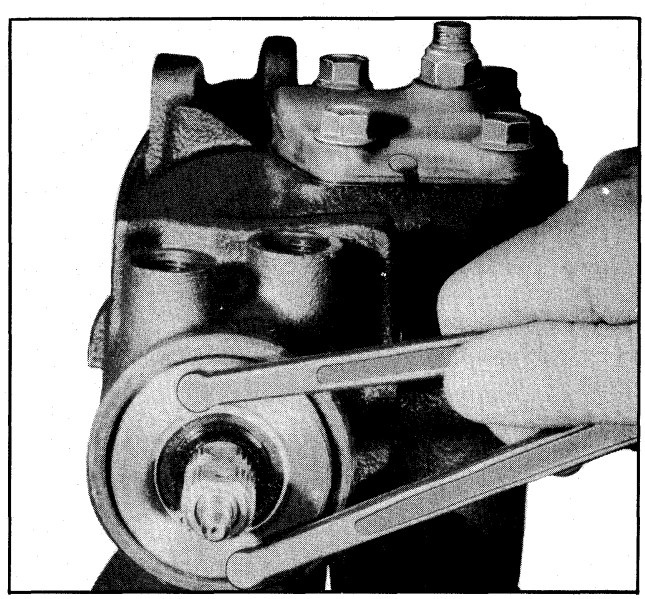


Fig. 3B-66 Turning Adjuster Plug

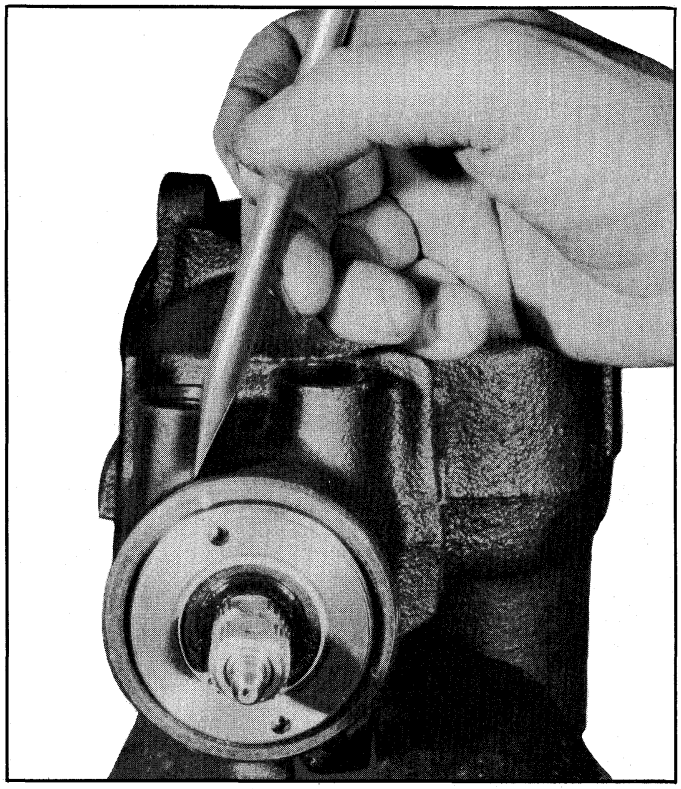


Fig. 3B-67 Marking Housing

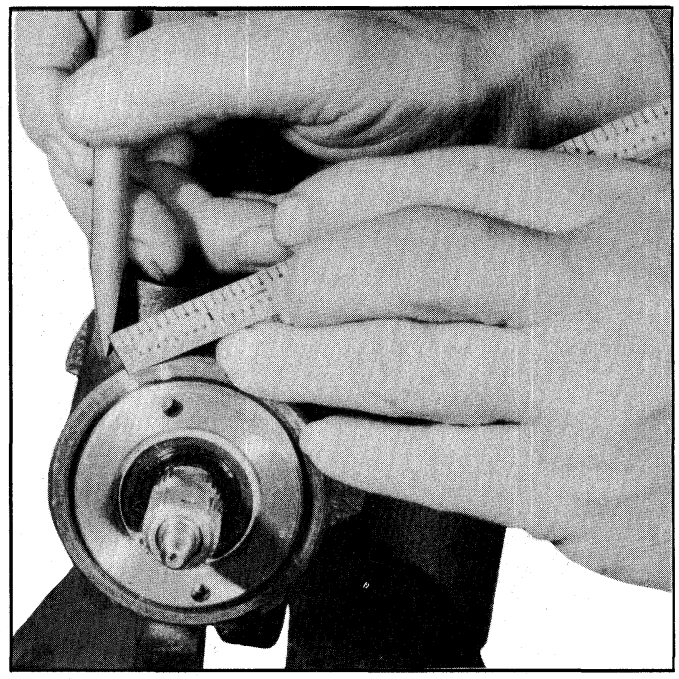


Fig. 3B-68 Making Measurement

a quarter turn. Measure the drag torque using an inch-pound torque wrench, Fig. 3B-71. Bottom the adjuster plug firmly (approximately 20 foot-pounds by turning it clockwise, Fig. 3B-73). Then back it off until the total torque reading is 3-4 inch-pounds in excess of the drag torque. (Ex: drag torque reading - 3 inch-pounds. Total torque reading with adjuster plug tightened - 6-7 inch-pounds).

6. Tighten the adjuster plug lock nut securely, Fig. 3B-70.

NOTE: Preload torque tends to drop off when the lock nut is tightened. Therefore, the torque reading must be rechecked with the lock nut tight, and the torque must still be 3-4 inch-pounds in excess of the seal drag.

CAUTION: *It is not possible to properly adjust the thrust bearing preload unless the adjuster plug is firmly bottomed out and the torque set while the adjuster plug is being loosened. Never attempt to adjust the thrust preload while tightening or advancing the adjuster plug into the gear assembly.*

7. Adjust pitman shaft "over-center" sector as described below.

Pitman Shaft "Over-Center" Sector Adjustment

1. Turn the stub shaft from stop to stop, counting the total number of turns. Divide this number by 2. Starting at either stop, turn the stub shaft 1/2 the total number of turns. This the "center" of the gear. The flat on the stub shaft is normally up and parallel with the side cover when the gear is "on center", Fig. 3B-74, and the block tooth on the pitman shaft is in line with the over-center preload adjuster, Fig. 3B-75.

2. Rotate the torque wrench approximately 45 degrees each side of center, and "read" near or on center (highest reading), Fig. 3B-76. Loosen the lock nut and turn the preload adjusting screw clockwise until the correct "ON" center torque, in excess of the reading just taken, is obtained, Fig. 3B-76.

Limits for "new" and "used" gears are different, as follows:

a. "New" gear over-center torque to be 4-8 inch-pounds additional torque, but total over-center torque must not exceed 18 inch-pounds.

b. "Used" gear 400 or more miles. Over-center torque to be 4 to 5 inch-pounds additional torque, but total over-center must not exceed 14 inch-pounds.

Tighten the lock nut to 35 foot-pounds while holding the

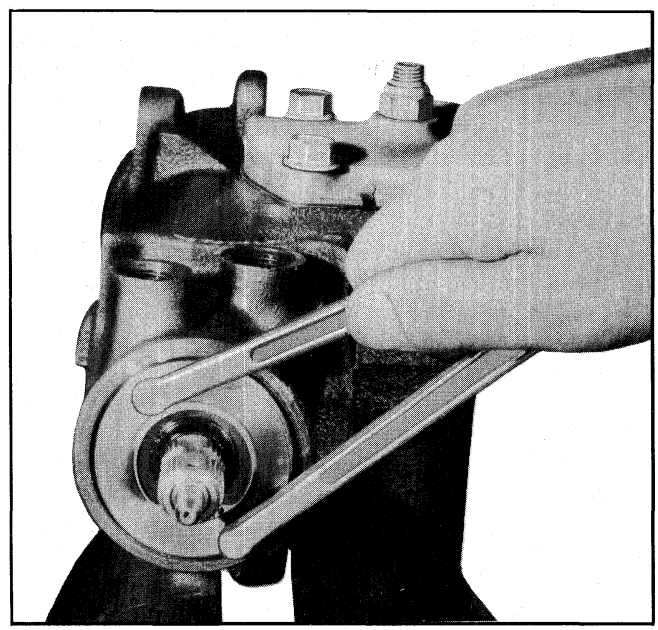


Fig. 3B-69 Rotating Adjuster

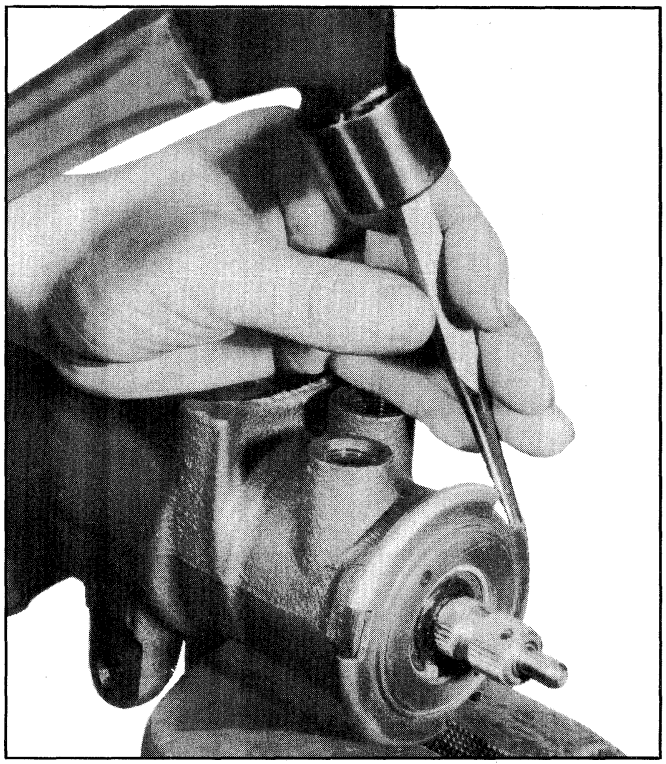


Fig. 3B-70 Tightening Lock Nut

preload adjuster screw. Recheck the "ON" center adjustment.

Steering Gear Line Connector Seats and Poppet Check Valve Replacement

The following procedure can be performed on car as well as on bench.

1. Disconnect pressure and return lines at steering gear and plug lines to prevent loss of fluid.

2. To prevent metal chips from becoming lodged in valve assembly, pack inside of connector seats of pressure and return port housing with petrolatum or equivalent.

3. Tap threads in connector seats, using a 5/16"-18 tap.

CAUTION: *Do not tap threads too deep in pressure hose connector seat as tap will bottom poppet valve against housing and damage it. It is necessary to tap only 2 or 3 threads deep.*

4. Thread a 5/16"-18 bolt with a nut and flat washer into tapped hole, Fig. 3B-77.

5. To pull connector seat, hold bolt from rotating while turning nut off bolt. This will pull connector from housing. Discard connector seat.

NOTE: It is also possible to remove connector by using a No. 4 screw extractor.

6. Wipe lubricant from housing and clean housing thoroughly to remove any metal chips or dirt.

7. Remove poppet check valve and spring from pressure port and discard.

8. Install new check valve spring in pressure port with large end down. Make sure spring is seated in counterbore in pressure port.

9. Install new check valve over spring with tangs pointing down. Make sure valve is centered on small end of spring.

10. Install new connector seats, using petrolatum or equivalent to hold connector seat on check valve in pressure port. Drive connector seats in place using Valve Connector Seat Installer, J-6217, Fig. 3B-78.

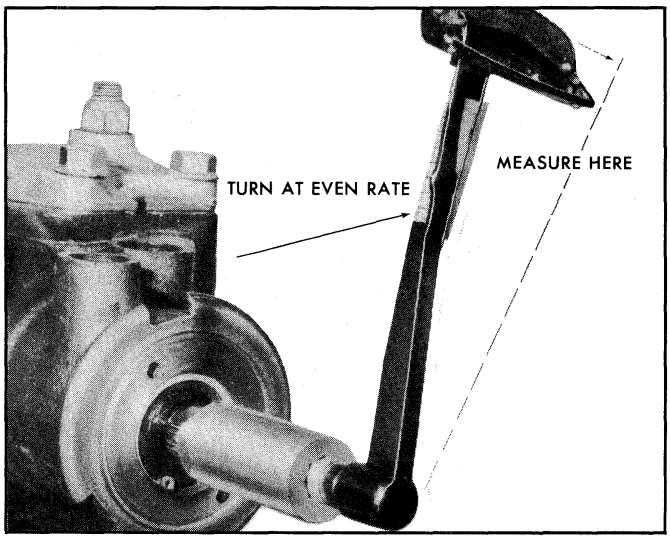


Fig. 3B-71 Measuring Torque

11. Check operation of valve by pushing lightly against valve with a small punch or small rod. Valve should reseat itself against connector seat when pressure is removed from spring.

12. Connect pressure and return lines on steering gear. Tighten fittings to 30 foot-pounds.

13. Check fluid in pump reservoir and add if necessary.

Removal and Installation of Pitman Shaft Seals–On Car

If upon inspection of the gear, it is found that oil leakage exists at the pitman shaft seals, the seals may be replaced without removing the gear assembly from the vehicle as follows:

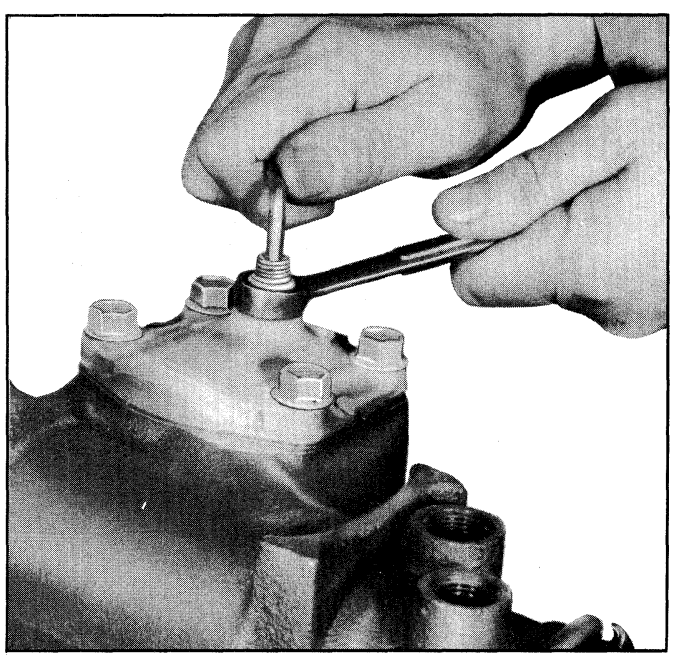


Fig. 3B-72 Loosening Pitman Shaft Lock Nut

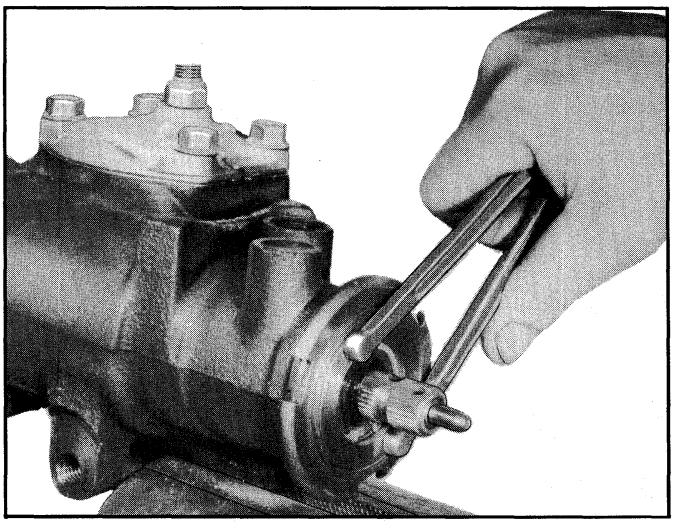


Fig. 3B-73 Loosening Adjuster Plug

a. Removal

1. Remove pitman nut and disconnect pitman arm from pitman shaft using Puller, J-9172.

CAUTION: *Do not hammer on end of puller.*

2. Thoroughly clean end of pitman shaft and gear housing, then tape splines on end of pitman shaft to insure that seals will not be cut by splines during assembly.

NOTE: Use only one layer of tape. An excessive amount of tape will not allow seals to pass, due to close tolerance between seals and pitman shaft.

3. Remove pitman shaft seal retaining ring with Snap Ring Pliers, J-4245.

4. Start engine and turn steering wheel fully to the left so that oil pressure in the housing can force out pitman shaft seals. Turn off engine.

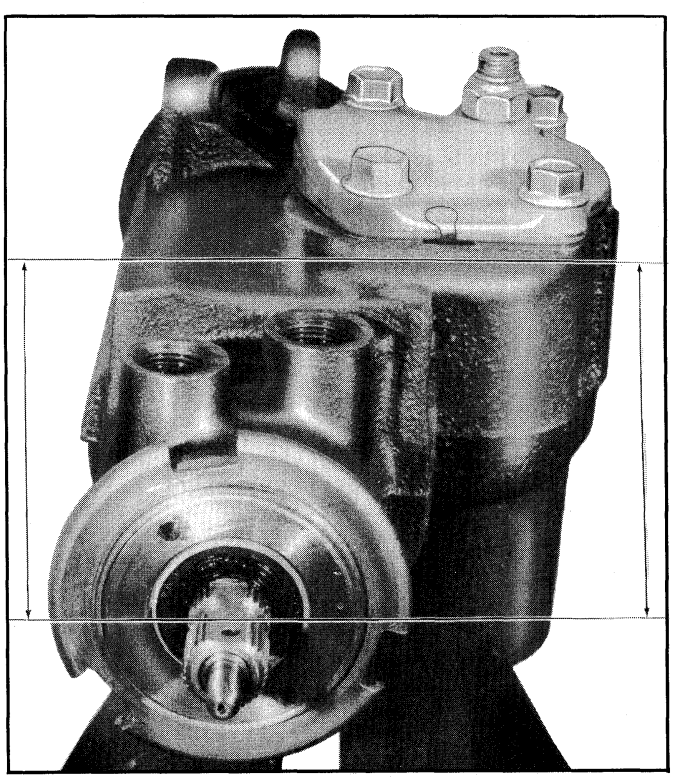


Fig. 3B-74 Aligning Stud Shaft With Side Cover

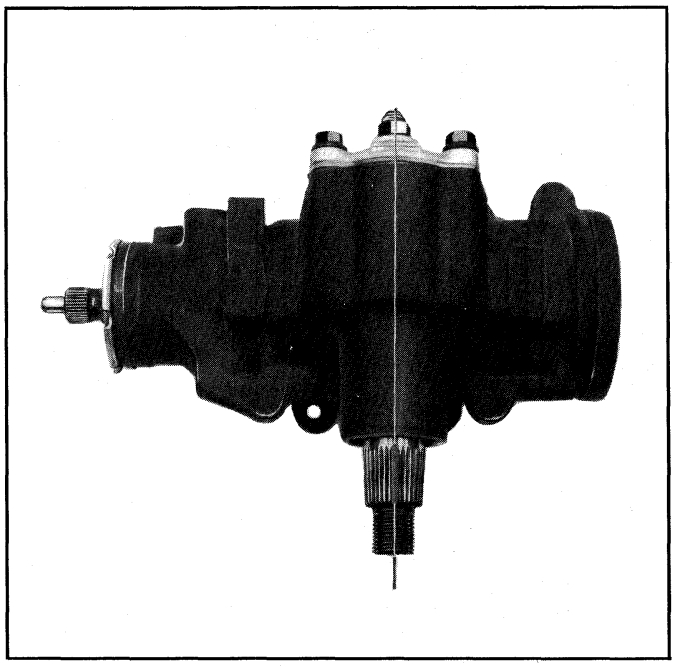


Fig. 3B-75 Block Tooth on Pitman Shaft in Line with Over-Center Preload Adjuster

NOTE: Use suitable container to catch oil forced out of gear. This method of removing the pitman shaft seals is recommended, as it eliminates the possibility of scoring the housing while attempting to pry seals out. If pressure of oil does not remove seals, turn off engine and pry seals, being careful not to score seal bore in housing.

b. Installation

1. Inspect old seals for damage to rubber covering on O.D. If O.D. appears scored, inspect housing for burrs and remove before attempting new seal installation.

2. Clean end of housing thoroughly so that dirt will not enter housing with the installation of new seals.

3. Lubricate the seals thoroughly with power steering fluid to install seals with Installer, J-6219. Install inner single lip seal first, then back-up washer. Drive seal in far enough to provide clearance for outer seal, back-up washer, and

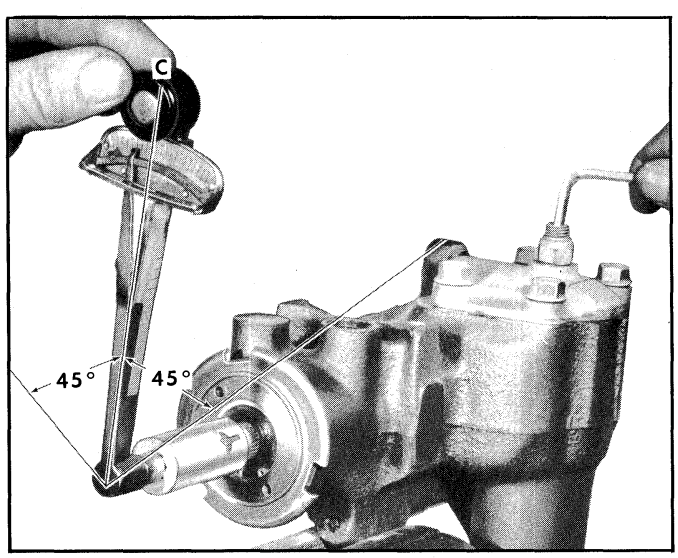


Fig. 3B-76 Obtaining Correct "ON" Center Torque

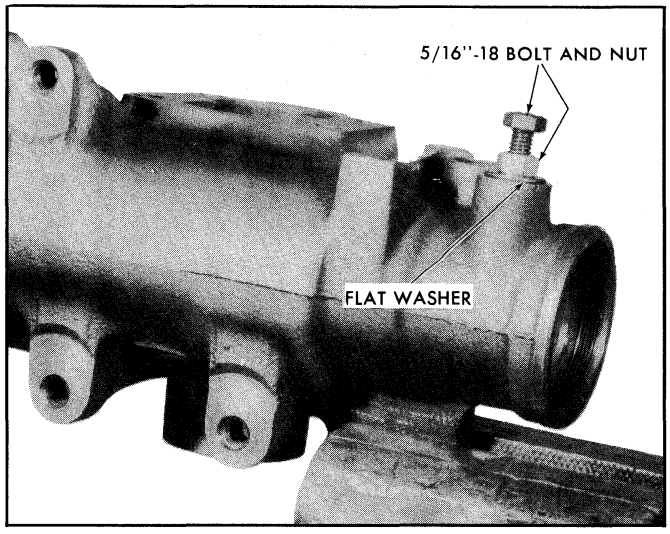


Fig. 3B-77 Removing Line Connector Seat

retaining ring. Make sure that the inner seal does not bottom on counterbore. Install outer double lip seal and second back-up washer just far enough to provide clearance for the retaining ring. Install retaining ring.

4. Fill pump reservoir to proper level with power steering fluid. Start engine and allow engine to idle for at least three minutes without turning steering wheel. Turn wheel to left and check for leaks.

5. Remove tape and reconnect pitman arm, tightening nut to 185 foot-pounds.

CAUTION: *See "CAUTION" on page 3B-20 of this section.*

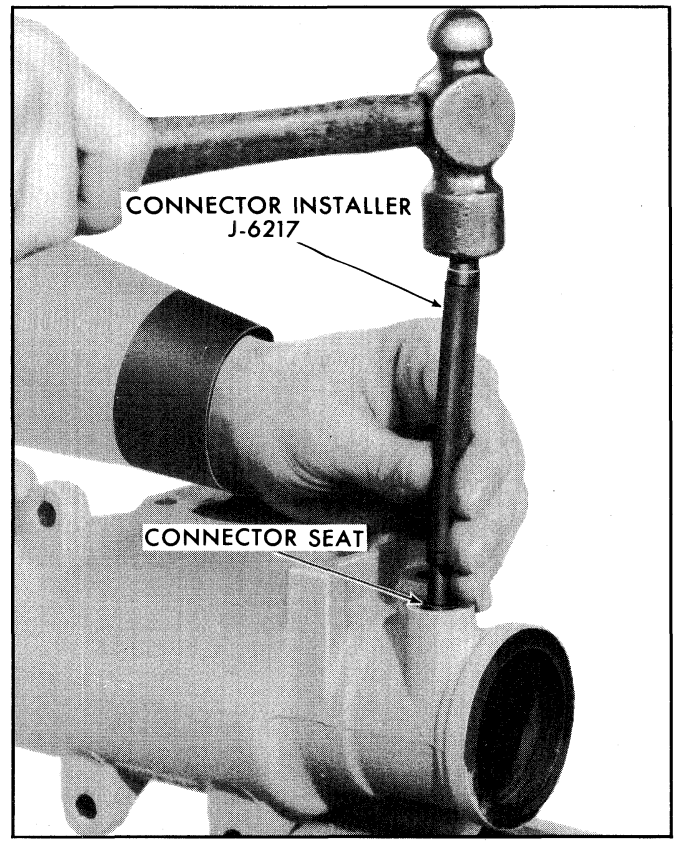


Fig. 3B-78 Installing Line Connector Seat

STEERING WHEEL AND COLUMNS

TABLE OF CONTENTS

General Description 3B-46
Standard Column Diagnosis 3B-50
Tilt and Telescoping Column Diagnosis 3B-53
Turn Signal Switch Diagnosis 3B-57
Key Buzzer Diagnosis 3B-60
On-Car Service 3B-62
Steering Wheel 3B-62
Column 3B-63
Column Alignment - Seville and Eldorado 3B-64
Unit Repair 3B-66
Standard Column 3B-66
Column Lower Bearing 3B-71
Steering Shaft 3B-71
Tilt and Telescope Column 3B-71
Checking Column for Accident Damage 3B-76
Torque Specifications 3B-78

GENERAL DESCRIPTION

Mechanical Neutral Start System

Cadillac steering columns contain a mechanical neutral start system. It can be identified by the yellow and black instruction label attached to the jacket adjacent to the ignition switch, Fig. 3B-79. This system relies on a mechanical block, rather than the starter safety switch to prevent starting the engine in other than "P" (Park) or "N" (Neutral).

The mechanical block is achieved by a cast in finger added to the switch actuator rack, Fig. 3B-80, which interferes with the bowl plate, Fig. 3B-81, in all shift positions except "N" (Neutral) or "P" (Park). This interference prevents rotation of the lock cylinder into the "START" position.

In either "P" or "N", this finger passes through the bowl plate slots, Figs. 3B-82 and 3B-83, allowing the lock cylinder full rotational travel into the "Start" position.

Servicing procedures remain the same as does assembly and disassembly. Some parts have been changed dimensionally and are identified as follows:

1. Mechanical neutral start system column is identified by yellow instruction tag adjacent to the ignition swtich, Fig. 3B-79.

2. The switch actuator rack has the projection or cast

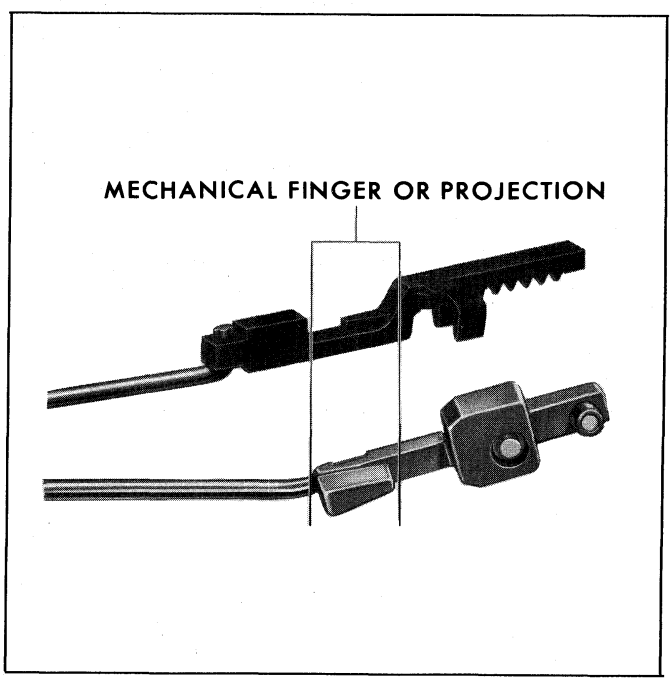


Fig. 3B-80 Actuator Rack

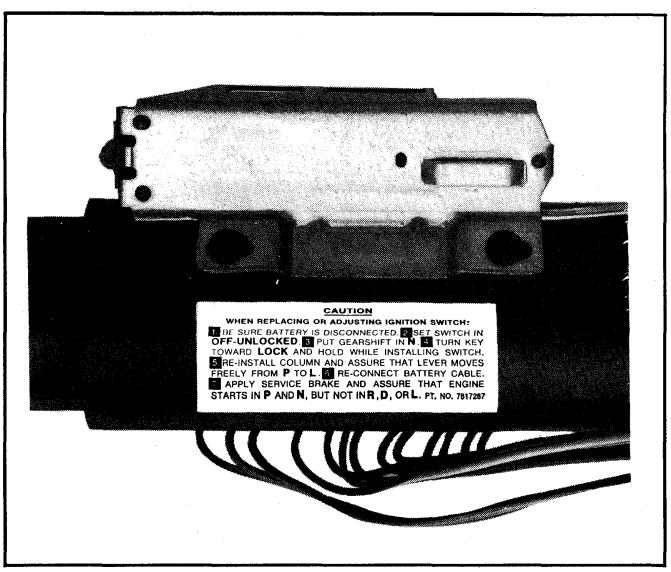


Fig. 3B-79 Instruction Label

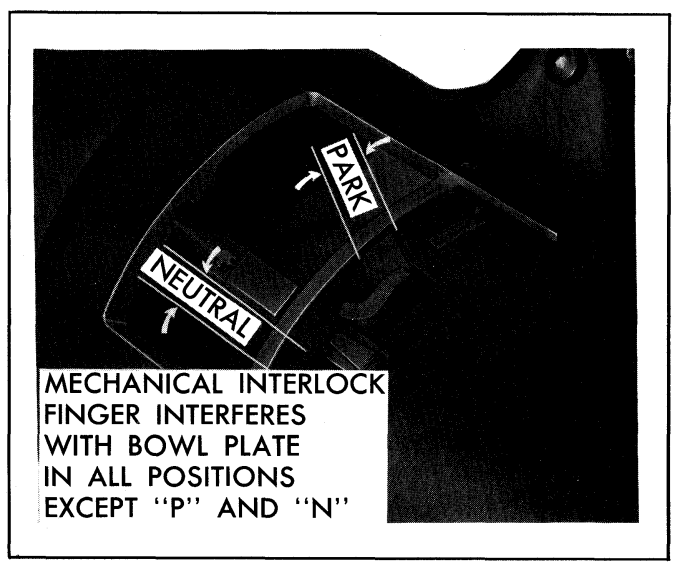


Fig. 3B-81 Bowl Plate

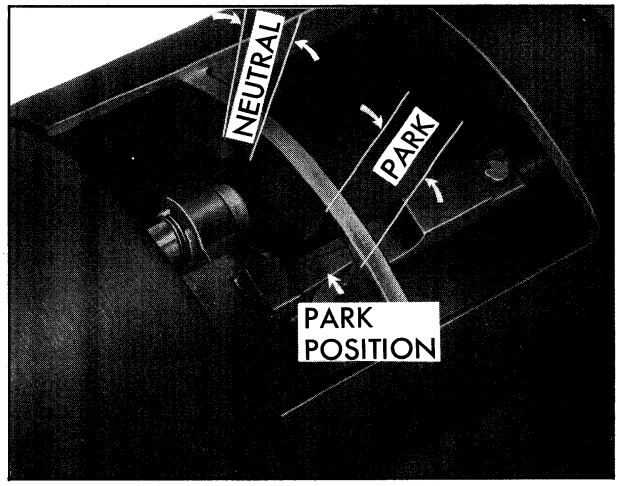


Fig. 3B-82 Bowl Plate - Park Slot

in finger and is dyed black on the standard column. The T & T column has a small strip of blue paint, Fig. 3B-80.

3. The shift bowl park and neutral slots are more precise in size and location. On the standard column it is marked with yellow paint adjacent to the "Park" slot. The tilt and telescope is different in design, Fig. 3B-84.

4. The counterbore in the standard column lower bowl bearing is not as deep. This bearing is blue, Fig. 3B-85.

CAUTION: *Do not substitute "old" style parts in service as this could defeat the mechanical neutral start system.*

Ignition Switch

The ignition switch weld nuts are chamfered as shown in Fig. 3B-86 and the flat-head screws chamfered as shown in Fig. 3B-87. Witness marks left in the switch sheet metal help re-position the switch correctly, should maintenance be performed in this area, Fig. 3B-87.

CAUTION: *When replacing or adjusting ignition switch:*

1. Be sure battery is disconnected.
2. Set switch in OFF-UNLOCKED.
3. Put gearshift in "N".

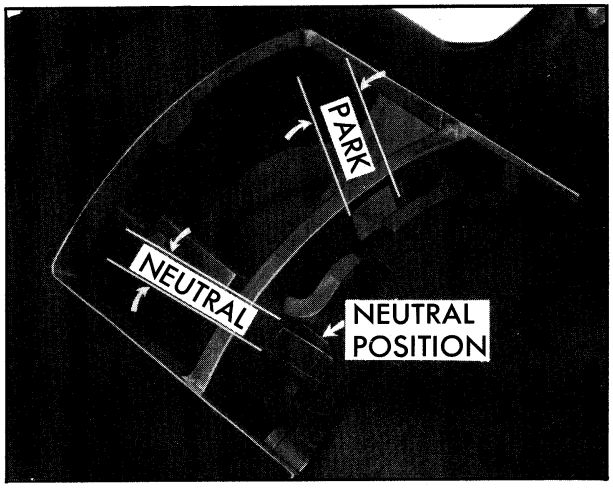


Fig. 3B-83 Bowl Plate - Neutral Slot

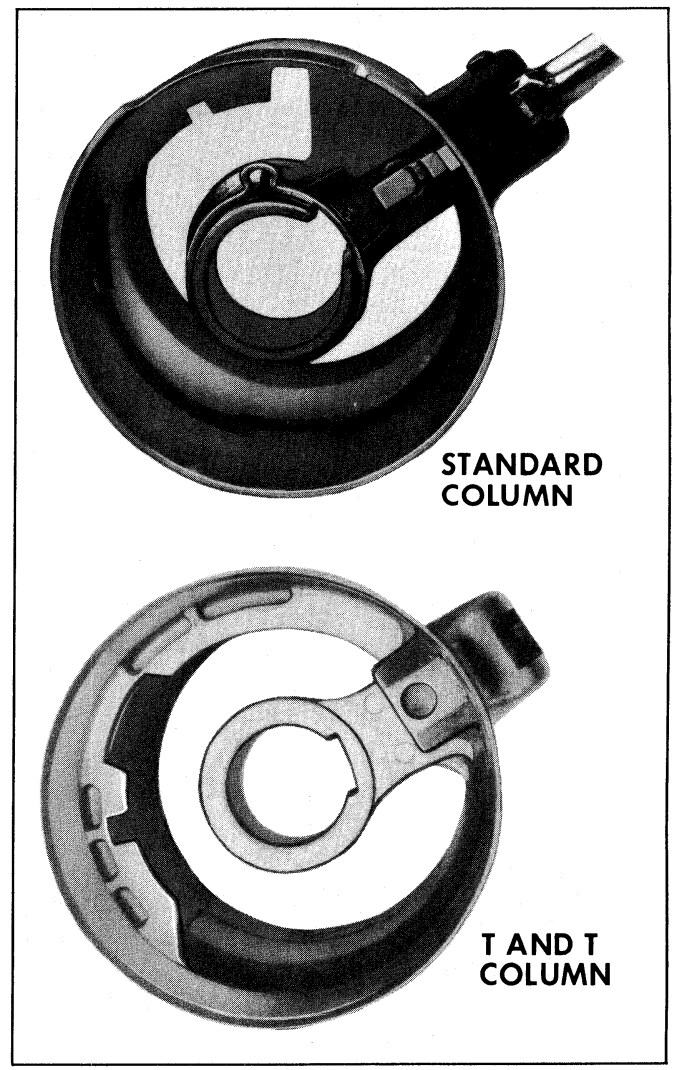


Fig. 3B-84 Shift Bowl

4. Turn key toward LOCK and hold while installing switch.

5. Re-install column and assure that lever moves freely from "P" to "L".

6. Re-connect battery cable.

7. Apply service brake and assure that engine starts in "P" and "N", but not in "R", "D", or "L".

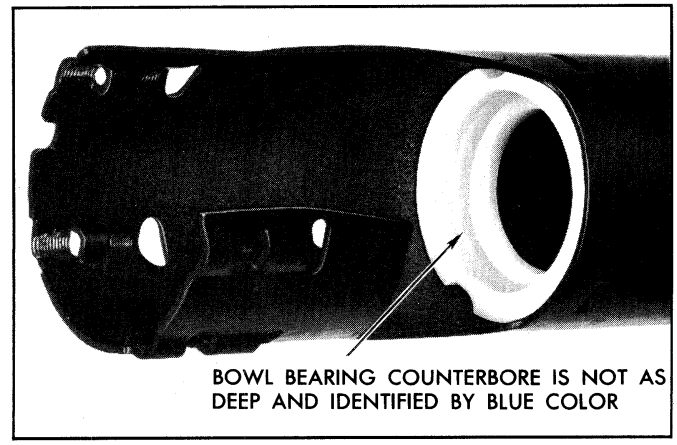


Fig. 3B-85 Bowl Bearing - Standard Column

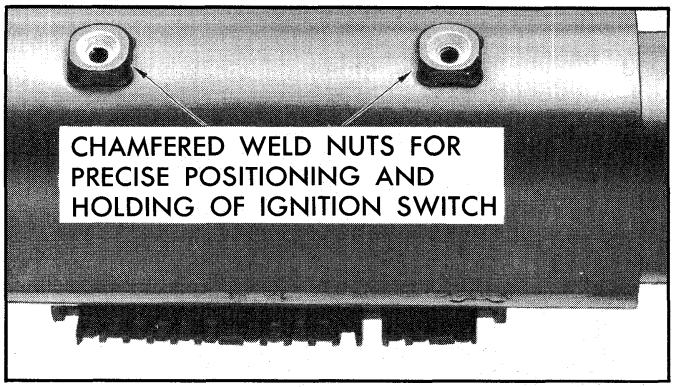


Fig. 3B-86 Chamfered Nuts

If either the ignition switch or column jacket is replaced, any "witness" marks, Fig. 3B-87, on the switch bracket must be removed by flattening and the ignition switch adjusted per the above procedure.

CAUTION: *Always check the start system as directed on the instruction label before releasing the vehicle.*

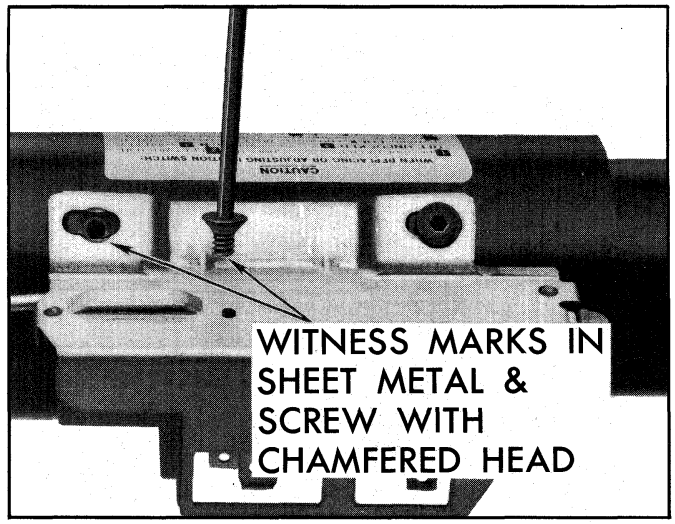


Fig. 3B-87 Witness Marks

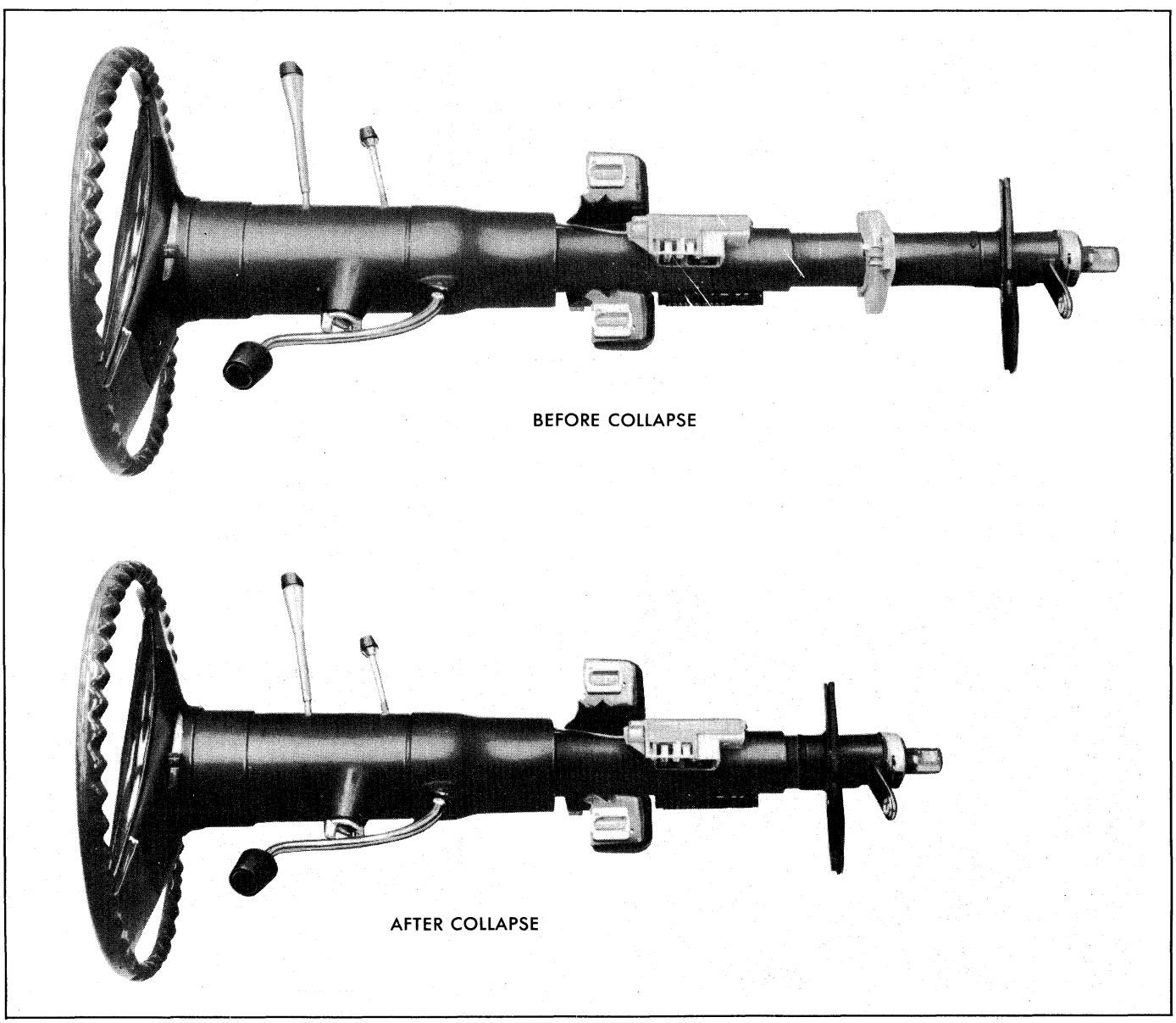


Fig. 3B-88 Energy Absorbing Steering Column

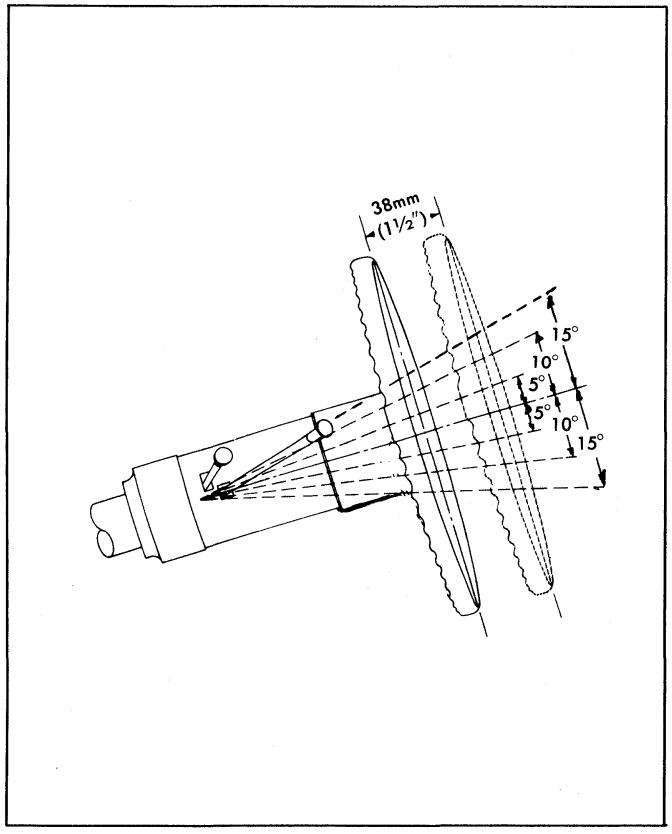


Fig. 3B-89 Tilt and Telescope Steering Wheel

Energy Absorbing Steering Column (Fig. 3B-88)

The steering columns used on Cadillac automobiles are of the energy absorbing type. The outer jacket consists of two tubes of different diameters joined together by four rows of ball bearings (36 balls total) that are pressed into position. During impact, the ball bearings roll along the jacket wall allowing the smaller, lower end of the jacket to collapse within the larger upper end. The steering shaft is constructed in two parts fitting together so that they can telescope. The shift tube is constructed in two telescoping parts. An injected plastic joint holds the telescoping parts of both the steering shaft and the shift tube so that they remain in the proper relationship under normal operation.

The column is supported in the car at the upper mounting position by a bracket containing two release capsules. If an excessive impact load acts on the upper end of the column, the upper mount release capsules will shear and allow the column to collapse downward.

CAUTION: *Do not use bolts longer than specified at the upper mounting capsule bracket to jacket attachment as it may adversely effect the column collapse.*

Equally important is the correct torquing of all nuts and bolts. Follow exactly the torque recommendations given in every step. The column must be handled and serviced with **extreme care.** Use only the specified screws, bolts and nuts during assembly.

At no time should the column, shift tube, or steering shaft be struck from either end with a hammer, or pulled excessively. Care must also be taken never to let the column drop when removing or installing to prevent accidental collapse of either the steering shaft or the outer jacket.

Tilt and Telescope Steering Column (Figs. 3B-89 and 3B-103)

The Tilt and Telescope steering column consists of a steering shaft with a spherical joint, adjusting and locking mechanism for tilt adjustment; a telescoping upper shaft and yoke assembly, and locking mechanism for telescopic adjustment. These adjustments are made independently of each other.

The up and down tilt action is achieved by pulling upward on a small lever located on the left side of the steering column just below the directional signal lever, which allows the steering wheel to be positioned at any one of seven possible angles. Releasing the lever will lock the wheel in position.

A knob located at the top of the steering column, where it meets the steering wheel, releases the steering column telescoping mechanism for adjustment. To lengthen or shorten the steering column within its range, move the telescope lock-unlock knob fully left, push or pull the steering wheel to the desired position, and move the lock-unlock knob fully right.

Service operations on the steering gear, power steering pump, and steering linkage are exactly the same on cars equipped with a Tilt and Telescope wheel as on cars with the standard wheel. Steering gear adjustments are performed in the same manner and to the same specifications. Steering column to gear alignment and steering wheel alignment also are the same.

STANDARD COLUMN DIAGNOSIS CHART

CONDITION	CAUSE	CORRECTION
Will not unlock.	Sector collapsed. Lock bolt damaged. Damaged lock cylinder. Damaged housing.	Replace sector shaft. Replace lock bolt. Replace lock cylinder. Replace housing.
Will not lock.	Lock bolt spring broken or damaged. Damaged sector tooth. Damaged lock cylinder. Burr on lock bolt or housing. Damaged housing. Transmission linkage adjustment incorrect. Sector installed incorrectly.	Replace lock bolt assembly. Replace sector. Replace lock cylinder. Remove burr. Replace housing. Readjust. Install correctly.
High effort.	Lock cylinder damaged. Ignition switch damaged. Rack preload spring broken or deformed. Burrs on sector, rack or housing. Bent sector shaft. Actuator rod restricted.	Replace lock cylinder. Replace ignition switch. Replace rack preload spring. Remove burr. Replace housing assembly. Remove restriction.
High effort on lock cylinder between "off" and "off-lock".	Burr on tang of shift gate. Distorted rack.	Remove burr. Replace rack.
Will stick in "start".	Actuator rod deformed. Any high effort condition. Ignition switch damaged.	Straighten or replace. Check items under high effort section. Replace switch.
Lock bolt hits shaft lock in "off" position and "park".	Ignition switch is not set correctly.	Readjust ignition switch.
Key cannot be removed in "off-lock".	Ignition switch is not set correctly. Damaged lock cylinder.	Readjust. Replace lock cylinder.
Lock cylinder can be removed without depressing retainer.	Lock cylinder with damaged retainer. Lock cylinder without retainer. Burr over retainer slot in housing.	Replace lock cylinder. Replace lock cylinder. Remove burr in housing.

STANDARD COLUMN DIAGNOSIS CHART (Cont'd.)

CONDITION	POSSIBLE CAUSE	CORRECTION
	IGNITION SYSTEM	
Electrical system will not function.	Blown fuse in "Accessory" circuit.	Replace fuse.
	Connector body loose or damaged.	Seat locking tangs or replace.
	Broken wiring.	Repair or replace.
	Damaged ignition switch.	Replace ignition switch.
Switch will not actuate mechanically.	Damaged ignition switch.	Replace ignition switch. NOTE: Follow installation procedure outlined on label attached to column.
Switch cannot be set correctly.	Switch actuator rod deformed.	Repair or replace switch actuator rod.
Noise in column.	Coupling bolts not tightened.	Tighten pinch bolts to specified torque.
		Tighten coupling bolts to specified torque. (Parts should be inspected for damage before reassembling. If serrations or threads are damaged, replace parts).
	Coupling pulled apart.	Realign column and replace coupling.
		Broken shaft plastic injected joint. If shaft is damaged, replace -- if not, repair joint using steering shaft repair kit.
	Horn contact ring not lubricated.	Lubricate with lubriplate or equivalent.
	Lack of grease on bearings or bearing surface.	Lubricate.
	Lower shaft bearing tight or frozen.	Replace bearing. Check shaft and replace if scored.
	Upper shaft bearing tight or frozen.	Replace housing assembly.
	Shaft lock plate cover loose.	Tighten three screws to specified torque or, if missing, replace. *CAUTION: Use specified screws only.*
	Lock plate retaining ring not seated.	Replace retaining ring. Check for proper seating in groove.
	Shaft lock plate cover loose.	Tighten three screws.

Method to Determine Column Collapse

Measure distance between top of neutral-start switch window opening and the bottom of the upper jacket.

The correct dimension is:

73mm - 67mm (2 7/8" - 2 5/8") – "C" Car
144mm - 140mm (5 11/16" - 5 1/2") – Eldorado
105mm - 99mm (4 1/8" - 3 7/8") – Seville

STANDARD COLUMN DIAGNOSIS CHART (Cont'd.)

CONDITION	POSSIBLE CAUSE	CORRECTION
One click when in "off-lock" position and the steering wheel is moved.		None - normal -- lock bolt is seating.
High steering shaft turning effort.	Column assembly misaligned in vehicle. Improperly installed or deformed dust seal. Tight or frozen upper or lower bearings. U-Joint binding (Eldorado only)	Align correctly. Replace dust seal. Replace. Replace U-Joint
High shift effort.	Column not aligned correctly in car. Lower bowl bearing not assembled correctly. Improperly installed dust seal. Lack of grease on seal or bearing areas.	Realign Reassemble correctly. Remove and replace. Lubricate.
Improper transmission shifting.	Sheared shift tube joint. Improper transmission linkage adjustment. Improper gate plate.	Replace shift tube assembly. Readjust. Replace with correct part.
Miscellaneous.	Shroud loose on shift bowl. Housing loose on jacket -- will be noticed with ignition in "off-lock" and a torque applied to the steering wheel.	Bend tabs on shroud over lugs on bowl. Tighten four mounting screws to specified torque.
Lash in mounted column assembly.	IP to dash mounting bolts loose. Broken weld nuts on jacket. IP bracket capsule sheared. IP to jacket mounting bolts loose.	Tighten to specified torque. Replace jacket assembly. Replace bracket assembly. Tighten to specified torque.

TILT AND TELESCOPING COLUMN DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Will not unlock.	Shear flange on sector shaft collapsed.	Replace sector shaft.
	Lock bolt damaged.	Replace lock bolt.
	Inoperative lock cylinder.	Replace lock cylinder.
	Damaged housing.	Replace housing.
	Damaged sector.	Replace sector.
	Damaged rack.	Replace rack.
Will not lock.	Lock bolt spring broken or defective.	Replace lock bolt spring.
	Damaged sector tooth.	Replace sector.
	Inoperative lock cylinder.	Replace lock cylinder.
	Burr on lock bolt or housing.	Remove burr.
	Damaged housing.	Replace housing.
	Transmission linkage adjustment incorrect.	Readjust.
	Damaged rack.	Replace rack.
	Interference between bowl and rack coupling.	Replace bowl or actuator rod as required.
	Ignition switch stuck.	Replace ignition switch.
	Actuator rod restricted.	Readjust.
High effort.	Lock cylinder inoperative.	Replace lock cylinder.
	Ignition switch inoperative.	Replace ignition switch.
	Rack preload spring broken or deformed.	Replace preload spring.
	Burrs on sector, rack, housing, support or actuator rod coupling.	Remove burr.
	Bent sector shaft.	Replace shaft.
	Defective rack.	Replace rack.
	Extreme misalignment of housing to cover.	Replace either or both.
	Distorted coupling slot in rack.	Replace rack.
	Bent actuator rod.	Straighten or replace.
	Ignition switch mounting bracket bent.	Straighten or replace.
Will stick in "start".	Actuator rod deformed.	Straighten or replace.
	Any high effort condition.	Check items under high effort section.
	Ignition switch inoperative.	Replace switch.

TILT AND TELESCOPING COLUMN DIAGNOSIS CHART (Cont'd.)

CONDITION	POSSIBLE CAUSE	CORRECTION
Key cannot be removed in "off-lock".	Ignition switch is not adjusted correctly.	Readjust
	Inoperative lock cylinder.	Replace lock cylinder.
Lock cylinder can be removed without depressing retainer.	Lock cylinder with damaged retainer.	Replace lock cylinder.
	Lock cylinder without retainer.	Replace lock cylinder.
	Burr over retainer slot in housing cover.	Remove burr.
	IGNITION SYSTEM	
Electrical system will not function.	Poor battery connection.	Connect securely.
	Connector body loose.	Tighten or replace.
	Defective wiring.	Repair or replace.
	Inoperative ignition switch.	Replace ignition switch.
	Ignition switch not adjusted properly.	Readjust.
Switch will not actuate mechanically.	Inoperative ignition switch.	Replace.
Switch cannot be set correctly.	Switch actuator rod deformed.	Repair or replace.
	Sector to rack engaged in wrong tooth.	Engage correctly.
	COLUMN	
Noise in column.	Coupling bolts not tightened.	Tighten pinch bolts to specified torque.
	Column not correctly aligned. (Eldorado and Seville only)	Realign column.
	Coupling pulled apart.	Realign column and replace coupling.
	Broken steering shaft plastic injected joint.	Repair joint using steering shaft repair kit and realign column.
	Horn contact ring not lubricated.	Lubricate with lubriplate or equivalent.
	Lack of grease on bearings or bearing surfaces.	Lubricate
	Loose tilt lever opening shields.	Bend to eliminate rattle.
	Lower shaft bearing worn or broken.	Replace bearing.
		Check shaft and replace if scored.
	Upper shaft bearing worn or broken.	Replace bearing assembly.
	One click when in "off-lock" position and the steering wheel is moved.	Normal -- lock bolt is seating.

TILT AND TELESCOPING COLUMN DIAGNOSIS CHART (Cont'd.)

CONDITION	POSSIBLE CAUSE	CORRECTION
High steering shaft effort.	Column assembly misaligned. (Eldorado and Seville only).	Realign.
	Improperly installed or deformed dust seal.	Install new seal.
	Defective upper or lower bearing.	Replace.
	Flashing on I.D. of shift tube from plastic joint.	Replace shift tube.
	Tight steering upper coupling.	Repair or replace. (Except Eldorado)
	Tight steering universal joint (Eldorado only.)	Repair or replace.
High shift effort.	Column not aligned correctly in car. (Eldorado and Seville only.)	Realign.
	Wave washer with burrs.	Replace.
	Improperly installed dust seal.	Remove and replace.
	Lack of grease on seal or bearing.	Lubricate.
	Improper screws used for ignition switch, neutral start switch or mounting bracket.	Use correct fasteners.
	Burr on upper or lower end of shift tube.	Remove burr.
Improper transmission shifting.	Sheared shift tube joint or lower shift lever weld.	Replace tube assembly.
	Improper transmission linkage adjustment.	Readjust.
Miscellaneous.	Housing loose on jacket -- will be noticed with ignition in "off-lock" and a torque applied to the steering wheel.	Tighten four mounting screws to specified torque.
Lash in mounted column assembly.	IP to dash mounting bolts loose.	Tighten to specified torque.
	Broken weld nuts on jacket.	Replace jacket assembly.
	IP bracket capsule sheared.	Replace bracket assembly.
	Loose shoes in housing.	Replace shoes.
	Loose tilt head pivot pins.	Replace pivot pins.
	Loose shoe lock pin in support.	Replace pin.
	Loose support screws.	Tighten to specified torque.
Housing scraping on bowl.	Bowl bent or not concentric with hub.	Replace bowl.

TILT AND TELESCOPING COLUMN DIAGNOSIS CHART (Cont'd.)

CONDITION	POSSIBLE CAUSE	CORRECTION
Steering wheel loose.	Wheel loose on shaft.	Tighten nut to specified torque.
	Inoperative or missing anti-lash spring in spheres.	Add spring or replace both.
	Upper bearing not seating in bearing race.	Replace both.
	Upper bearing inner race seat missing.	Install seat.
	Improperly adjust T & T locking lever.	Readjust.
	Loose support screws.	Tighten to specified torque.
	Bearing preload spring missing or broken.	Replace preload spring.
Steering wheel loose -- every other tilt position.	Loose fit between shoe and shoe pivot pin.	Replace both.
Steering column not locking in any tilt position.	Shoe seized on its pivot pin.	Replace both.
	Shoe grooves may have burrs or dirt.	Replace shoe.
	Shoe lock spring weak or broken.	Replace lock spring.
Steering wheel fails to return to top tilt position.	Pivot pins are seized.	Replace pivot pins.
	Wheel tilt spring is inoperative.	Replace tilt spring.
	Turn signal switch wires too tight.	Readjust.
Noise when tilting column.	Upper tilt bumpers worn.	Replace housing assembly.
	Tilt spring rubbing in housing.	Lubricate.

Method to Determine Column Collapse

Measure distance between top of neutral-start switch window opening and the bottom of the upper jacket. The correct dimension is:

73mm - 67mm (2 7/8" - 2 5/8") – "C" Car
144mm - 140mm (5 11/16" - 5 1/2") – Eldorado
105mm - 99mm (4 1/8" - 3 7/8") – Seville

TURN SIGNAL SWITCH DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Turn signal will not cancel.	Loose switch mounting screws.	Tighten to specified torque.
	Switch or anchor bosses broken.	Replace switch.
	Broken, missing or out of position detent, return or cancelling spring.	Reposition or replace spring as required.
	Uneven or incorrect cancelling cam to cancelling spring interference.	Replace cancelling cam. If "will not cancel" condition still exists, replace turn signal switch.
Turn signal difficult to operate.	Actuator rod loose.	Tighten to specified torque.
	Yoke broken or distorted.	Replace switch.
	Loose or misplaced springs.	Reposition or replace springs.
	Foreign parts and/or material.	Remove foreign parts and/or material.
	Switch mounted loosely.	Tighten mounting screws to specified torque.
Turn signal will not indicate lane change.	Broken lane change pressure pad or spring hanger.	Replace switch.
	Broken, missing or misplaced lane change spring.	Replace or reposition as required.
	Jammed base or wires.	Loosen mounting screws, reposition base or wires and retighten screws to specified torque.
Turn signal will not stay in turn position.	Foreign material or loose parts impeding movement of yoke.	Remove material and/or parts.
	Broken or missing detent or cancelling spring.	Replace spring.
	None of the above.	Replace switch.
Hazard switch cannot be turned off.	Foreign material between hazard support cancelling leg and yoke.	Remove foreign material.
		No foreign material impeding function of hazard switch -- replace turn signal switch.
Hazard switch will not stay on or difficult to turn off.	Loose switch mounting screws.	Tighten mounting screws to specified torque.
	Interference with other components.	Remove interference.
	Foreign material.	Remove foreign material.
	None of the above.	Replace switch.
	Actuating lever not installed properly.	Reinstall switch and lever assembly.

TURN SIGNAL SWITCH DIAGNOSIS CHART (Cont'd.)

CONDITION	POSSIBLE CAUSE	CORRECTION
No turn signal lights.	Inoperative or blown fuse.	Replace fuse.
	Inoperative turn signal flasher.	Replace turn signal flasher. Note: There are two flashers in the system.
	Loose chassis to column connector.	Connect securely. (Make sure locking tang is secured.)
	Disconnect column to chassis connector. Connect new switch to chassis and operate switch by hand.	
	If vehicle lights now operate normally, signal switch is inoperative.	Replace signal switch.
	If vehicle lights do not operate, check chassis wiring for opens, grounds, etc.	Repair chassis wiring as required using service manual as guide.
Turn indicator lights on, but not flashing.	Inoperative turn flasher.	Replace turn flasher. Note: There are two flashers in system.
	Loose chassis to column connection.	Connect securely.
	Inoperative turn signal switch. To determine if turn signal switch is inoperative, substitute new switch into circuit and operate switch by hand. If the vehicle's lights operate normally, signal switch is inoperative.	Replace turn signal switch.
	If the vehicle's lights do not operate, check light sockets for high resistance connections, the chassis wiring for opens, grounds, etc.	Repair chassis wiring as required using service manual as guide.
Front or rear turn signal lights not flashing.	Burned out fuse.	Replace fuse.
	Burned out or damaged turn signal bulb.	Replace bulb.
	High resistance connection to ground at bulb socket.	Remove or repair connection.
	Loose chassis to column connector.	Connect securely.
	Disconnect column to chassis connector. Connect new switch into system and operate switch by hand.	
	If turn signal lights are now on and flash, turn signal switch is inoperative.	Replace turn signal switch.
	If vehicle lights do not operate, check chassis wiring harness to light sockets for opens, grounds, etc.	Repair chassis wiring as required using service manual as guide.
Stop light not on when turn indicated.	Burned out fuse.	Replace fuse.
	Loose column to chassis connection.	Connect securely.
	Disconnect column to chassis connector. Connect new switch into system without removing old switch and operate by hand.	

TURN SIGNAL SWITCH DIAGNOSIS CHART (Cont'd.)

CONDITION	POSSIBLE CAUSE	CORRECTION
Stop light not on when turn indicated (cont.)	If brake lights work with switch in the turn position, signal switch is inoperative.	Replace signal switch.
	If brake lights do not work, check connector to stop light, circuits, for grounds, open, etc.	Repair connector to stop light circuits using service manual as guide.
Turn indicator panel lights not flashing.	Burned out bulbs.	Replace bulbs.
	High resistance to ground at bulb socket.	Replace socket.
	Opens, grounds in wiring harness from front turn signal bulb socket to indicator lights.	Locate and repair as required. Use service manual as guide.
Turn signal lights flash very slowly.	Inoperative turn signal flasher.	Replace turn signal flasher.
	System charging voltage low.	Increase voltage to specified. Use service manual.
	High resistance ground at light sockets.	Repair high resistance grounds at light sockets.
	Loose chassis to column connection.	Connect securely.
	Disconnect column to chassis connector. Connect new switch into system without removing old switch and operate by hand. If flashing occurs at normal rate, the signal switch is inoperative.	Replace signal switch.
	If the flashing rate is still extremely slow, check chassis wiring harness from the connector to light sockets for grounds, high resistance points, etc.	Locate and repair as required. Use manual as guide.
Hazard signal lights will not flash -- turn signal functions normally.	Blown fuse.	Replace fuse.
	Inoperative hazard warning flasher.	Replace hazard warning flasher.
	Loose chassis to column connection.	Connect securely.
	Disconnect column to chassis connector. Connect new switch into system without removing old.	
	Depress the hazard warning button and observe the hazard warning lights. If they now work normally, the turn signal switch is inoperative.	Replace the turn signal switch.
	If the lights do not flash, check wiring harness for open between hazard flasher and harmonica connector. If open, fuse block is inoperative.	Replace fuse block.

KEY BUZZER DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Buzzer does not sound with key fully inserted in lock cylinder with the driver's door open.	Inoperative buzzer.	Replace buzzer.
	Bad connection at buzzer.	Connect securely.
	Power not available to buzzer.	Check continuity of chassis wiring and repair as required.
	Horn relay inoperative.	Check by grounding #4 terminal on horn relay, if buzzer does not sound, replace horn relay.
	Door jamb switch on driver's side misadjusted or inoperative.	Adjust or replace as required.
	Short in chassis wiring.	Check by separating chassis to column connector. Connect (black) and (black w/pink stripe) female contacts on the chassis side. A bent paper clip will work. If buzzer sounds, continue diagnosis. If not, locate and repair chassis wiring.

Note 1: If the buzzer fault has not yet been detected, connect a continuity meter (light) to the male "E & F" connector contacts of the turn signal switch connector, Fig. 3B-99. Insert the key the full depth into the lock cylinder.

If contact is made with the key in, and is not made with it out, the function is normal. Retrace initial diagnostic steps.

If contact is not established, the fault is in the column. Proceed to Note 2.

Note 2: With the fault isolated in the column, disassemble the upper end of the column until the signal switch mounting screws have been removed. Lift the switch and check the probes of the buzzer switch to insure good contact with the pads on the signal switch. Bend probes, if required, then reseat the signal switch and install the three screws. Check the function, as in Note 1.

CONDITION	POSSIBLE CAUSE	CORRECTION
Buzzer does not sound, cont'd.	Short or fault in signal switch wiring.	Check wiring by connecting continuity meter on "E" terminal of connector and turn signal switch, buzzer switch pad with black wire attached and "F" terminal to pad with pink wire attached. If contact is made, function is normal. If not, replace signal switch.

Note 3: If the buzzer has not yet been isolated and repaired, connect a continuity meter to the buzzer switch electrical contact probes. Fully insert and remove the key from the lock cylinder.

If contact is made with the key in, and is broken with it out, the function is normal. Retrace diagnostic steps starting at Note 2.

If contact is not made, the fault is in the lock cylinder or buzzer switch.

KEY BUZZER DIAGNOSIS CHART (Cont'd.)

CONDITION	POSSIBLE CAUSE	CORRECTION
Buzzer does not sound cont'd.	Chips, burrs, foreign material preventing actuator tip function. *CAUTION: Key must be removed or cylinder in "run" position before removing lock cylinder.*	Remove chips, burrs, etc. Reassemble and recheck, see note 3.
	Sticking lock cylinder.	With the lock cylinder out (observing caution above), fully insert and remove the key. The actuator should extend and retract smoothly.
	Chips, foreign material affecting buzzer switch operation.	Remove and clean as required. Reassemble and re-check, see note 3.
	Damaged or broken buzzer switch.	Replace buzzer switch.
	Switch appears good but will not make contact.	Connect continuity meter leads to the buzzer switch probes, Fig. 3B-99. Press on the actuator pad until the interior points contact. If contact is not made, replace buzzer switch.
	Buzzer switch contact gap too large.	Reset contact gap.

Note 4: Setting the contact gap, (Fig. 3B-99). Press a .030 wire type spark plug gage with flat piece of stock on the actuator pad.

If contact is not made adjust switch as shown until positive contact is made. (Use continuity meter).

With positive contact at .030, use a .025 plug gage wire beneath the flat stock. No contact should occur. Adjust as shown in Fig. 3B-99. When the switch will make contact with the .030 wire, and not with the .025, the buzzer switch is set at the low limit.

CONDITION	POSSIBLE CAUSE	CORRECTION
Buzzer continues to operate with key in the lock cylinder with the driver's door either opened or closed and ceases when key is removed.	Door jamb switch on driver's side misadjusted or inoperative.	Adjust or replace as required.
	Wire from signal switch to door jamb switch shorted.	If on signal switch side, replace signal switch.
		If on chassis side, find and repair as outlined in service manual.

Note 5: This condition indicates the lock cylinder or buzzer switch is at fault. To verify, check for continuity at the "E" & "F" male connector contacts with the key removed from the lock cylinder, Fig. 3B-99. If continuity exists, the fault is in the column.

CONDITION	POSSIBLE CAUSE	CORRECTION
Buzzer continues to operate with key out, but stops when driver's door is closed.	Turn lock towards start position. If buzzer stops in "Run" position or when turned past "Run" towards "Start" the problem is a sticky lock cylinder actuator.	Replace lock cylinder.
	Chips, foreign material in lock cylinder bore.	Remove, reassemble and recheck function.
	Sticky lock cylinder actuator tip.	Replace lock cylinder.
	Damaged or broken buzzer switch.	Replace buzzer switch.
	Buzzer switch contact gap too close.	Adjust as specified.

ON-CAR SERVICE

Steering Wheel (Fig. 3B-90)

a. Removal

CAUTION: *Under no circumstances should the steering shaft be struck on the end in an effort to remove the steering wheel. This action may damage delicate parts of the steering column.*

1. Disconnect battery.
2. Remove 2 screws from back of spokes and lift pad assembly from wheel.
3. Remove horn contact wire from plastic tower by pushing in on wire and turning counterclockwise. Wire will then spring out of tower.

NOTE: Turn ignition to ON to facilitate removal.

4. On Tilt and Telescope wheel proceed with Steps 5 and 6. On standard wheels proceed to Step 7.
5. Remove three screws securing the telescope locking lever assembly to flange and screw assembly.
6. Unscrew flange and screw assembly from steering shaft and remove.
7. Remove locking lever assembly.
8. Scribe an alignment mark on steering wheel hub in line with slash mark on steering shaft to be used at time of installation.
9. Loosen nut on steering shaft positioning it flush with end of shaft.
10. Carefully install Steering Wheel Puller, J-1859-03 with two 5/16"-18 x 4" bolts, Fig. 3B-90.
11. Tighten center bolt until steering wheel is loose on shaft.
12. Remove puller.
13. Remove steering shaft nut.

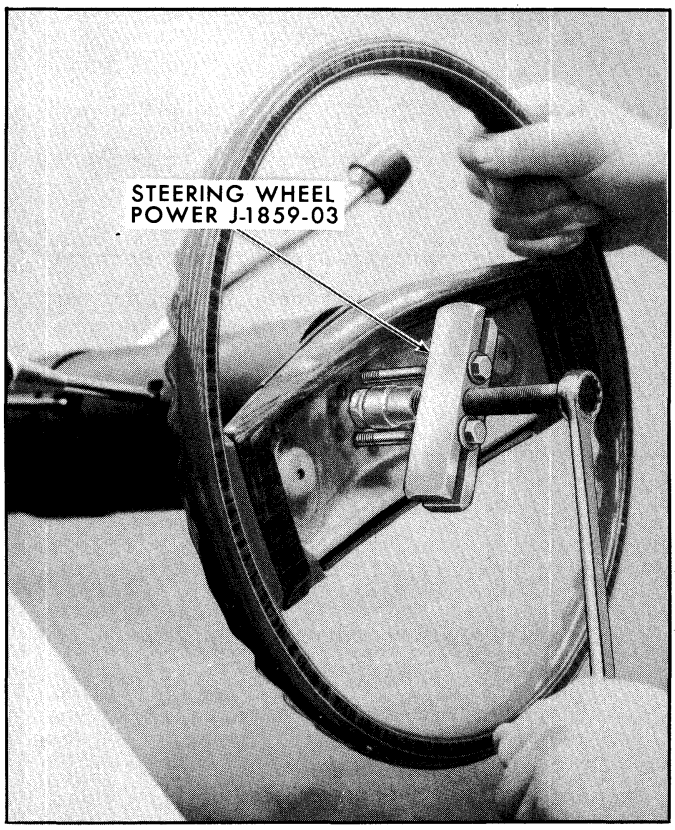


Fig. 3B-90 Steering Wheel Removal

14. Lift wheel off steering shaft.

CAUTION: *When laying wheel face down, place a cloth on work bench to prevent wheel from being scratched or marked.*

b. Installation

1. Install steering wheel, aligning scribe mark on hub with slash mark on end of shaft.

CAUTION: *The steering wheel should not be driven on the steering shaft. This action may cause damage to the steering column components.*

2. Install steering shaft nut and tighten to 30 foot-pounds.

CAUTION: *See "CAUTION" on page 3B-20 of this section.*

3. On Tilt and Telescope columns, proceed to steps 4 thru 7. On standard columns, proceed to step 8.
4. Install locking lever assembly on steering wheel.
5. Screw flange and screw assembly finger tight into steering shaft.
6. Position locking lever assembly against flange and screw assembly with lever in vertical position. Secure with three screws. Check operation of lever after tightening screws to assure proper release and tightening of telescoping shaft.
7. Check operation of telescoping mechanism by rotating locking lever against stops. Check to see that wheel is free to telescope in left position and is securely locked in right position.

NOTE: When lever is securely locked, it should not contact steering wheel slot. If necessary, readjust as described in steps 5 and 6.

8. Insert horn contact wire into plastic tower by pushing in against spring pressure and turning to the right to lock in position.
9. Position pad assembly on wheel and secure with two screws from rear side of wheel.

c. Alignment

In the event the steering wheel spokes are "off-center" when the car is being driven down the road, it will be necessary to align steering wheel or front wheels as described below:

1. Check steering wheel for proper position on steering shaft. With steering wheel "centered" in car, slot in flexible coupling upper shaft flange should be facing upward with scribe mark on upper end of steering shaft at "12 o'clock". If necessary, reposition steering wheel on shaft.
2. Drive car on a straight flat road to determine whether or not steering wheel is still "off-center".
3. If steering wheel is still "off-center", mark top of the wheel with a small piece of tape or crayon for reference when making correction.
4. Set wheel straight ahead and adjust tie rods. Shorten left tie rod and lengthen right tie rod if top of wheel is to the left of center, or shorten right tie rod and lengthen left tie rod if top of wheel is to the right of center. Be careful not to damage joint seals when adjusting tie rods.

NOTE: Tie rod adjustment must be made on a wheel alignment machine so that correct toe-in setting is maintained.

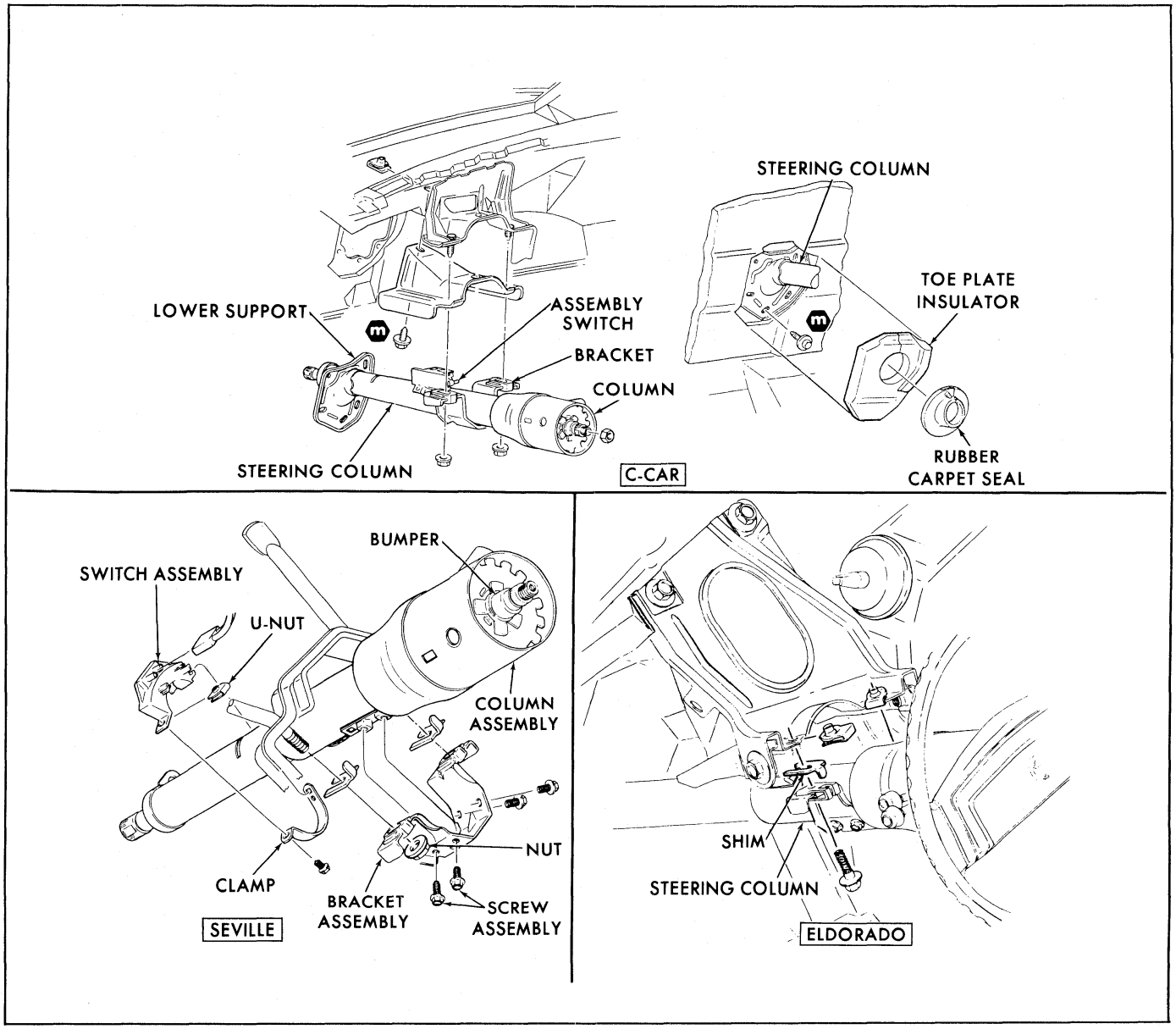


Fig. 3B-91 Steering Column Mounting

Steering Column (Fig. 3B-91)

NOTE: If an electrical problem in the steering column is encountered, steering column analyzer, J-23980, is available as a diagnostic tool.

a. Removal

1. Center steering wheel to gain access to upper coupling pinch bolt and nut.
2. Raise hood and disconnect negative battery cable.
3. Disconnect transmission linkage at lower shift lever. Remove pinch bolt and remove intermediate shaft from spline. For Eldorado, remove bolt securing universal joint to lower steering shaft.
4. Remove steering column lower cover as described on page 8-4. (for Seville, page 8-41; Eldorado, page 8-21).
5. Disconnect turn signal wiring at connector.

NOTE: If car is equipped with Cruise Control, disconnect harness at this time.

6. Remove screw securing shift cable to shift bowl.
7. Loosen two vertical nuts at steering column upper support and on Seville only, remove shims. (On Eldorado, loosen two vertical bolts at steering column upper support far enough to remove shim packs from either side of support and remove shims.

CAUTION: *Do not remove upper support nuts (or bolts) at this time, as column may bend under its own weight.*

8. Move rubber carpet seal at toe plate up the steering column as far as possible.
9. Position carpet out of way to gain access to toe plate.
10. Except C-car: Remove four screws (six for Eldorado) securing lower mounting brackets to toe pan.
11. Remove toe plate insulator at lower column support.
12. C-Car only: Remove 5 screws securing fixed toe plate bracket to toe pan.
13. (Seville and Eldorado): Remove clamp bolt and nut, separate mounting bracket halves and remove bracket assembly.

CAUTION: *(Seville and Eldorado): The lower*

support bracket assembly must be removed before the upper attachment screws are removed, as column may bend under its own weight.

14. Remove two nuts (or bolts if Eldorado) securing upper column bracket to column support. Disconnect ignition and back-up light switch connectors and parking brake release hose. (If equipped with automatic door locks, disconnect wiring at connector).

15. Carefully pull steering column up and out of car, being careful not to damage column mounted switches or dash seal.

NOTE: If shaft hangs up in upper coupling (on Eldorado, universal joint), reattach upper mounting bracket, then pry steering shaft from coupling with a screwdriver.

CAUTION: *When laying wheel face down, place a cloth on work bench to prevent wheel from being scratched or marked.*

16. Eldorado only: Remove two shim retainers from upper mounting bracket.

b. Installation

1. Eldorado only: Install two shim retainers from upper mounting bracket.

2. If toe pan seal or carpet cover seal were removed, position seals on column.

3. Insert lower end of column through hole in toe pan. Take care to avoid damage to lower shift lever and back-up light switch.

4. Plug in ignition switch connector and install two nuts (or bolts) to secure upper column bracket to column support. Do not torque nuts at this time.

5. Seville and Eldorado: Install column upper mounting bracket shims in the same location and quantity as found when column was removed, Fig. 3B-91.

NOTE: On Seville, shims must be installed with tang pointing up.

CAUTION: *Place shims on top of shim retainers so that tangs on shims are fully inserted in retainer slot. Shims must not be placed directly against aluminum capsule.*

6. Connect back-up light switch connector, parking brake release hose, and turn signal connector. (If equipped with automatic door locks, connect wiring at connector. If equipped with Cruise Control, connect Cruise Control wiring harness at this time).

7. a. Seville and Eldorado: Loosely install four screws (six screws for Eldorado) securing lower mounting brackets to toe pan.

b. Connect mounting bracket. Clamp halves together and install clamp bolt and nut.

c. Align the steering column following procedure in column 2 on this page, beginning with Steps 7 through 13.

8. a. C-car only: Install one screw in toe plate locator hole, aligning toe plate to toe pan. Install four other screws securing toe plate to toe pan, tightening all screws to 5 N·m (50 inch-pounds).

b. Install toe plate insulator at lower column support.

c. Install carpet at lower column support and position rubber carpet seal over carpet.

d. Tighten upper mounting bracket to upper column support nuts to 20 foot-pounds.

e. Position shift pointer cable to shaft bowl and secure with screws. Check for proper alignment.

f. Install steering column lower cover as described on page 8-4.

g. Connect transmission linkage at lower shift lever.

h. Secure upper coupling onto steering shaft.

CAUTION: *Install steering shaft with 5/16" clearance between shaft and upper coupling or lower steering bearing damage may result. Tighten pinch bolt and nut to 45 foot-pounds.*

9. Connect negative battery cable and close hood.

Steering Column Alignment - Seville and Eldorado

NOTE: Do not raise car on hoist while aligning column as full weight of car must be on wheels for proper alignment.

1. Start engine and position front wheels in the straight ahead position for easy access to flex-coupling adjustment screws.

2. Remove steering column lower cover as described on page 8-41 (Eldorado: page 8-21).

3. Loosen screw that attaches shift cable to right hand side of column shift bowl to avoid damage to shift pointer while adjusting column.

4. Loosen two nuts (on Eldorado, two bolts) that secure upper steering column mounting bracket to upper steering column support.

5. Move carpet seal up and move carpet back. Loosen four screws (on Eldorado, six screws) that secure lower steering column bracket to toe pan and one clamp screw securing lower steering column bracket to column.

6. On Eldorado, loosen clamp screw securing steering shaft to universal joint clamp.

7. Align the steering column to the instrument panel as follows:

a. Adjust in and out position of column to instrument panel as described below:

Upper edge of column shift bowl (at column center-line) must be the proper distance from instrument panel bezel to have correct steering wheel to driver relationship. Position steering column so gearshift boss clears instrument panel bezel. Eldorado: If working on standard column, this distance should be 4-7/16"; on tilt and telescope column, measurement should be 2-1/4".

b. After making the above adjustment, center column within the instrument panel bezel. Lightly torque two upper mounting nuts or bolts if working on Eldorado.

8. Eldorado only: Check alignment of flex-coupling disc. The steering column and gear are correctly aligned when the rubber disc is flat and the pins are centered in the "C" slots in the upper flange. The pins should extend beyond the edges of the flange slots equally at both locations. After alignment, tighten clamp screw to 20 foot-pounds.

CAUTION: *See "CAUTION" on page 3B-20 in this section.*

9A. Seville: Install steering column lower support and make final adjustments as follows:

a. Position lower mounting bracket against column and lightly torque bracket screws to toe pan.

b. Tighten clamp bolt securing bracket halves to 50 inch-pounds.

c. Tighten upper mounting bracket nuts to 20 foot-pounds.

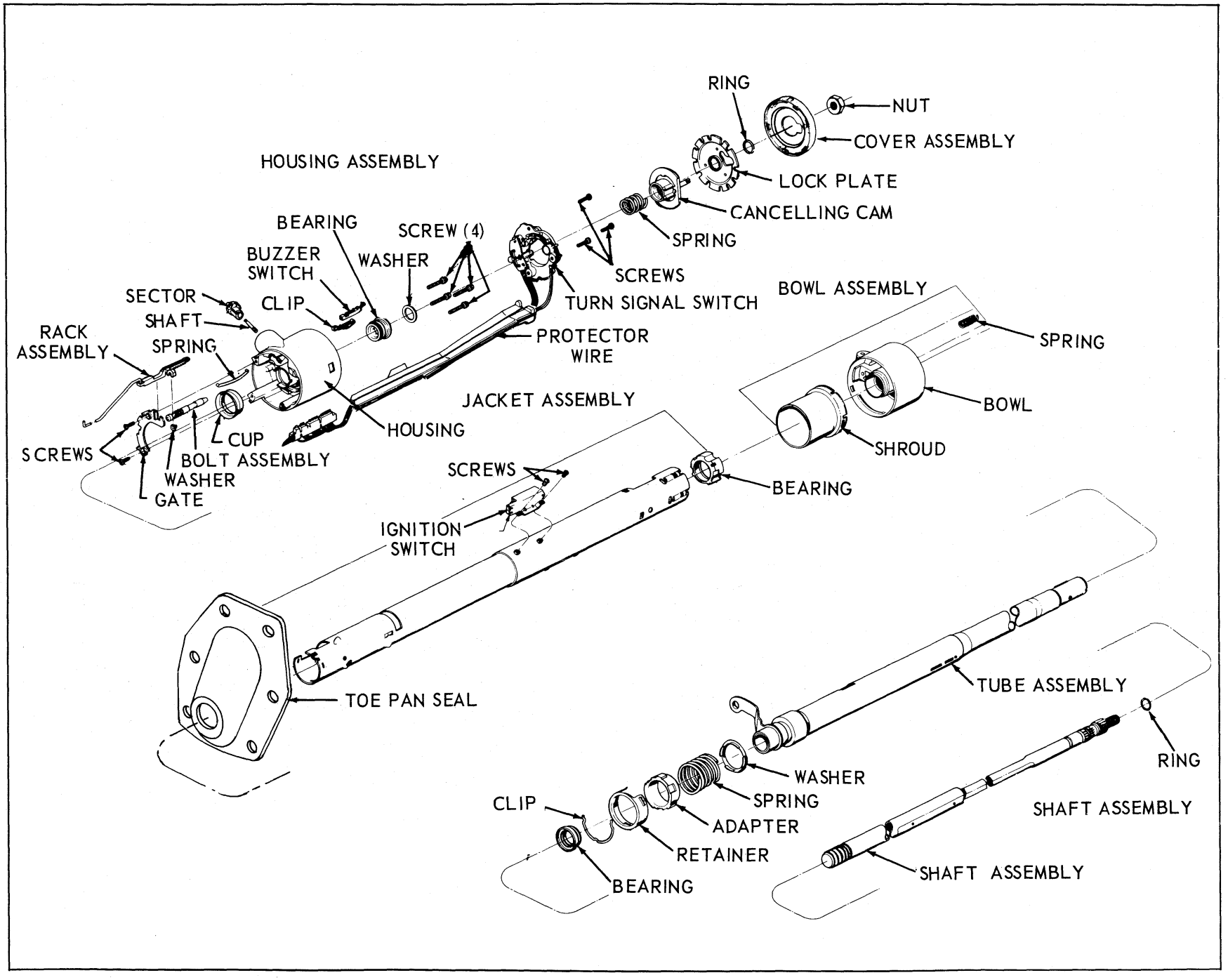


Fig. 3B-92 Standard Steering Column Disassembled

CAUTION: *DO NOT exceed 20 foot-pounds as this is the maximum torque the release capsule can withstand and still provide satisfactory release.*

d. Tighten all four lower mounting bracket to toe pan screws to 50 inch-pounds.

9B. Eldorado: Install steering column lower support and make final adjustments as follows:

a. Position lower half of mounting bracket against column and lightly torque two bottom most bracket to toe pan screws.

b. Position upper half of mounting bracket and lightly torque remaining four bracket to toe pan screws.

c. Tighten clamp bolt securing bracket halves to 50 inch-pounds.

d. Start engine and turn steering wheel from stop to stop several times to neutralize position of column.

e. Tighten two upper mounting bracket to support bolts to 24 foot-pounds.

CAUTION: *DO NOT exceed 24 foot-pounds as that is the maximum torque the release capsule can withstand and still provide satisfactory release.*

f. Tighten all six lower mounting bracket to toe pan screws to 50 inch-pounds.

10. Adjust shift pointer and tighten attaching screw.

11. Install carpet at lower column support and position rubber carpet seal over carpet.

12. Install steering column lower cover as described on page 8-41 (Eldorado: page 8-21).

13. Check shift linkage for proper operation. Adjust if necessary as outlined on page 7A-24 (For Eldorado, page 7B-8).

UNIT REPAIR

Standard Steering Column Disassembly, Inspection, and Assembly-Out of Car (Fig. 3B-92)

NOTE: Extreme care must be taken when working on the column as certain parts of the assembly can be damaged if not handled correctly.

a. Disassembly

1. Remove steering wheel as described on page 3B-62.

CAUTION: *When laying wheel facing down, place a cloth on work bench to prevent wheel from being scratched or marked.*

2. Position screwdriver blade into cover slots, Fig. 3B-93. Pry up and out to free cover from lock plate.

3. Install spring Compressor, J-23131, on steering shaft, Fig. 3B-94.

4. Compress lock plate and spring and remove snap ring from groove in shaft, Fig. 3B-94. Discard snap ring.

CAUTION: *The shaft could slide out bottom of column when snap ring is removed, causing damage to shaft.*

5. Remove lock plate by sliding plate up and off upper shaft.

6. Slide turn signal cancelling cam and upper bearing preload spring off upper steering shaft.

7. Slide thrust washer off upper steering shaft.

CAUTION: *Care should be taken at this point. Steering shaft is free and could slide out of the column.*

8. Push hazard warning switch in, remove cap from knob, remove screw and remove knob from column.

9. Remove turn signal lever screw and remove turn signal lever.

NOTE: If car being worked on is equipped with Cruise Control, perform the following procedure.

a. Attach a long piece of piano wire to connector on Cruise Control switch harness, Fig. 3B-95.

b. Using extreme care, gently pull Cruise Control harness up through and out of column.

c. Remove piano wire from harness connector and secure lower end of piano wire to steering column.

NOTE: Piano wire must be used so that Cruise Control harness can be guided through the proper passages on installation. Disassemble column by sliding internal components over wire, to permit location of passages for reassembly.

10. Remove three turn signal switch mounting screws, Fig. 3B-96.

11. Slide turn signal switch connector out of bracket on steering column jacket.

12. Wrap a piece of tape around the turn signal switch connector and harness, Fig. 3B-97, to facilitate removal.

13. Remove four bolts that secure upper mounting

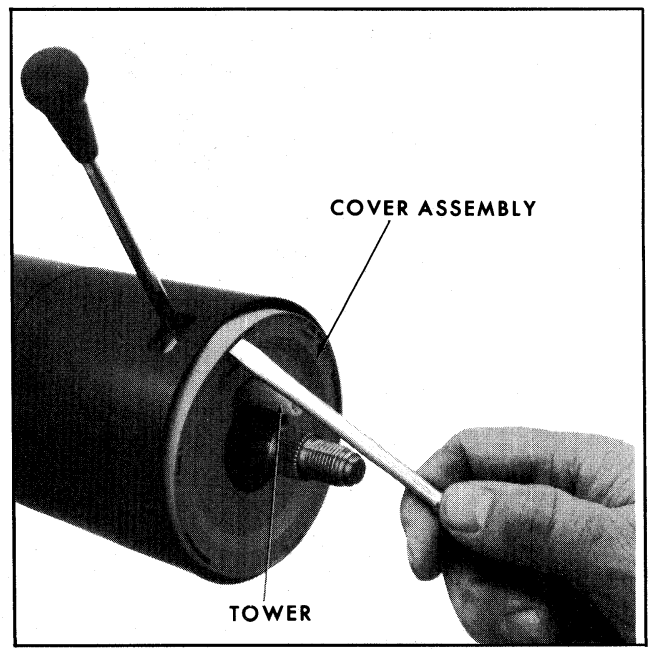


Fig. 3B-93 Cover Plate and Tower

bracket to steering column and remove bracket.

14. Free turn signal switch wiring protector from bracket mounting bosses on upper column jacket.

15. Pull turn signal straight up with wire protector attached and remove switch, switch harness, and connector from column, Fig. 3B-97.

16. Turn ignition switch to the On or Run position.

17. Insert a small, thin screwdriver into slot next to the switch boss, Fig. 3B-98. Depress lock cylinder retaining tab with screwdriver and remove lock cylinder.

18. Using a piece of stiff wire (such as a paper clip) hook wire in exposed loop of buzzer switch wedge spring, Fig. 3B-99. Pull straight out on spring and remove switch and wedge spring.

CAUTION: *If wedge spring is dropped on removal, spring could become lost in column, requiring complete disassembly of column.*

19. Pull actuator rod as far as possible, then move rod back two detents.

20. Remove two screws securing ignition switch to lower steering column jacket. Slide switch off actuator rod and remove switch from column.

21. Support upper end of steering column and drive out shift lever pivot pin. Remove shift lever.

b. Upper Housing Disassembly–On Bench (Fig. 3B-92)

1. Place shift bowl in Park position.

2. Remove four screws securing upper housing assembly to steering column jacket and remove housing assembly.

3. Remove thrust cap from housing.

4. Remove rack and lock bolt, Fig. 3B-100.

5. Remove load spring from housing, and remove shift gate.

6. Remove sector through lock cylinder hole by pushing firmly on block tooth with a blunt punch, Fig. 3B-101.

c. Shift Bowl and Shift Tube Disassembly

These parts are not to be removed from outer jacket. Where servicing is required, replace with complete shift bowl, shift tube, and outer jacket assembly.

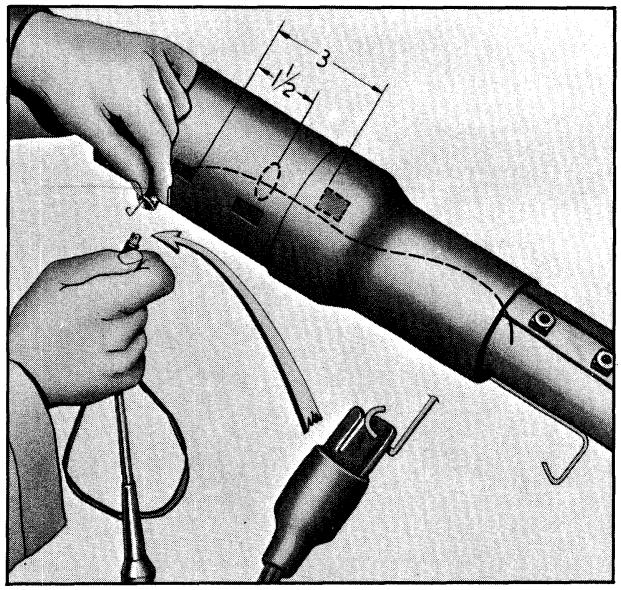


Fig. 3B-95 Removing Cruise Control Harness

d. Steering Shaft Removal–On Bench

1. Using a screwdriver, remove lower bearing adapter retaining clip.

2. Slide lower bearing reinforcement collar, bearing adapter and bearing, shift tube spring, and washer off shift tube and out of jacket.

NOTE: Bearing may be removed from adapter by a light pressing operation on the outer race.

3. Remove steering shaft through lower end of column.

e. Steering Shaft Installation (On Bench)

1. Install washer, shift tube spring, bearing adapter with bearing installed, and reinforcement collar onto lower end of column.

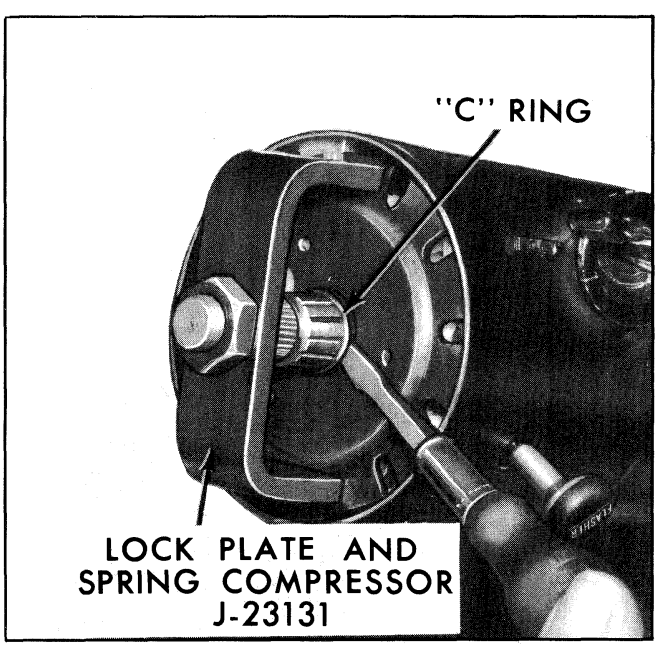


Fig. 3B-94 Removing and Installing C-Ring (Standard)

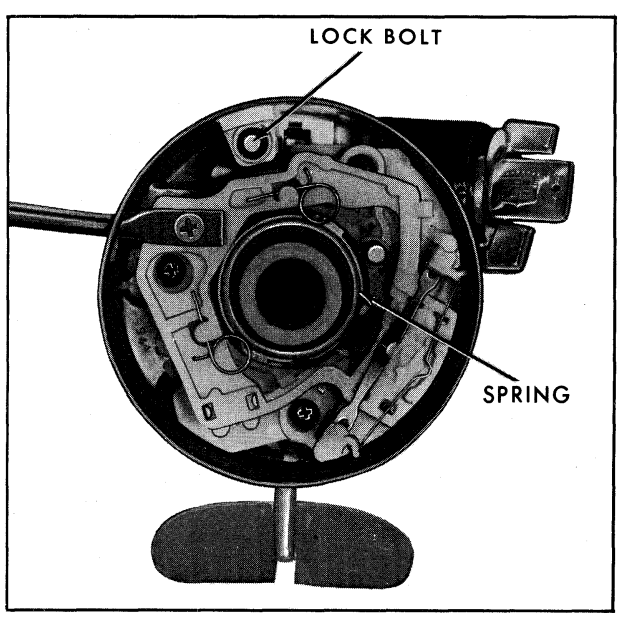


Fig. 3B-96 Turn Signal Switch

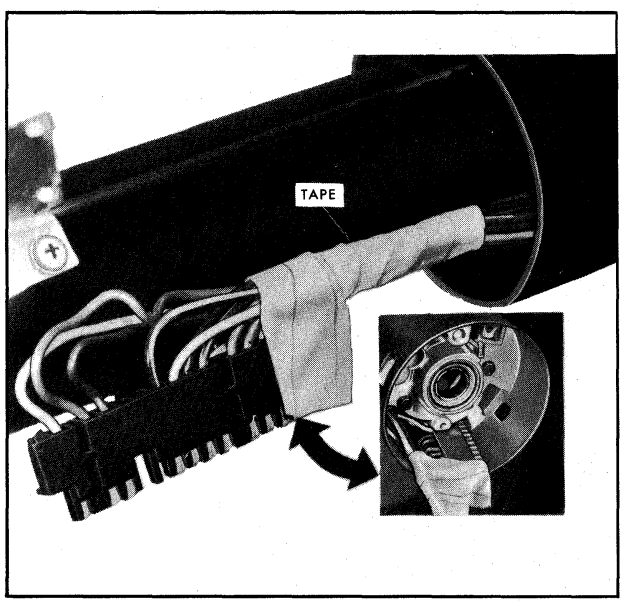


Fig. 3B-97 Taping Connector

2. Hold bearing adapter and reinforcement collar in position and install retaining clip in slots in steering column jacket.

3. Slide steering shaft up into column from lower end.

CAUTION: *Take care not to hit the drive tab on the back-up switch assembly when sliding shaft up through column.*

f. Upper Housing Assembly-On Bench (Fig. 3B-92)

NOTE: Apply a thin coat of lithium grease or equivalent to all friction surfaces, If column is equipped with Cruise Control, assemble parts over piano wire used for disassembly to assure proper installation of Cruise Control harness.

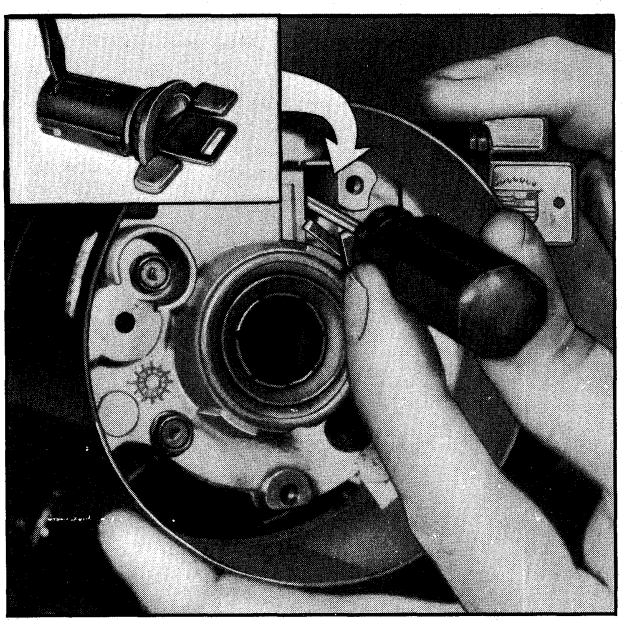


Fig. 3B-98 Removing Lock Cylinder

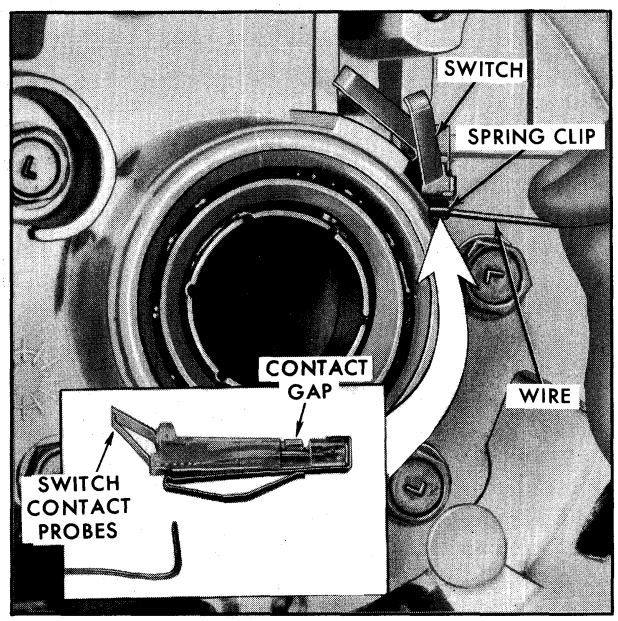


Fig. 3B-99 Removing Buzzer Switch

1. Install sector onto support shaft through lock cylinder hole with drive tang end of sector facing out. Press the sector onto shaft with a blunt punch.

2. Install shift gate in housing.

3. Insert rack spring in housing from bottom side.

4. Assemble lock bolt to cross-over arm of rack, Fig. 3B-102.

5. Install rack and lock bolt assembly into the housing from the lower end of housing, with teeth up and toward centerline of column. Make sure wide tooth on sector aligns with wide gap at bottom end of rack.

6. Install thrust cup on bottom hub of housing.

7. Install ignition switch actuator rod through shift bowl and position housing on shift bowl. Secure housing to outer jacket with four screws. Torque to 60 inch-pounds.

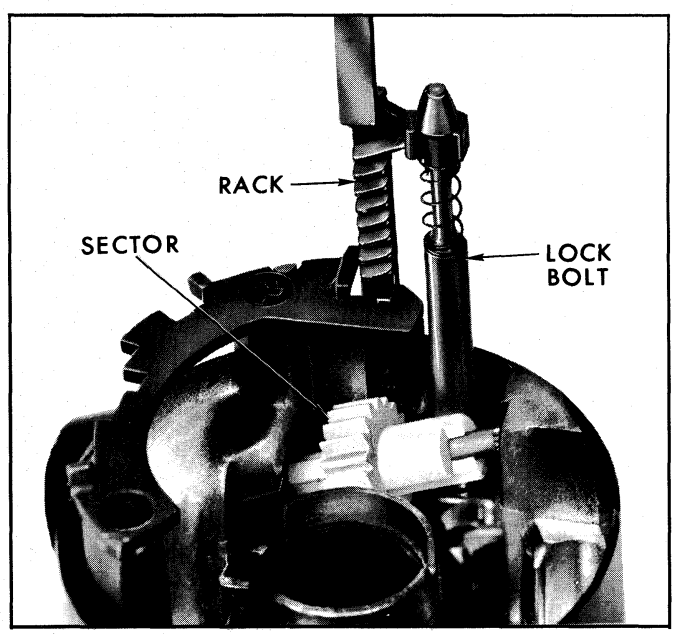


Fig. 3B-100 Removing Rack and Lock Bolt

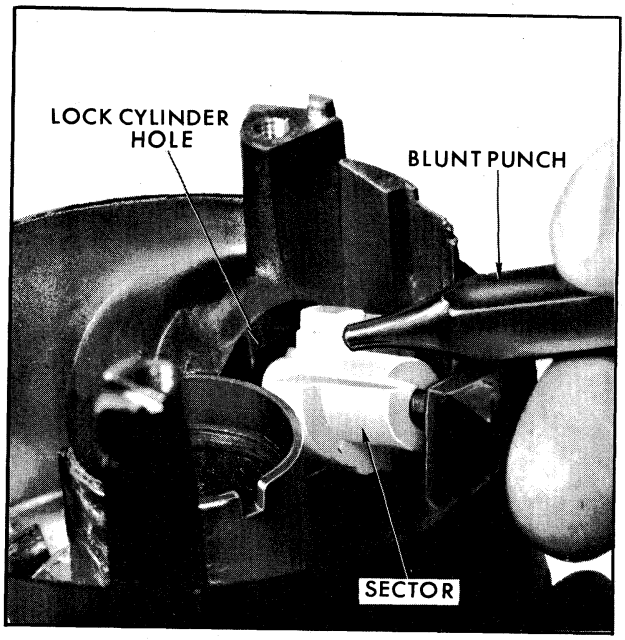


Fig. 3B-101 Removing Sector

8. Position wedge spring on buzzer switch with formed end of clip around the lower end of switch making the spring bow away from the switch.

9. Push switch and spring into hole in housing with switch contacts pointing toward the center of the column and up.

10. Hold lock cylinder sleeve and rotate key clockwise against stop when viewed from key end. Make sure buzzer switch drive tang is below O.D. of lock cylinder.

11. Insert ignition lock cylinder and sleeve assembly into housing bore with key on cylinder sleeve aligned with keyway in housing. Maintaining a light push inward on cylinder, push until drive section of cylinder touches sector.

12. Rotate key counterclockwise while maintaining inward pressure until lock sector drive engages sector drive. Then, push in until lock cylinder retaining tab pops into groove and lock cylinder is secured in housing. Check freedom of lock cylinder rotation. There must be a free spring return from Start to Run position.

NOTE: A 1/16" drill shank gage must be inserted between the lock cylinder knob and the column housing to avoid assembling the lock cylinder into the column beyond its normal position.

13. Assemble ignition switch on actuator rod and adjust to the Lock position.

NOTE: The Lock position can be found by holding the switch actuating rod stationary with one hand, then moving the switch toward the bottom of the column with the other hand until the end of travel in the switch has been reached. This is the Accessory position. Next back off one detent in the switch and this will be the Lock position. Make sure the ignition key is in the Lock position, then assemble the ignition switch to the column using the two screws provided. Take care to assure proper engagement of drive rod and switch slider without moving from Lock position. Tighten screws to 35 inch-pounds.

CAUTION: *When replacing or adjusting ignition switch:*

1. Be sure battery is disconnected.

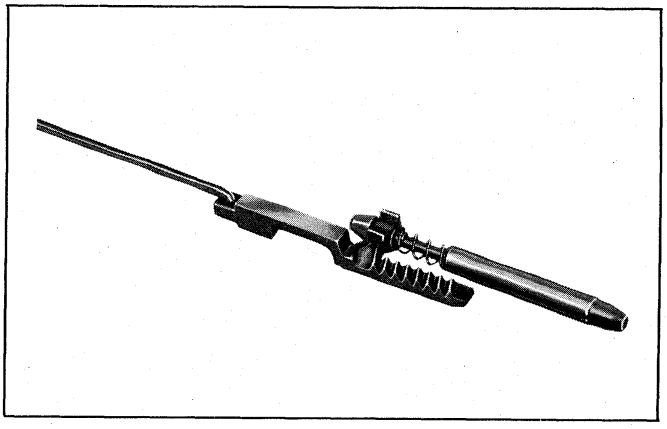


Fig. 3B-102 Assembling Rack and Lock Bolt

2. Set switch in OFF-UNLOCKED.

3. Put gearshift in "N".

4. Turn key toward LOCK and hold while installing switch.

5. Re-install column and assure that lever moves freely from "P" to "L".

6. Re-connect battery cable.

7. Apply service brake and assure that engine starts in "P" and "N", but not in "R", "D", or "L".

If either the ignition switch or column jacket is replaced, any "witness" marks on the switch bracket must be removed by flattening and the ignition switch adjuster per the above procedure.

CAUTION: *Always check the start system as directed on the instruction label before releasing the vehicle.*

CAUTION: *Use only those screws provided for the ignition switch.*

14. Install turn signal switch, feeding the harness, connector and harness protector down through the housing, Fig. 3B-97.

15. Position turn signal switch in neutral position and install three screws securing switch to upper housing, Fig. 3B-96. Tighten screws to 35 inch-pounds.

16. On cars equipped with Cruise Control, perform the following procedure:

a. Connect Cruise Control harness connector to piano wire used on removal, Fig. 3B-95.

b. Feed Cruise Control harness into turn signal lever opening steering column housing assembly. Next, gently pull on piano wire and pull Cruise Control harness through the steering column and into position.

c. Remove tape from turn signal wire harness.

d. Remove piano wire from harness connector.

e. Position turn signal lever on turn signal switch and secure lever to turn signal switch with one screw. Tighten screw to 35 inch-pounds.

17. Position turn signal switch wiring protector over upper bracket mounting bosses on upper steering column.

18. Position steering column upper mounting bracket over turn signal wiring harness protector and secure bracket to column with four screws. Tighten screws to 20 foot-pounds.

19. Install turn signal switch connector in bracket on steering column upper jacket.

20. Install hazard warning switch knob.

21. Install thrust washer on steering shaft.

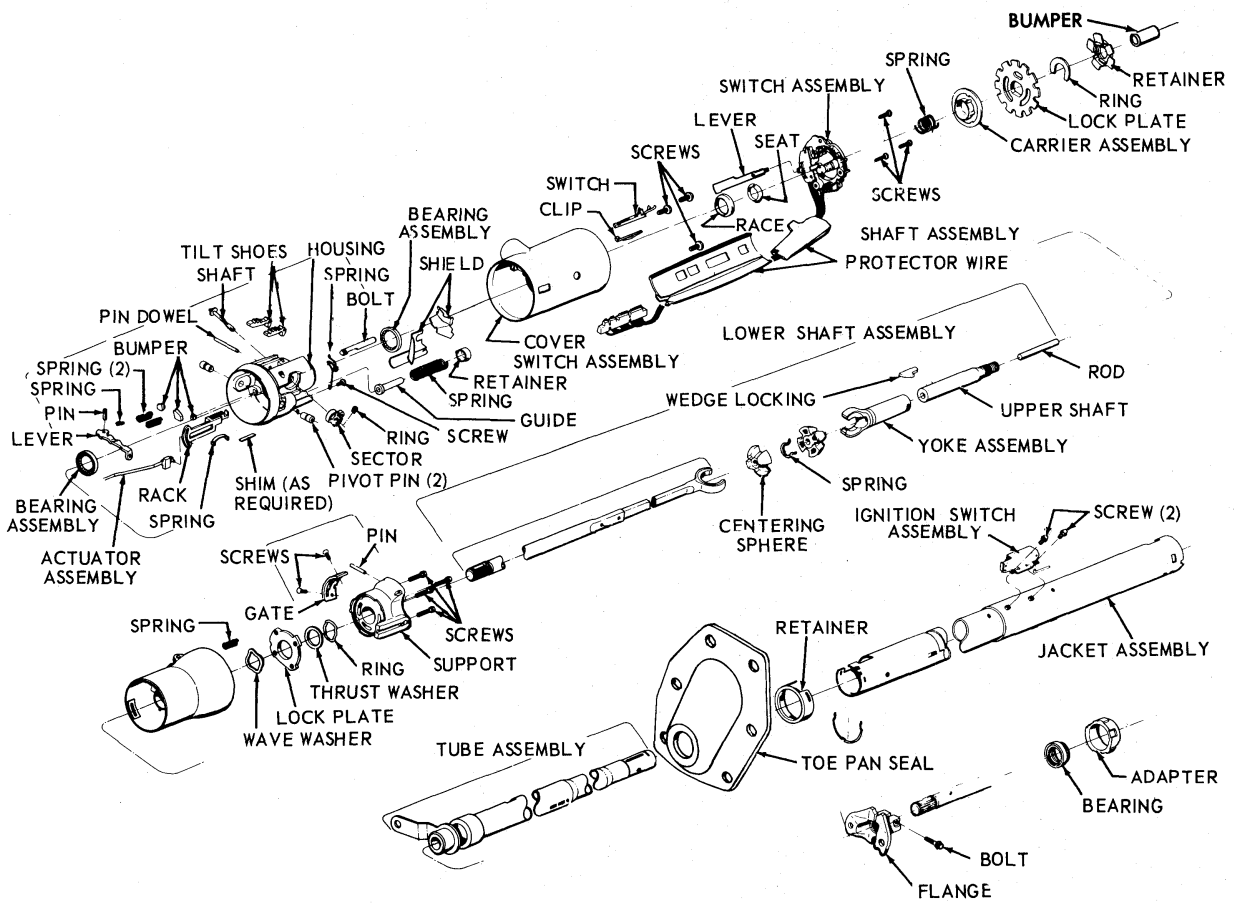


Fig. 3B-103 Tilt and Telescope Column Disassembled

22. Install upper bearing preload spring and turn signal cancelling cam.

23. Install lock plate with large flat on plate aligned with large flat on steering shaft.

24. Place a new snap ring on upper end of steering shaft.

CAUTION: *Do not use old snap ring because ring becomes distorted upon removal.*

25. Install Spring Compressor, J-23131, on steering shaft, Fig. 3B-94.

26. Compress lock plate and spring. Next slide new snap ring down shaft until ring locks in groove in upper end of shaft. Remove spring compressor tool.

27. Position plastic lock plate cover on upper end of shaft and snap the three fingers over lock plate assembly. Turn shaft to make certain cover does not contact upper housing assembly. Install shift lever.

28. Install steering wheel as described on page 3B-62.

29. Install steering column into car as outlined on page 3B-63.

Steering Column Lower Bearing Removal

a. Removal

1. Remove intermediate shaft as described on page 3B-3B-21.

NOTE: If car being worked on is an Eldorado, remove lower steering shaft as described on page 3B-21.

2. Remove lower bearing adapter retaining clip and reinforcement collar.

STEERING SHAFT LENGTHS		
Series	Standard Column	Tilt And Telescope Column
All C-Cars	36—31/32	30—13/32
Eldorado	37— 1/16	30—17/32
Seville	—	27—11/16

3. Carefully pry lower bearing and adapter assembly from shaft.

4. Pry bearing assembly out of adapter and discard bearing.

b. Installation

1. Install new lower bearing into bearing adapter.

CAUTION: *Make certain that bearing is properly seated in adapter.*

2. Install bearing and adapter on shaft and up into steering column lower jacket.

3. Install reinforcing collar over end of jacket.

4. Install retaining clip that holds adapter and collar to jacket.

NOTE: If working on Eldorado, install lower steering shaft as described on page 3B-21.

Steering Shaft

In the event that the two nylon shear pins in the energy-absorbing steering column break due to impact not strong enough to collapse steering column jacket or shift tube, steering shaft must be repaired ONLY in the manner prescribed below.

NOTE: If jacket or shift tube collapses, column must be replaced as an assembly.

1. Remove steering column from car as outlined on page 3B-63.

2. Remove steering shaft from column as described on page 3B-67 for standard column or page 3B-73 for Tilt and Telescope column.

3. Pull upper solid shaft out of lower tube shaft approximately 3/8″ or until a stop is felt. Plastic will be just visible.

NOTE: It should not be necessary to repair the lower plastic joint in a two-joint shaft.

4. Obtain a steering shaft repair kit. Kit consists of three snap rings and a supply of special primer and adhesive. Materials in kit are sufficient to service three cars.

5. Wipe shaft clean and dry for about one inch from tube.

6. Spray this area liberally with special primer. Allow not more than 20 minutes to dry.

7. Spread a 3/8″ wide strip of special adhesive around primed area of shaft, and push shaft together until proper overall length is obtained.

Allow joint to set up at least five minutes, then wipe off excess adhesive. Adhesive will harden to 3557 Newtons (350 pounds) yield strength.

8. Install shaft into column using a new snap ring, as outlined on page 3B-67 for standard column or page 3B-74 for Tilt and Telescope column.

9. Install column in car, page 3B-63.

Tilt and Telescope Column Disassembly, Inspection, and Assembly - Out of Car (Fig. 3B-103)

NOTE: Extreme care must be taken when working on the column as certain parts of the assembly may be damaged if handled incorrectly.

a. Disassembly

1. Remove steering wheel as described on page 3B-62.

CAUTION: *When laying wheel face down, place a cloth on work bench to avoid scratches or marks on steering wheel.*



Fig. 3B-104 Removing and Installing C-Ring (T&T)

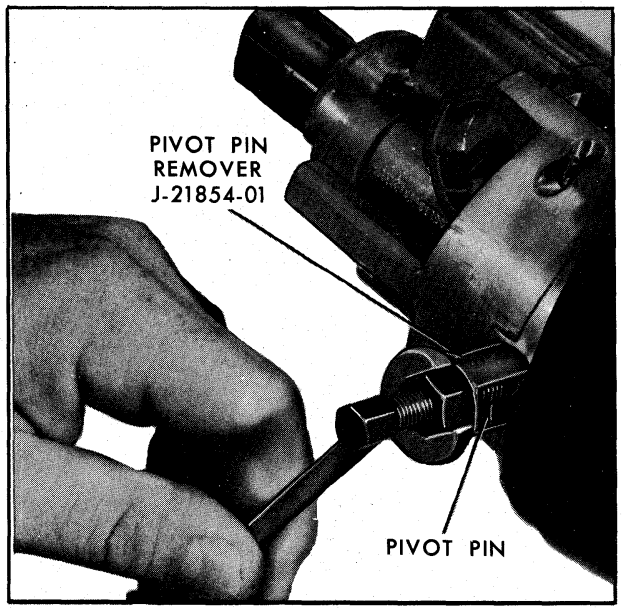


Fig. 3B-105 Removing Pivot Pin

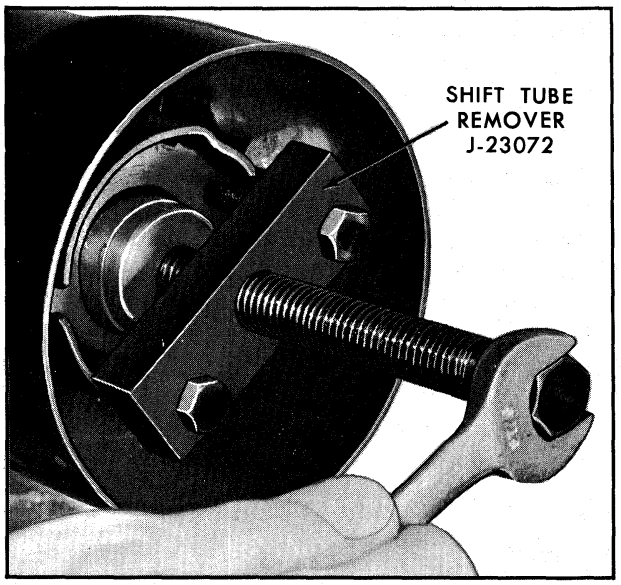


Fig. 3B-106 Removing Shift Tube

2. If rubber sleeve bumper is to be removed, cut retainer clamp off with side cutters. If bumper does not require removal, remove the entire sliding portion of the upper steering shaft.

NOTE: Save rubber sleeve bumper as it must be reinstalled at column assembly. If distorted, it should be replaced with a new bumper.

3. Carefully remove plastic retainer, using small screwdriver to disengage tabs on retainer from C-ring.

4. Install Spring Compressor, J-23063, on steering shaft, Fig. 3B-104 threading bolt into steering shaft telescoping lock hole.

NOTE: When installing spring compressor, pull upper shaft up 12mm (1/2") from bottomed position, then turn ignition to Lock to hold shaft in place.

5. Compress upper steering shaft preload spring and remove C-ring, Fig. 3B-104.

6. Remove Spring Compressor, J-23063, and remove upper steering shaft lock plate, horn contact carrier and upper steering shaft preload spring.

7. Remove four screws and washers securing upper mounting bracket to column and remove bracket.

8. Slide harness connector out of bracket on steering column jacket.

9. Slide harness protector down to harness connector and remove protector from column.

10. Wrap a piece of tape around upper part of harness and connector, Fig. 3B-97.

11. Remove cap from hazard warning flasher button, remove screw and remove button from column.

12. Position shift bowl in park position.

13. Remove turn signal lever screw and remove turn signal lever.

NOTE: On cars equipped with Cruise Control, perform the following procedure:

a. Slide harness protector down to harness connector. Then open protector and remove protector from harness.

b. Attach a piece of piano wire to the switch harness connector.

c. Unscrew turn signal lever, being sure to pass Cruise Control harness over the lever each time the turn signal lever makes one complete turn.

d. Gently pull Cruise Control harness out through turn signal lever opening.

e. Gently pull remainder of harness up through and out of column.

f. Disconnect guide wire from connector and secure wire to column.

NOTE: Piano wire must be used so that Cruise Control harness can be guided through the proper passages on installation. Disassemble column by sliding internal components over wire to permit location of passages for reassembly.

g. Remove turn signal lever from car.

14. Remove three mounting screws and pull turn signal switch straight up until connector is inside shift bowl. Remove hazard warning flasher lever from switch assembly. Allow switch assembly to hand from column.

15. Turn ignition key to Run position.

16. Insert a small, thin screwdriver into slot next to mounting screw boss, Fig. 3B-98. Depress center of lock cylinder retaining tab with screwdriver and remove lock cylinder.

17. Using a piece of stiff wire, hook wire in exposed loop of buzzer switch wedge spring, Fig. 3B-99. Pull straight out on spring and remove switch and wedge spring.

CAUTION: *If wedge spring is dropped on removal, spring could become lost in column, requiring complete disassembly of column.*

18. Remove tilt release lever.

19. Remove three screws securing cover to upper housing and dislodge cover from housing. Allow cover to rest on turn signal switch.

20. Pull carefully on wiring harness until connector is removed from housing.

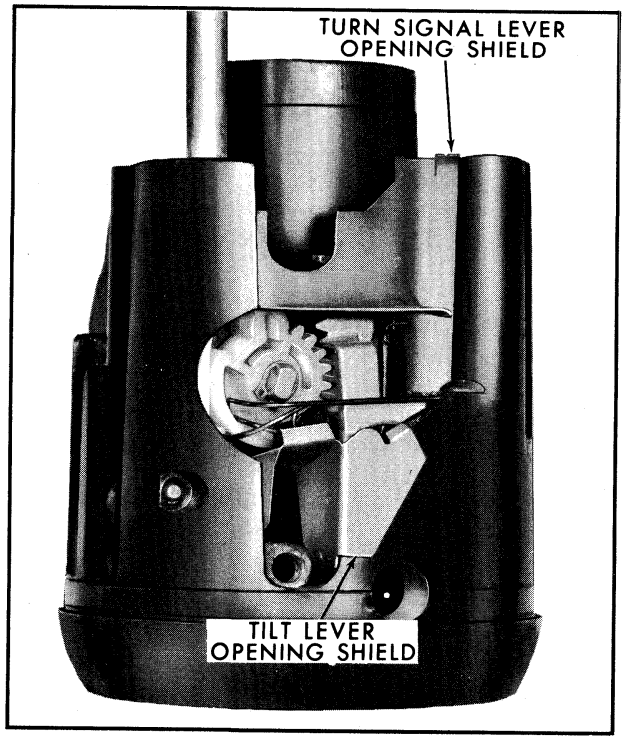


Fig. 3B-107 Lever Opening Shields

21. Install tilt release lever and position housing in full up position.

22. Using a wide bladed screwdriver, remove tilt spring by pushing in and turning spring retainer cap counterclockwise.

23. Remove two screws securing ignition switch to steering column jacket. Slide switch off actuator rod and remove switch from column.

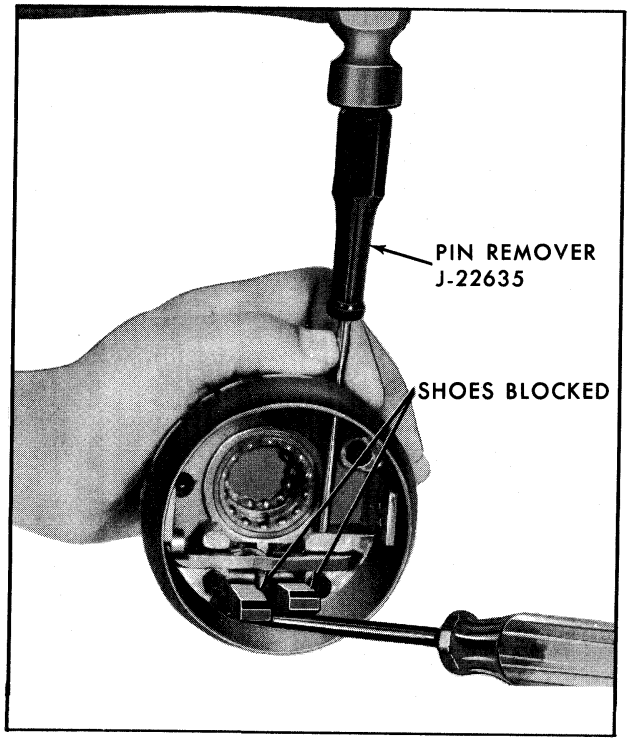


Fig. 3B-108 Removing Release Mechanism

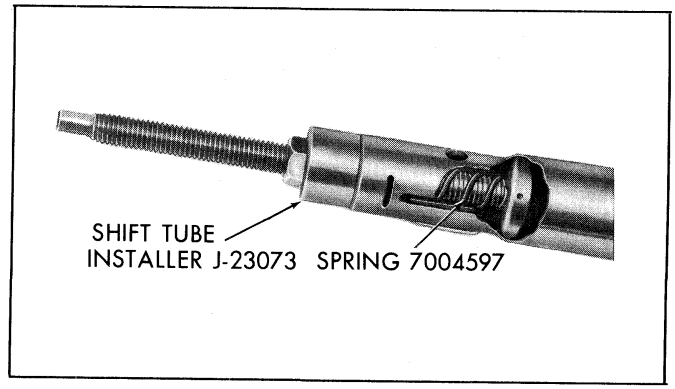


Fig. 3B-109 Installing Shift Tube Installer

24. Install Pivot Pin Remover, J-21854-01, and remove pivot pins, Fig. 3B-105.

25. Pull back on tilt release lever to release upper housing tilt shoes, disconnect actuator rod, and slide upper housing off column. Remove bearing inner race and retainer from upper housing.

26. Remove actuator rod.

b. Steering Shaft and Support Removal

1. Using a screwdriver, dislodge and remove lower steering shaft bearing retainer clip, bearing adapter and bearing.

2. Carefully pull steering shaft out of upper end of column.

3. Remove four screws securing support assembly to steering column and remove support assembly.

4. Turn upper portion of shaft at a right angle (90°) to the lower shaft to disassemble the U-joint.

5. Remove two-piece plastic centering sphere from upper yoke by rotating sphere so flats align with open end of yoke, then remove sphere.

c. Shift Tube Removal

1. Remove one screw and strap securing backup light switch to lower steering column jacket and remove switch.

2. Remove shift tube retainer clip.

3. Secure Shift Tube Remover, J-23072, to plate lock and remove shift tube from column, Fig. 3B-106.

CAUTION: *Use extreme care when removing shift tube to prevent lower shift lever arm from getting caught at lower end of column jacket resulting in separation of the lower and upper outer jackets at the collapse joint. If separation occurs, a new outer jacket assembly will be required.*

4. Remove thrust washer, plate lock, and wave washer and remove shift bowl.

d. Upper Housing Disassembly

1. Remove tilt lever and opening shield and turn signal lever and opening shield from housing, Fig. 3B-107.

2. Remove lock bolt spring by removing spring retaining screw. Then, turn spring clockwise and remove spring from bolt.

3. Remove snap ring from sector drive shaft. Using a small punch, lightly tap drive shaft out of sector.

4. Remove drive shaft, sector and lock bolt.

5. Remove rack and rack spring.

6. Wedge shoes inward with a block between top of the shoes, and bearing housing. Using Pin Remover, J-22635,

through slot in opposite side of housing, with flat on tool over shoulder next to pin, drive release lever pin out of bearing housing, Fig. 3B-108. Remove Pin Remover, J-22635, and remove release lever and spring.

7. Using Pin Remover, J-22635, drive out lock shoe pin. Carefully remove pin remover and remove lock shoes and springs.

NOTE: With tilt lever opening on left side and shoes facing up, the four slot shoe is on the left.

e. Inspection

1. Inspect all bearings for wear, roughness and binding. Replace as required.

2. Inspect centering sphere for nicks, damage, and wear. If damage is evident, replace centering sphere.

3. Inspect bearing surfaces of upper shaft for brinelling, nicks, scratches, and wear.

4. Inspect rubber bumpers, making certain they are not torn or damaged.

5. Inspect telescoping mechanism for wear in keyway.

6. Inspect all threads and splines for damage.

7. Inspect locking rod for straightness.

8. Inspect shift bowl for cracks.

9. Inspect steering shaft, shift tube, and outer jacket for signs of damage.

NOTE: If collapse joint between upper and lower jacket shows movement or is loose, the outer jacket assembly must be replaced.

10. Inspect all other parts for damage and wear. Replace if necessary.

f. Upper Housing Assembly

1. Apply a thin coat of lithium base (spherical joint) grease or equivalent to all friction parts.

2. Using Pin Remover, J-22635, to line up shoes, install lock shoe springs and lock shoes in upper housing and retain with pin.

NOTE: With tilt lever opening in housing on left side, and shoes facing up, the four slot shoe is on the left.

3. Wedge shoes inward with a block between top of shoes and bearing housing. Install spring, release lever, and pin in bearing housing. Remove block from shoes.

4. Install drive shaft in housing, then lightly tap sector onto the shaft far enough to install snap ring. Install snap ring.

5. Install lock bolt and engage sector cam surface.

6. Install rack spring and rack.

NOTE: Block tooth on rack must engage block tooth on sector.

7. Install lock bolt spring with "U" shaped arm of spring in the large cavity of the sector and the single wire arm attached to the lock bolt. Install spring retaining screw and tighten to 35 inch-pounds.

8. If removed, install shift lever spring in bowl by widing spring up with pliers and pushing in.

9. Install tilt lever opening shield and turn signal lever opening shield into housing, Fig. 3B-107.

g. Shift Tube Installation (On Bench)

1. Install part of Shift Tube Installer, J-23073, in shift tube, Fig. 3B-109.

2. Position shift bowl on steering column. 3. Position wave washer in shift bowl.

4. Install plate lock in shift bowl.

CAUTION: *Plate lock can be installed backwards by mistake. When installing plate, make sure long flat edge of plate is down and that the long tab is toward shift lever. This will position the two closely spaced holes to bottom of bowl and the larger spaced holes to the top.*

5. Using a grease pencil, locate shift tube key on upper face of Shift Tube Installer, J-23073.

6. Slide shift tube up and into column from lower end of column aligning with keyway in shift bowl.

7. Using alignment marks on Shift Tube Installer, J-23073, align shift tube key with keyway in shift bowl and install remaining parts of Shift Tube Installer, J-23073, Fig. 3B-110.

8. Tighten nut on Shift Tube Installer, J-23073, and install shift tube, Fig. 3B-110.

CAUTION: *When installing shift tube, make sure transmission linkage lever on lower end of tube is centered in slot in lower end of steering column jacket.*

9. Remove Shift Tube Installer, J-23073.

10. Install thrust washer on upper end of shift tube.

11. Install snap ring on upper end of shift tube. Snap ring is installed when notches are engaged.

h. Steering Shaft and Support Assembly - Installation

1. Install support assembly by aligning "V" in support with "V" notch in jacket and install four screws securing support assembly to plate lock. Tighten screws to 60 inch-pounds.

CAUTION: *See "CAUTION" on page 3B-20 of this section.*

2. Install sphere in upper yoke.

CAUTION: *Make sure lash take-up spring (horseshoe in shape) is properly positioned between spheres before assembling to upper yoke.*

3. Rotate centering sphere so that lower steering shaft can be installed over flats on sphere (approximately 90° from center line of upper portion of shaft). Then install lower shaft coupling over the sphere. Looking along shaft from top make sure keyway faces right when flat on lower shaft splines is

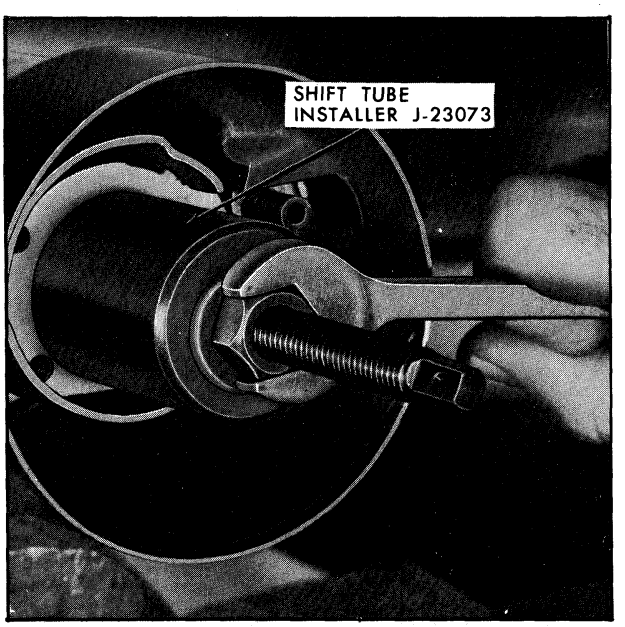


Fig. 3B-110 Installing Shift Tube

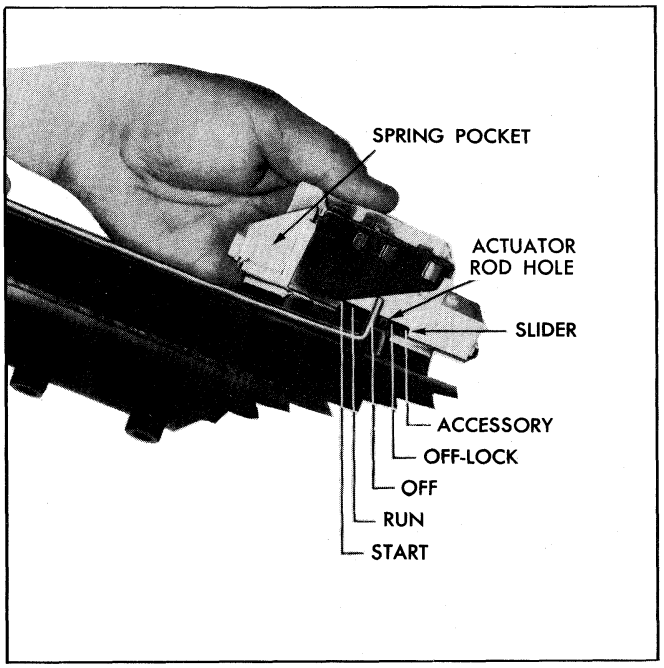


Fig. 3B-111 Installing Ignition Switch - T&T Column

facing up. If parts are mispositioned, turn signals will not cancel after turn signal is used for lane changing.

4. Install steering shaft in upper end of column.

CAUTION: *If back-up switch was not removed, be careful not to hit switch drive tang with end of shaft as breakage may result.*

5. Install bearing and bearing adapter in lower end of steering column jacket.

6. Install cup over lower end of steering column jacket and install lower steering shaft bearing retainer clip.

i. Housing Cover, Lock Cylinder, Ignition Switch and Back-Up Light Switch–Assembly

1. Pull up on tilt lever and install upper housing assembly with lock bolt toward top.

2. Install actuator rod in rack in housing assembly.

3. Guide actuator rod through shift bowl while positioning housing assembly on support assembly. Extend rack as far as possible and engage actuator rod.

4. Pull back on tilt lever and engage tilt shoes in support assembly.

5. Align pivot pin holes and install pivot pins by hand, then tap them in with a plastic mallet. The column must be supported to prevent any bending forces on the collapse area.

6. If removed, install upper bearing in housing assembly.

7. Install upper bearing inner race and retainer ring.

8. Tilt housing to full up position.

9. Position tilt spring guide, tilt spring, and spring retainer in housing assembly.

10. Using a large screwdriver, press in on tilt spring retainer, compress spring and rotate retainer clockwise until retainer locks in housing.

11. Remove tilt release lever.

12. Position turn signal wiring harness inside steering column cover and insert harness into housing until connector is through shift bowl.

13. Install cover over housing assembly.

14. Check tilt lever and turn signal lever opening shields for proper alignment.

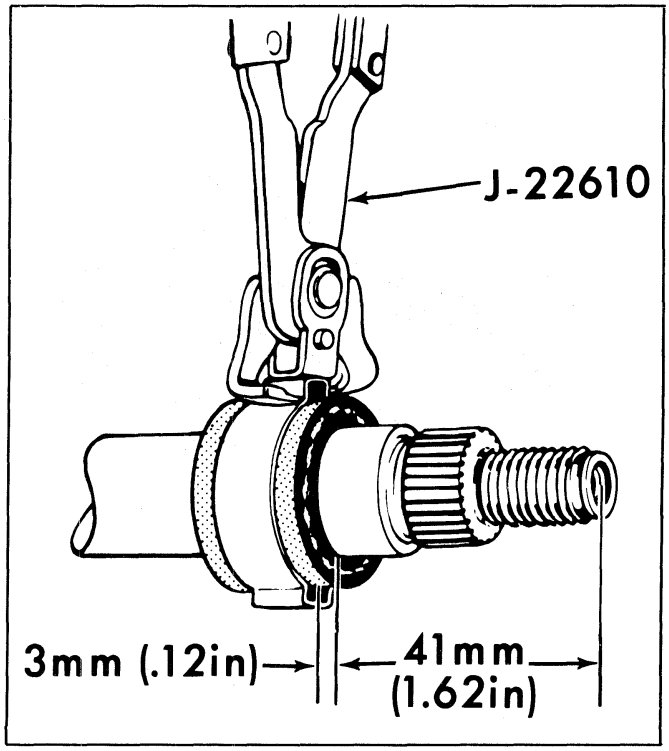


Fig. 3B-112 Installing Rubber Bumper

15. Install three screws securing cover to housing assembly. Tighten screws to 110 inch-pounds.

16. Position wedge spring on buzzer switch with formed end of clip around the lower end of switch making the spring bow away from the switch, Fig. 3B-99.

17. Push switch and spring into hole in housing with switch contacts pointing up, making sure that switch is fully installed.

18. Install hazard warning lever in turn signal switch.

19. Finish installing turn signal switch by feeding harness connector through housing, Fig. 3B-97.

20. Position turn signal switch in neutral position and install three screws securing switch to upper housing, Fig. 3B-96. Tighten screws to 28 inch-pounds.

NOTE: When properly installed, cancelling springs should be equal distance from steering shaft. If they are not, one turn signal will not cancel when column is reinstalled on car.

21. Install hazard warning flasher button and check operation.

22. Assemble ignition switch on actuator rod, Fig. 3B-111.

CAUTION: *When replacing or adjusting ignition switch:*

1. Be sure battery is disconnected.

2. Set switch in OFF-UNLOCKED.

3. Put gearshift in "N".

4. Turn key toward LOCK and hold while installing switch.

5. Re-install column and assure that lever moves freely from "P" to "L".

6. Re-connect battery cable.

7. Apply service brake and assure that engine starts in "P" and "N", but not in "R", "D", or "L".

If either the ignition switch or column jacket is replaced, any "witness" marks Fig. 3B-87, on the switch bracket must

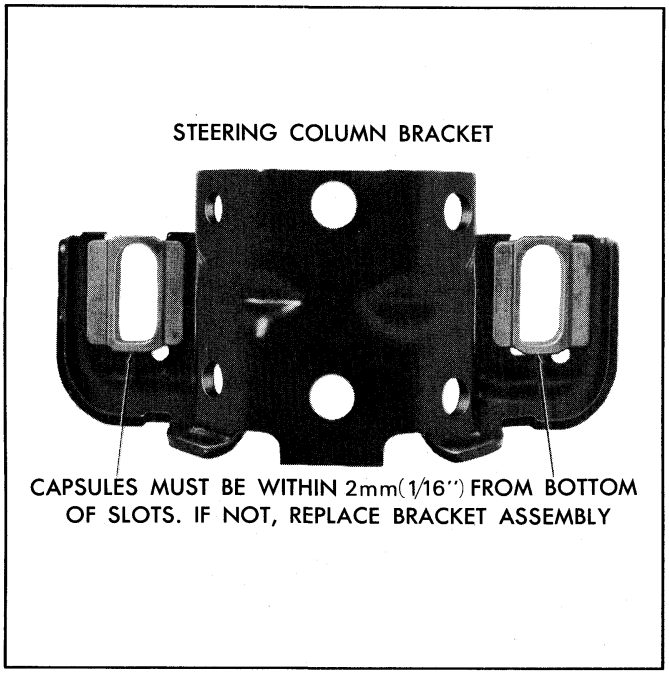


Fig. 3B-113 Checking Capsules in Bracket

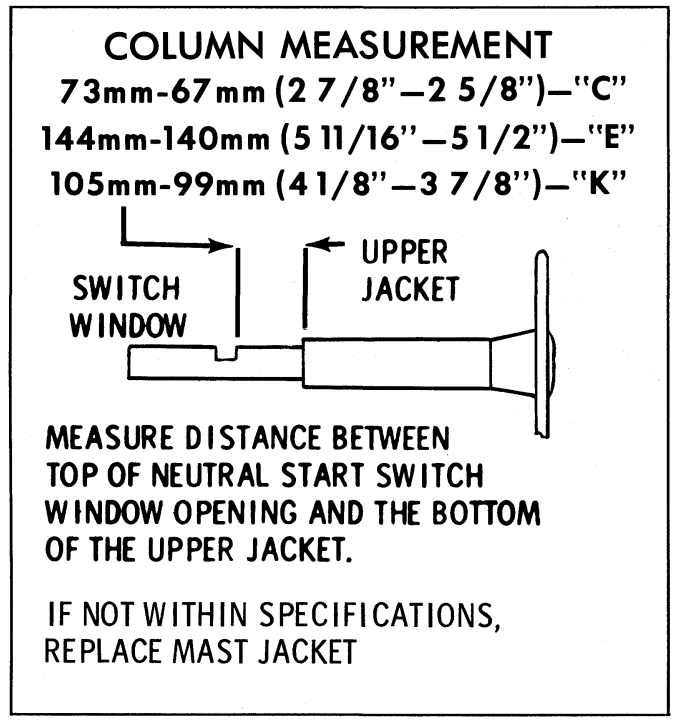


Fig. 3B-114 Checking Mast Jacket for Collapse

be removed by flattening and the ignition switch adjusted per the above procedure.

CAUTION: *Always check the start system as directed on the instruction label before releasing the vehicle.*

23. To install lock, hold lock cylinder sleeve and rotate key clockwise against stop. Make sure buzzer switch drive tang is below O.D. of lock cylinder. Insert cylinder into cover bore with key on cylinder sleeve aligned with keyway in housing until cylinder touches lock sector shaft.

NOTE: A 1/16" drill shank gage must be inserted between the lock cylinder knob and the column housing to avoid assembling the lock cylinder into the column beyond its normal position.

24. Maintaining a light push inward on cylinder, rotate cylinder counterclockwise until drive section of cylinder mates with sector drive shaft. Push in until snap ring on lock cylinder pops into groove in housing. Check freedom of rotation of lock cylinder in housing. There must be a free spring return from start to run position.

25. Install turn signal lever.

NOTE: On cars equipped with Cruise Control, proceed as follows:

a. Insert guide wire into opening and route through column.

b. Attach guide wire to Cruise Control switch harness connector.

c. Gently pull harness down through steering column cover until slack is removed.

d. Position turn signal lever on turn signal switch and secure lever to turn signal switch with one screw. Tighten screw to 20 inch-pounds.

e. After lever is installed, gently pull remainder of harness through column and into position.

f. Remove guide wire from Cruise Control harness.

g. Install harness protector on harness and slide protector up harness and into position.

h. Connect Cruise Control harness to connector.

26. Attach connector to column.

27. Install upper steering shaft preload spring.

28. Install lock plate and carrier assembly.

NOTE: When installing lock plate and carrier assembly, make sure flat on lower end of steering shaft is pointing up and that the small plastic tab on the carrier is up or nearest the top of the shift bowl. Flat surface of lock plate must be installed facing down against turn signal switch.

29. If upper end of upper shaft hub was removed, replace shaft and wedge at this time.

30. Install Spring Compressor, J-23063, Fig. 3B-104. Compress preload spring and lock plate and install C-ring with wide side toward keyway.

31. Remove Spring Compressor, J-23063.

32. Carefully insert plastic retainer on C-ring.

33. Position turn signal switch harness protector over weld nut on upper steering column jacket.

34. Position steering column upper mounting bracket over turn signal wiring harness protector and secure bracket to column with four screws and washers. Tighten screws to 20 foot-pounds.

35. Remove tape from turn signal switch wiring harness and connector.

36. Connect turn signal harness to connector and install connector in bracket on steering column jacket.

37. If rubber bumper was removed, reinstall in position shown in Fig. 3B-112, and compress both clamp ears using tool J-22610.

38. Install and adjust back-up light switch as outlined on page 8-110

39. Install steering wheel as described on page 3B-62.

Checking Steering Column for Accident Damage

NOTE: Cars involved in accidents resulting in frame damage, major body or sheet metal damage, or where

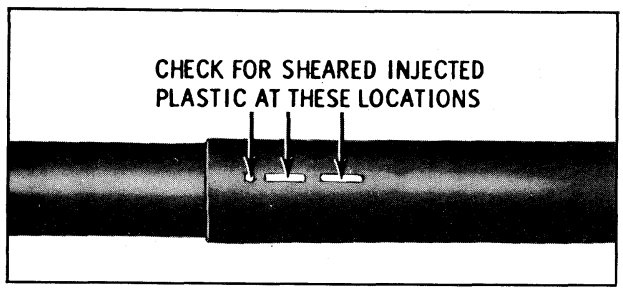


Fig. 3B-115 Checking Shift Tube Injected Plastic

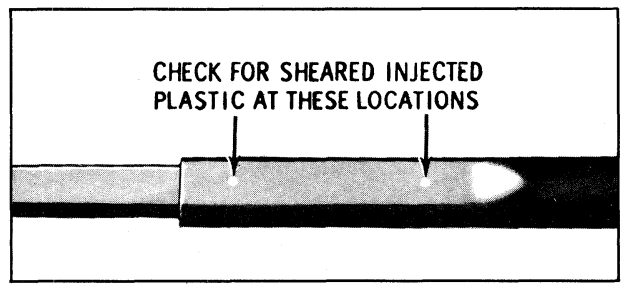


Fig. 3B-116 Checking Steering Shaft Injected Plastic

the steering column has been impacted may also have a damaged or misaligned steering column.

Checking Procedure

1. Check capsules on steering column bracket assembly; all should be within 2mm (1/16″) from the bottom of the slots, Fig. 3B-113. If not, bracket should be replaced.

2. On standard column, check operation of the shift lever. If you are able to move lever to "Park" position without raising lever, it is an indication that the upper shift tube plastic bearing is broken.

3. Check for mast jacket collapse by measuring the distance from edge of the neutral-start switch window to the lower edge of upper jacket. Refer to Fig. 3B-114 for dimensions. If mast jacket dimensions, Fig. 3B-114, are not within specifications, a NEW mast jacket must be installed and shift tube and steering shaft visually inspected for sheared injected plastic. If shift tube shows sheared plastic, a NEW shift tube must be installed, Fig. 3B-115. If steering shaft shows sheared plastic and not bent, it can be repaired by using a Service Steering Shaft Repair Kit. Kit contains instructions and dimensions for all steering shafts, Fig. 3B-116.

4. Check for broken plastic bearing adapter at lower end of steering shaft. If adapter is cracked or broken, it must be replaced.

5. Check steering gear flexible coupling for tears or for no pin engagement. This indicates possible misalignment or frame damage. If flexible coupling damage is evident, the coupling is to be replaced.

6. Any frame damage that could cause a bent steering shaft must have steering shaft runout checked in the following manner: Disconnect the lower shaft at flex-coupling, then remove bolt and nut from clamp of coupling assembly. Remove lower shaft. Hold ruler against lower end of steering shaft and have steering wheel rotated. Runout must not exceed 1/16″. Dial indicator may be used instead of a ruler.

NOTE: This check cannot be made if the bearing adapter is broken.

TORQUE SPECIFICATIONS

Material No.	Application	Thread Size	Newton-Metres	Foot-Pounds
	STEERING COLUMN & INTERMEDIATE SHAFT			
301M	Column Shaft to Upper Coupling Clamp Nut	7/16 - 20	—	*45
	(Exc. Eldorado)	5/16 - 18	—	24
275M	Column Upper Mounting Bracket Screws to Column			
286M	Column Upper Mounting Bracket to Instrument Panel Bracket (Eldorado)	5/16 - 18	—	24
286M	Column Upper Mounting Bracket to Instrument Panel	3/8 - 16	—	20
	Bracket (Exc. Eldorado)	10 x 1.5	15	*30
500M	Flexible Coupling Bolt to Steering Gear Stub Shaft	5/16 - 24	—	*22
286M	Flexible Coupling Nut to Intermediate Shaft			
286M	Flexible Coupling Nut to Lower Steering Shaft	3/8 - 24	—	*22
	(Eldorado)	1/2 - 20	—	*30
301M	Steering Wheel Nut	7/16 - 20	—	*80
300M	Universal Joint Clamp Bolt (Eldorado)			
	STEERING GEAR	7/16 - 20	—	35
Special	Gear Adjuster Lock Nut	3/8 - 16	—	45
280M	Gear Side Cover Screws	7/16 - 14	—	*70
*300M	Gear to Frame	Part of	—	*30
Special	Hose Connections to Gear	Hose Asm.		
		1/4 - 20	—	* 5
Special	Rack-Piston Ball Guide Clamp Screw	1-5/16-16	—	*75
Special	Rack-Piston Plug			
	STEERING LINKAGE			
301M	Idler Arm to Frame (Eldorado)	5/8 - 11	—	*95
300M	Idler Arm to Frame (Exc. Eldorado)	7/16 - 14	—	*50
Special	Idler Arm to Intermediate Rod (C-Car)	7/16 - 20	—	*35
Special	Idler Arm to Intermediate Rod (Eldorado)	1/2 - 20	—	*60
Special	Idler Arm to Intermediate Rod (Seville)	7/16 - 20	—	*40
Special	Pitman Arm to Intermediate Rod (Eldorado)	1/2 - 20	—	*60
Special	Pitman Arm to Intermediate Rod (Exc. Eldorado)	7/16 - 20	—	*45
Special	Pitman Shaft Nut	7/8 - 14	—	*185
301M	Shock Damper Bracket to Frame (Seville)	3/8 - 16	—	*25
301M	Shock Damper to Frame Bracket (Eldorado)	7/16 - 14	—	*40
301M	Shock Damper to Frame Bracket (Exc. Eldorado)	7/16 - 14	—	*35
301M	Shock Damper to Intermediate Rod (Eldorado)	7/16 - 14	—	*40
301M	Shock Damper to Intermediate Rod (Exc. Eldorado)	1/2 - 20	—	*35
Special	Tie Rod Adjuster Clamp Nut	3/8 - 16	—	*14
Special	Tie Rod Pivot to Steering Knuckle (Eldorado)	1/2 - 20	—	*40
Special	Tie Rod Pivot to Steering Knuckle (Exc. Eldorado)	7/16 - 20	—	*35
Special	Tie Rod to Intermediate Rod (Eldorado)	1/2 - 20	—	*60
Special	Tie Rod to Intermediate Rod (Exc. Eldorado)	7/16 - 20	—	*40

TORQUE SPECIFICATIONS (Cont'd.)

Material No.	Application	Thread Size	Newton-Metres	Foot-Pounds
	STEERING PUMP			
280M	Filter Bracket to Pump (Eldorado)	3/8 - 16	—	30
280M	Pump Belt Adjustment Bolt	3/8 - 16	—	30
300M	Pump Mounting Bracket Nut to Crankcase Bolt (Seville)	3/8 - 16	—	30
286M	Pump Mounting Bracket to Timing Chain Cover Stud (Seville)	3/8 - 16	—	30
286M	Pump Mounting Bracket Nut to Water Pump Stud (Seville)	5/16 - 18	—	20
260M	Pump Mounting Bracket to Engine Screw (Exc. Seville)	3/8 - 16	—	22
280M	Pump Pivot Bolt	3/8 - 16	—	30
Special	Pump Pressure Unions	Part of Hose Asm.	—	*55
				Inch-Pounds
Special	Column Ignition Switch to Jacket	—	—	*35
6010M	Cooler Tube to Crossmember (Eldorado)	1/4 - 20	—	75
500M	Cooler Tube to Radiator Support	6.3 x 1.0	10	50
Special	Hose Clamps (Exc. Seville)	Part of Hose Asm.	—	*20
Special	Hose Clamps (Seville)	Part of Hose Asm.	—	*18
275M	Lower Mounting Bracket Clamp Screws (Exc. C-Car)	5/16 - 18	—	50
6010M	Lower Mounting Bracket to Toe Pan Screws (Exc. C-Car)	1/4 - 14	—	50
6010M	Lower Toe Plate to Toe Pan Screw (C-Car)	6.3 x 1.81	10	50
6010M	Turn Signal Lever Screw	#08 - 32	—	*22

*CAUTION: This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

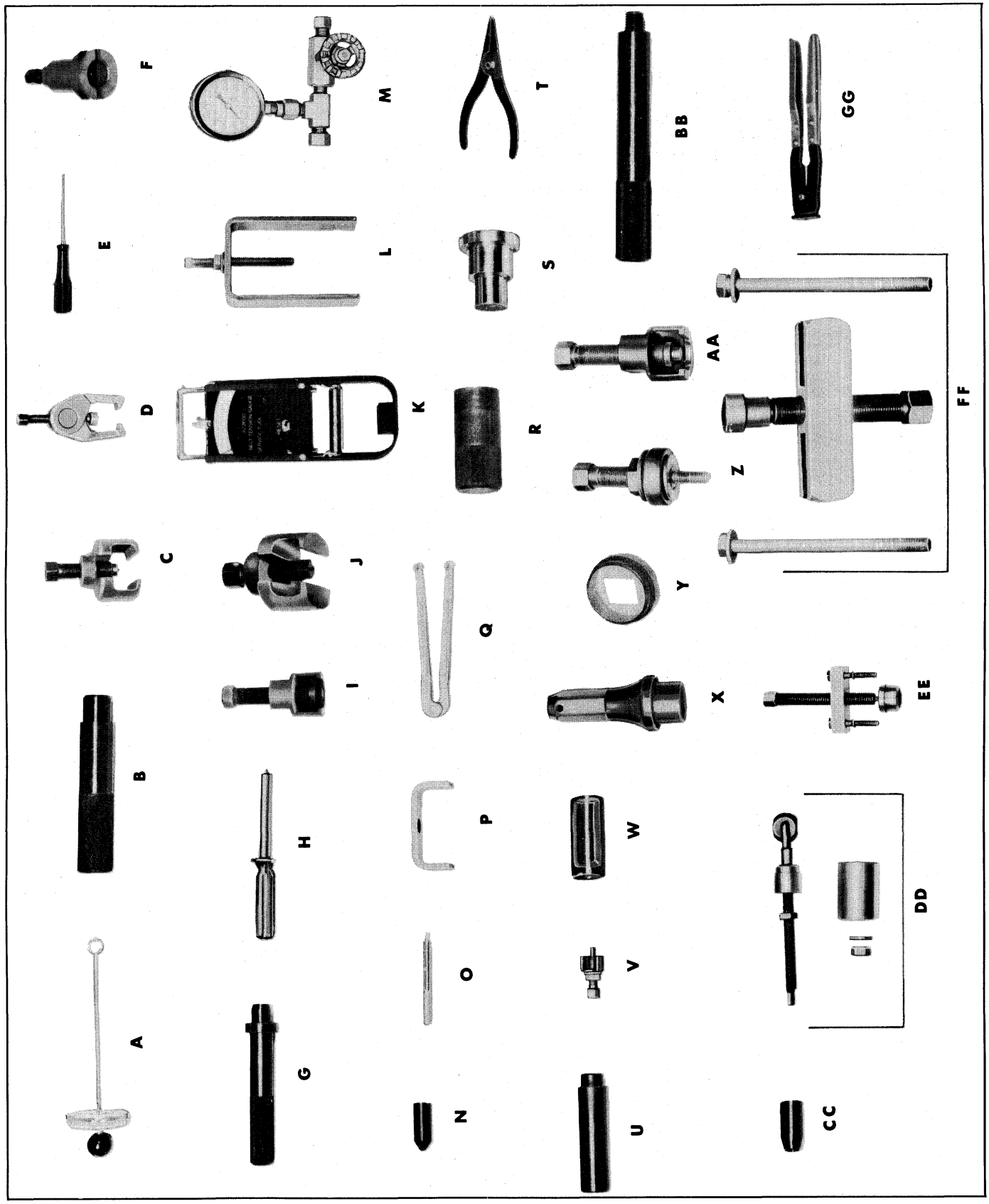


Fig. 3B-117 Special Tools

Key	Tool No.	Name
A	J-7754	Torque Wrench (0-25 inch-pounds)
B	J-6657	Pitman Shaft Bearing Remover
C	J-9172	Pitman Arm Puller (C and K-Car)
D	J-24319	Front Suspension Puller
E*	J-22635	Pin Remover
F	J-21883	Pump Pulley Remover (C and E-Car)
G	J-5188	Adjuster Plug Seal Installer
H	J-21552	Rack-Piston Arbor
I	J-25034	Pump Pulley Remover (Seville)
J	J-6632	Pitman Arm Puller (Eldorado)
K	J-23600	Belt Tension Gage
L*	J-23063	Carrier and Spring Compressor
M	J-5176-01	Pressure Testing Gage Assembly
N	J-22616	Pump Shaft Oil Seal Protector (Seville)
O	J-6217	Valve Connector Seat Installer
P	J-23131	Carrier and Spring Compressor
Q	J-7624	Spanner Wrench
R	J-6219	Pitman Shaft Seal Installer
S	J-22407	Pitman Shaft Bearing Installer
T	J-4245	Snap Ring Pliers
U	J-6221	Adjuster Plug Bearing Remover and Installer
V*	J-21854-01	Hardened Step Screw and Pivot Pin Adapter
W	J-7728	Pump Shaft Oil Seal Installer
X	J-21150	Seal Installer, Linkage
Y	J-7576	Rack-Piston Seal Compressor
Z	J-25033	Pump Pulley Installer
AA	J-25034	Pump Pulley Remover
BB	J-8092	Universal Handle
CC	J-6222	Adjuster Plug Seal Protector
DD	J-23073	Shift Tube Installer
EE	J-23072	Shift Tube Remover
FF	J-1859-03	Steering Wheel Puller
GG	J-22610	Band Installer

*Denotes Tilt and Telescope Column only.

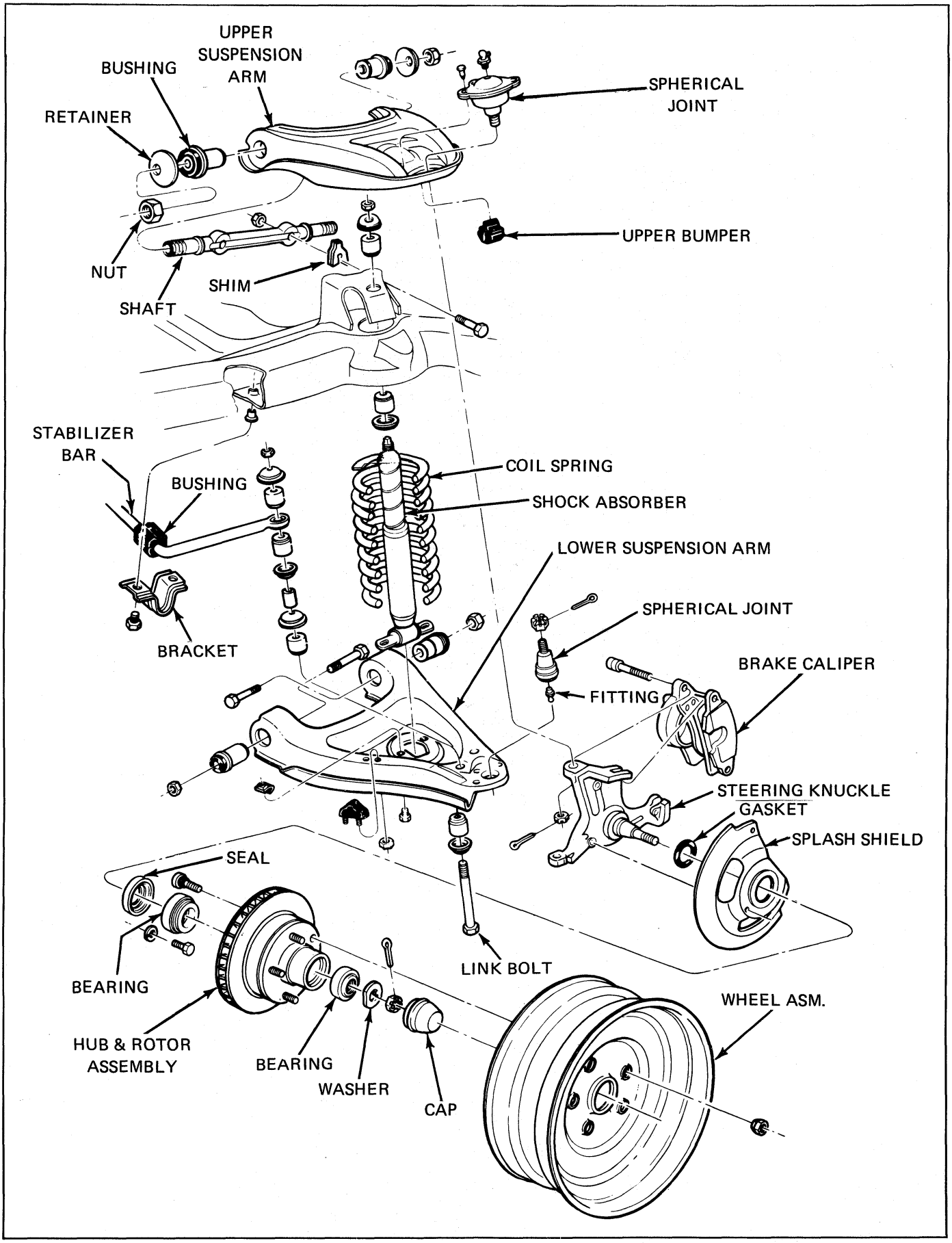


Fig. 3C-1 Front Suspension Disassembled

FRONT SUSPENSION

TABLE OF CONTENTS

Diagnosis 3C-2
General Description 3C-1
Hub Bearing and Knuckle Assembly (E-Car) 3C-25
Lower Spherical Joint 3C-11
Lower Spherical Joint (E-Car) 3C-25
Lower Suspension Arm 3C-14
Lower Suspension Arm (E-Car) 3C-24
Lower Suspension Arm Bushings 3C-14
Lower Suspension Arm Bushings (E-Car) 3C-24
Shock Absorbers 3C-8
Shock Absorbers (E-Car) 3C-18
Stabilizer Bar 3C-9
Stabilizer Bar (E-Car) 3C-18
Steering Knuckle 3C-15
Steering Knuckle and Inner Seal (E-Car) 3C-21
Torsion Bar (E-Car) 3C-20
Upper Spherical Joint 3C-10
Upper Spherical Joint (E-Car) 3C-20
Upper Suspension Arm 3C-13
Upper Suspension Arm (E-Car) 3C-19
Upper Suspension Arm Bushing (E-Car) 3C-19
Upper Suspension Arm Shaft and Bushings 3C-13
Wheel Bearings 3C-6
Wheel Stud Replacement (E-Car) 3C-29

GENERAL DESCRIPTION

All model Cadillac except the Eldorado use an independent spring type front suspension system, consisting of two upper and two lower suspension arm assemblies, steel coil springs, shock absorbers, a stabilizer bar, and two integral steering arm and knuckles, Fig. 3C-1. The system is designed so that the geometry of the upper and lower suspension arms produces an anti-dive reaction during braking. The front suspension used on the Eldorado is described on page 3C-18.

Front Suspension System

a. Spherical Joints

Spherical joints are used at the outer ends of the upper and lower suspension arms. These joints are packed with lubricant at assembly. An inspection of the seals for physical damage is recommended each time the engine oil is changed. Lubrication fittings are provided in the spherical joint covers so that the joints may be lubricated. Refer to Section O for periodic maintenance.

The upper spherical joint is riveted to the upper suspension arm. The wear indicating lower spherical joint is pressed into the lower suspension arm. The suspension arms connect to the steering knuckle through tapered studs that are secured with nuts and cotter pins.

The spherical joints are designed to allow both the up-and-down movement of the wheel due to road irregularities, and the pivoting movement that takes place as the wheels are turned while steering.

b. Compression and Rebound Bumpers

A rubber compression bumper on the lower suspension arm limits upward travel of the suspension system and a rubber rebound bumper on the upper suspension arm limits downward travel. The upper bumpers are held in place by means of pull-through tabs. The lower bumpers are held in place by integral studs and nuts.

c. Suspension Arms

The upper suspension arms pivot at their inner ends on two flanged rubber bushings, one at each end of the one-piece suspension arm shaft, which is bolted to the mounting bracket above the top surface of the frame spring tower.

d. Steering Knuckle

The integral steering knuckle is a combination steering knuckle, brake caliper support, and steering arm. The splash shield is secured to the steering knuckle with three attaching screws.

e. Stabilizer Bar

A 28mm (29mm on Limousines and Commercial Chassis) front stabilizer bar is used to provide steering stability and to control body roll. It is mounted on the frame front side rails forward of the suspension arms and is connected to the lower suspension arms by steel links that are cushioned at each end in rubber bushings. The stabilizer bar extends across the car between its frame mounts.

f. Springs and Shock Absorbers

The front wheels are controlled in their up-and-down movement by steel coil springs and direct, double acting, permanently sealed shock absorbers.

The springs are mounted with the lower ends seated on the lower suspension arms and the upper ends seated in towers on the front suspension frame corssmember.

The shock absorbers incorporate a special piston ring for improved piston sealing with temperature variations in the shock. These shock absorbers provide efficient and constant damping control because oil is separated from air in the reservoir, which eliminates aeration of oil and prevents lag. Separation is accomplished by means of a pliacell envelope filled with an inert gas that takes the place of the air pocket.

The front shock absorbers are positioned in the center of the coil springs and are attached at the upper ends to the spring seat towers. The lower ends are attached to the lower suspension arms by bolts that go through the shock lower mount cross bars into nuts on the lower arms.

FRONT SUSPENSION DIAGNOSIS CHART

Condition	Cause	Correction
Car pulls to one side.	Uneven tire pressure.	Adjust tires to recommended pressure, page 3E-1.
	Radial tire lateral force. (conicity)	Rotate tires.
	Front wheel alignment out of specification. (Caster).	Check and adjust as necessary. See section 3A.
	Uneven standing height, left and right.	Perform procedure in section 3A.
	Intermediate rod height or parallelism incorrect. (Eldorado only)	Perform procedure on page 3B-9.
	Brakes dragging.	See brake diagnosis.
	Upper or lower suspension arm mounting bolts loose.	Check and correct all fastening torques.
	Wheel bearings adjusted too tight.	Check for binding with front wheels off floor. Adjust and lubricate bearings, page 3C-6.
	Steering gear valve off center.	Replace valve assembly, page 3B-37.
	Bent Frame.	Check frame for proper alignment and repair as necessary.
Scuffed tires.	Toe-in incorrect.	Adjust as in section 3A.
	Camber out of specification.	Adjust as in section 3A. .
	Tires improperly inflated.	Adjust to recommended pressure, page 3E-1.
Cupped tires.	Toe-in incorrect.	Adjust as in section 3A.
	Excessive wheel and/or tire runout.	Compensate as explained in section 3E, Diagnosis Charts.
	Wheels or tires out of balance.	Balance wheels and tires.
	Excessive on-center lash in steering gear.	Perform adjustments on page 3B-43.
	Front shock absorber inoperative.	Replace shock absorber. Page 3C-8 (Exc. Eldorado) or page 3C-18 (Eldorado).
	Spring rates and standing height incorrect.	Replace spring, page 3C-9.

Front Suspension Diagnosis Chart

FRONT SUSPENSION DIAGNOSIS CHART (Cont'd.)

Condition	Cause	Correction
Cupped Tires (Cont'd.)	Worn upper spherical joint.	Check joint as on page 3C-11 (3C-18 if E-car). Replace arm and joint assembly if necessary.
	Worn lower spherical joint.	Check joint as on page 3C-11, (3C-18 if E-car). Replace joint if necessary, following procedure.
	Excessive (1/4" or more) vertical lash in idler arm frame pivot.	Replace idler arm assembly, section 3B.
	Wheel bearings worn or incorrectly adjusted.	Adjust or replace bearings as necessary, page 3C-6.
Front wheel shimmy.	Wheels or tires out of balance.	Balance wheels and tires.
	Wheels or tires out of round.	Compensate for runout as described in section 3E, Diagnosis Charts.
	Rough or cupped tire.	Isolate and replace.
	Steering gear or steering connections incorrectly adjusted or worn.	Check and adjust to specifications.
	Worn spherical joints.	Replace lower joints and/or upper arm assembly.
	Front wheel bearings incorrectly adjusted or worn.	Adjust or replace as required.
	Shock absorbers weak or inoperative.	Check and replace if necessary.
Car wanders	Improper tire inflation.	Adjust to recommended pressure, page 3E-1.
	Steering gear or connections adjusted too loosely or worn.	Adjust or install new parts as necessary.
	Intermediate rod height or parallelism incorrect.	Check and adjust to specifications.
	Worn spherical joints.	Replace lower joints and/or upper arm assembly.
	Toe-in or caster incorrectly adjusted.	Adjust toe-in and caster.
	Mixed tire brands.	Replace tires so that all are identical brand and type.
	Excessive friction in front suspension.	Check spherical joint seals for damage. If necessary, replace seals and repack joints.
Car waddles 8-32 km/h. (5 to 20 mph)	Radial tire lateral force variation	Replace offending tire (Refer to tire section)

DIAGNOSIS

Bearing Problem Conditions

Whenever a front or rear wheel bearing or a pinion or differential bearing is removed, a careful inspection must be made to determine the cause of the problem and whether any related parts have been damaged.

Before diagnosing a bearing problem, clean the cone assembly thoroughly in solvent and allow to dry completely.

NOTE: If bearing has become magnetized, removal of metal particles from inside cage cannot be accomplished unless bearing is demagnetized.

Compare bearing in question to the examples in Fig. 3C-2 then refer to the corresponding explanation on this page and follow recommendations to prevent a similar problem in the replacement bearing.

Wear

Bearing lubricant is contaminated by fine particles of some abrasive material. The finish on the rollers and outer cup has become dulled in uniform pattern. If wear is very minor the bearing need not be replaced.

Cage Wear

This is a more advanced case of wear in which even the roller cage has been affected. Unit must be replaced.

Step Wear

A different kind of wear pattern, affecting only the ends of the rollers, could develop from contaminated lubricant. If bearing is already rough or noisy, it must be replaced. In any case, do not preload beyond specification on installation.

Indentations

Surface depressions or pits in the cups or rollers are caused by hard particles of foreign material. If condition is at least as advanced as that shown in the example, discard bearing and outer cap.

Regardless of whether or not replacement is necessary, if any bearing shows signs of indentation or of wear on cup, rollers, or cage, the lubricant must be completely removed from the bearing assembly and all associated parts before refilling or repacking. All seals must be examined very carefully for damage that could admit contaminants. If these precautions are not followed, an identical problem could result.

Misalignment

The roller and cage assembly in this example is cocked with respect to the outer cup. Check for small burrs or foreign material lodged between bearing and outer cup or between cup and housing. These surfaces must be absolutely smooth to prevent this type of problem.

Cracked Inner Race

When the press fit is at the inner cup, a cocked assembly will result in a cracked inner cup. This type of failure can be caused by improper removal and installation techniques. Always use the recommended tools when servicing bearings.

Fretting

"Fretting" is the term used to describe corrosion resulting from slight relative movement of parts with no coating of lubricant. Check and clean all related parts during the replacement procedure as these could also be damaged.

Stain Discoloration

Lubricant breakdown can leave brown or black stains. In this case, the unit is not necessarily damaged. If light polishing removes the stain, the bearing can be reused.

Heat Discoloration

An overload on the bearing or deterioration of the lubricant will result in discoloration different from stain discoloration, although the two can be confused.

Stains ranging in color from faint yellow to dark blue indicate the possibility of softening of cups or rollers. Draw a file across the discolored areas. If the file cuts metal, discard the bearing. If it glides readily over the affected parts, the bearing can be reused.

Galling

Metal smears on roller ends render bearings unusable. When installing new bearing, be certain that bearing is properly adjusted and that correct lubricant is used. Conduct a very careful examination of seals. This condition is easily caused when lubricant is allowed to escape.

Bent Cage

This kind of damage results from simple mishandling. Bearings are very vulnerable to forces other than those that they were designed to handle. A dent even as minor as the one pictured will ruin a bearing.

Always use a piece of cardboard or other soft covering on workbench when handling bearing parts.

Brinelling

A severe impact on a bearing or vibration while the unit is not rotating causes the rollers to dent the cup surface. Often, this condition is related to extraneous circumstances (such as a collision) rather than a problem in the vehicle.

Fatigue Spalling

Fatigue spalling is the flaking of metal from bearing surfaces. These particles can cause further damage when car is back in service. Remove all lubricant and clean all related parts completely before reassembly with replacement bearing.

Etching

Bearing appears gray or grayish black and there is some erosion of surface metal of the cup at the same spacing as the rollers. As in other cases in which hard particles have contaminated the lubricant, clean all parts thoroughly to prevent future damage. Check seals.

Smears

Smearing of metal can occur on any or all of the bearing surfaces. This is generally due to the overheating related to the unwanted slippage between parts, and this slippage generally stems from either a loose fit, poor lubricant, or an overload on the unit. When installing new bearing, make certain proper amount of correct lubricant is used and that bearing is adjusted to specification.

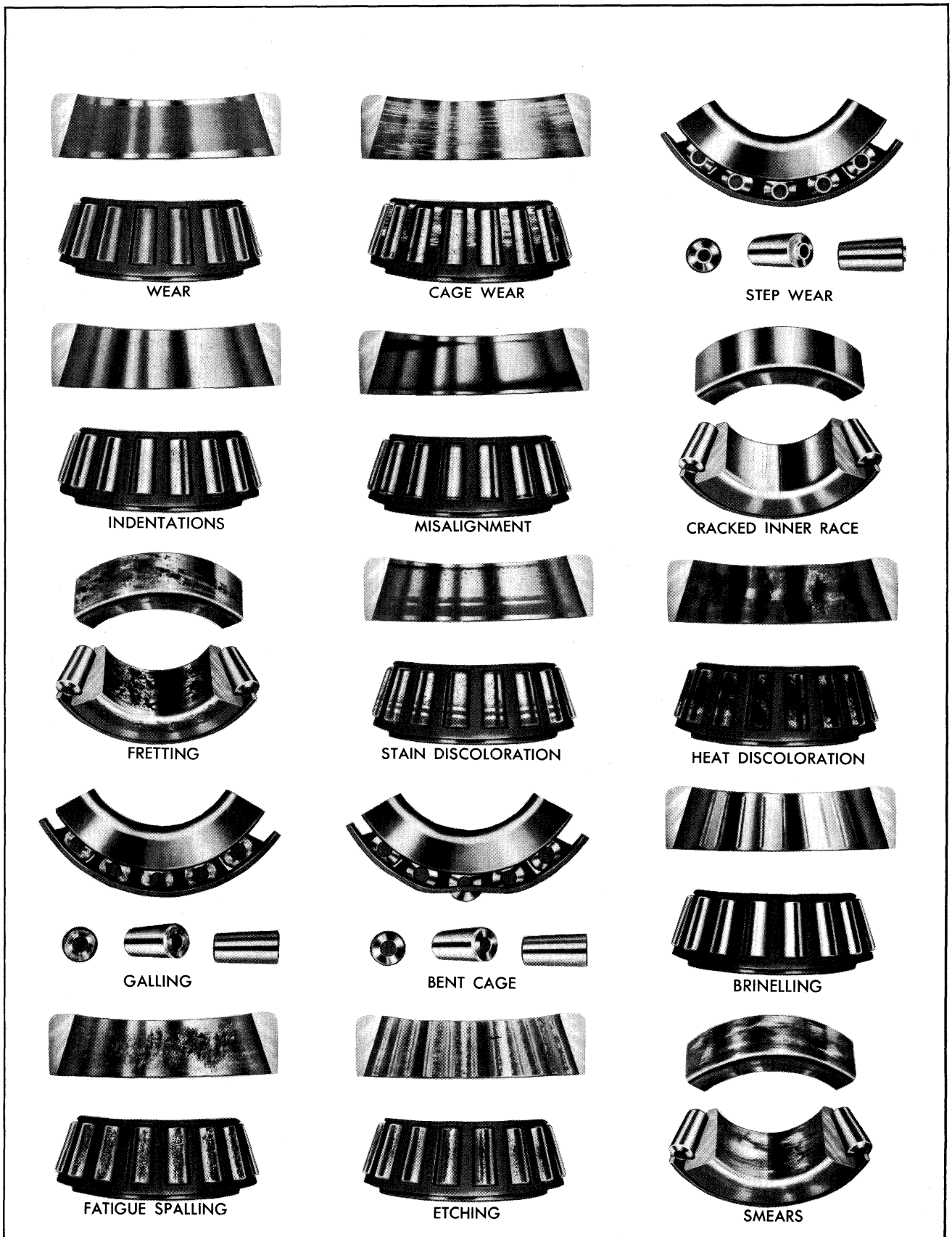


Fig. 3C-2 Bearing Problem Conditions

ON-CAR SERVICE

CAUTION: *If any mispositioning, incorrect assembly, or failure of components in the area of the brake system pipes, hoses, or cylinders is observed, be sure to check for any brake damage that may have resulted from such a condition and correct as required. Components that could damage the brake system due to mispositioning, incorrect assembly, or failure include the exhaust system, shock absorbers, springs, and suspension arms.*

The following caution applies to certain steps in the assembly procedure of components in this section. The critical fasteners to which this caution applies are identified by the terminology CAUTION:

CAUTION: *See "CAUTION" on page 3C-6 of this section.*

CAUTION: *This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.*

Front Wheel Stud Replacement (Off Car)

a. Removal

1. Remove front hub and rotor assembly as outlined on this page, column 2, Steps 1 through 7.

2. Place shop towel on cleaned surface of Arbor Press to avoid damage to face of rotor and press stud out, Fig. 3C-3.

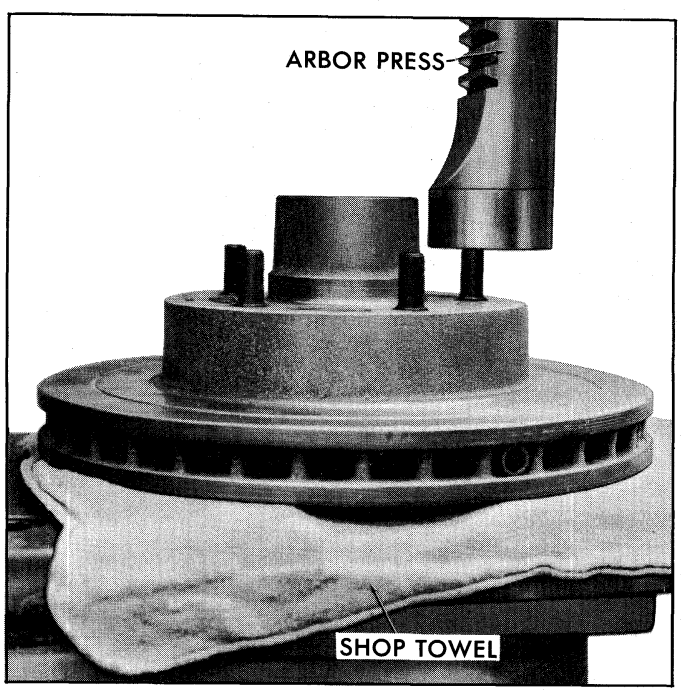


Fig. 3C-3 Removing Stud with Arbor Press

b. Installation

1. Turn rotor and press in new stud until fully seated. Use three equal length sockets over wheel studs for support. One socket must be used over new stud being pressed in.

2. Install hub and rotor assembly as outlined on page 3C-7, beginning with letter "D" of installation, starting with Step 7.

3. Install caliper assembly as outlined on page 5-13.

4. Adjust front wheel bearings as outlined below.

Front Wheel Bearings

Front wheels are equipped with a set of tapered roller bearings mounted in opposing directions to accommodate various combinations of vehicle loading.

CAUTION: *Tapered roller bearings are used on all series and they have a slightly loose feel when properly adjusted. A design feature of front wheel tapered roller bearings is that they must never be pre-loaded. Damage can result by the steady thrust on roller end which comes from pre-loading.*

a. Front Wheel Bearing Adjustment

1. Raise front of car. Remove wheel disc, dust cap, and cotter pin. Make sure hub is fully seated on spindle.

2. While rotating wheel and tire assembly, tighten spindle nut to 16 N·m (12 foot-pounds) to seat all bearing parts.

3. Back off spindle nut until free (approximately one flat) then retighten until nut is finger tight.

4. Install new cotter pin. If pin cannot be installed at finger tight position back off nut until holes line up and install pin.

5. Measure the looseness in the hub assembly.

NOTE: To check for tight or loose bearings, grip the tire at the top and bottom and move the wheel assembly in and out on spindle. Measure movement of hub assembly. Movement should be from 0.025 mm to 0.127 mm (.001" - .005").

6. Bend cotter pin ends against nut.

7. Install dust cap and make sure ends of cotter pin do not interfere with dust cap.

8. Install wheel disc and lower car.

b. Front Wheel Bearing Removal

1. Remove wheel disc.

2. Loosen wheel mounting nuts.

3. Raise front end of car.

4. Remove wheel mounting nuts and remove wheel assembly from hub.

5. Remove two bolts securing caliper to knuckle. Slide caliper off rotor and use a piece of wire to attach caliper to upper suspension arm.

CAUTION: *Never allow caliper to hang from brake hose, as the hose may be damaged.*

6. Remove dust cap, cotter pin, spindle nut, washer, and outer cone and roller assembly.

7. Remove hub and rotor assembly from steering knuckle spindle. Take care to prevent damage to spindle threads or grease seal.

8. Remove inner bearing grease seal, and bearing cone and roller assembly. Discard seal.

NOTE: A simple tool, Fig. 3C-4, may be made out of

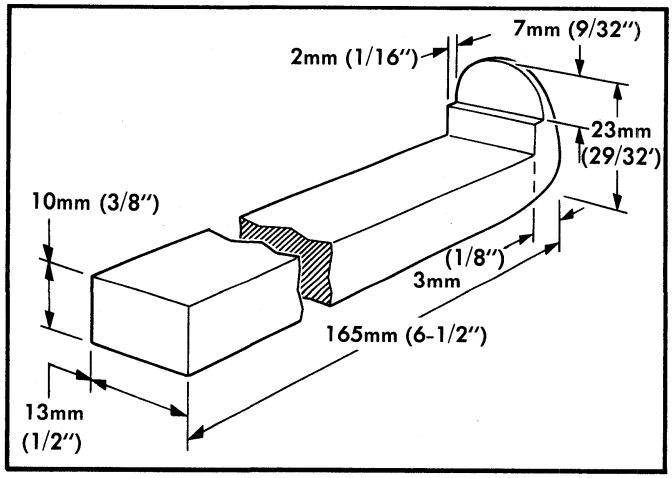


Fig. 3C-4 Grease Seal Removal Tool

cold rolled steel or from an old screwdriver to facilitate removal of the grease seal. Use of this tool will prevent possible damage to inner bearing assembly and hub surface when removing seal.

9. Inner and outer bearing cups are press fit in hub, and can be removed by driving out from opposite side with a long brass drift. Tap alternately on opposite sides of cup to avoid cocking cup and damaging inside of hub.

NOTE: Discolored stripes on bearing cups, particularly on low mileage cars, do not necessarily indicate a rough bearing race. If stains can be removed by light polishing, replacement is not required.

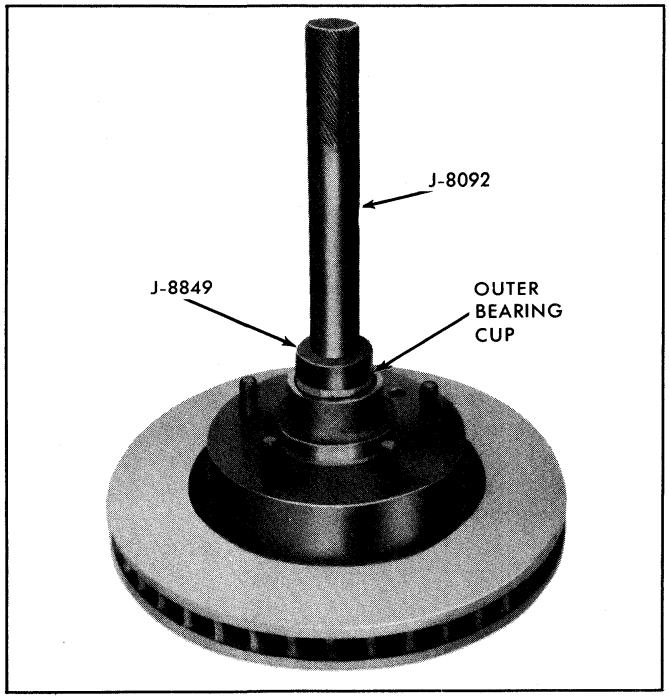


Fig. 3C-5 Installing Outer Bearing Cup

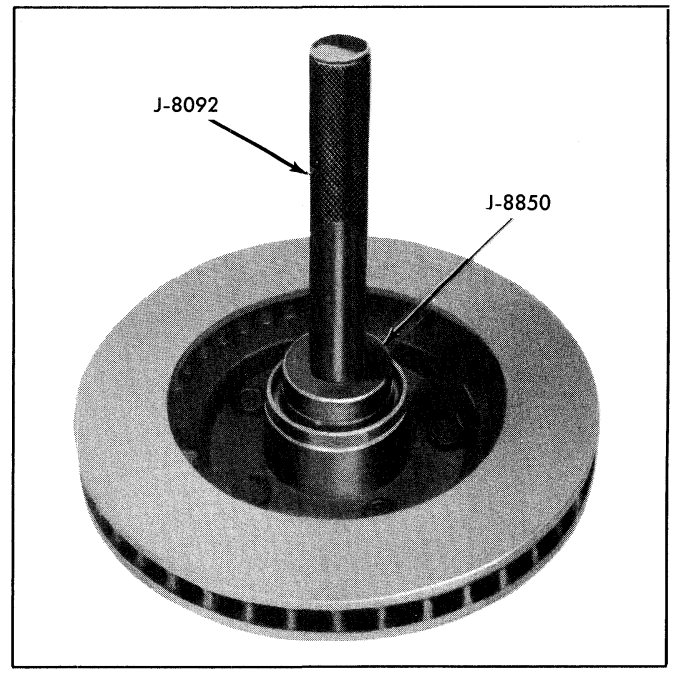


Fig. 3C-6 Installing Inner Bearing Cup

c. Cleaning and Inspection

1. Clean bearing cone assemblies and cups thoroughly with clean solvent. All traces of old grease and any contaminants must be removed. Replace complete assembly if any parts are worn, pitted, or rough. See page 3C-5 for diagnosis.

2. Inspect bearing cups and hub surfaces carefully for nicks or small particles of foreign material. All seating surfaces must be absolutely smooth.

3. If bearing cup O.D. is scored, or if bearing cup separated very easily from housing, a loose housing fit is indicated. Examine hub bearing surfaces to assure proper bearing cup seating and fit. Replace hub and rotor assembly if necessary.

4. Examine spindle bearing seats for excess wear or damage that could prevent proper slip fit seating of cone assemblies. Replace steering knuckle if necessary.

d. Installation

1. Lubricate spindle and hub bore with thin film of high melting point wheel bearing grease to prevent rust. Excess grease should be avoided to reduce possibility of leakage.

2. Install outer bearing cup, using Front Hub Outer Bearing Cup Installer, J-8849, and Handle, J-8092. Use arbor press to install bearing cup in hub, Fig. 3C-5.

3. Install inner bearing cup, using Front Hub Inner Bearing Cup Installer, J-8850, and Handle, J-8092. Use arbor press to install bearing cup in hub, Fig. 3C-6.

4. Pack bearing cone and roller assemblies with high melting point wheel bearing grease. Use a commercial bearing packer or pack bearings by hand. Force grease in at large end of roller cage until grease protrudes from small end.

5. Place inner bearing cone and roller assembly in inner bearing cup.

6. Install new grease seal using a flat plate until seal is flush with hub.

7. Carefully install hub and rotor assembly on spindle.

8. Place outer bearing cone and roller assembly in outer

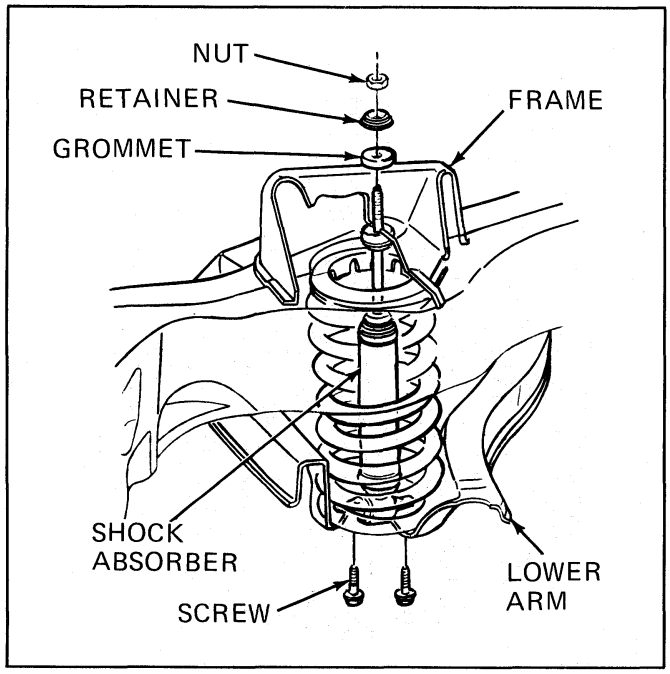


Fig. 3C-7 Shock Absorber Attachment

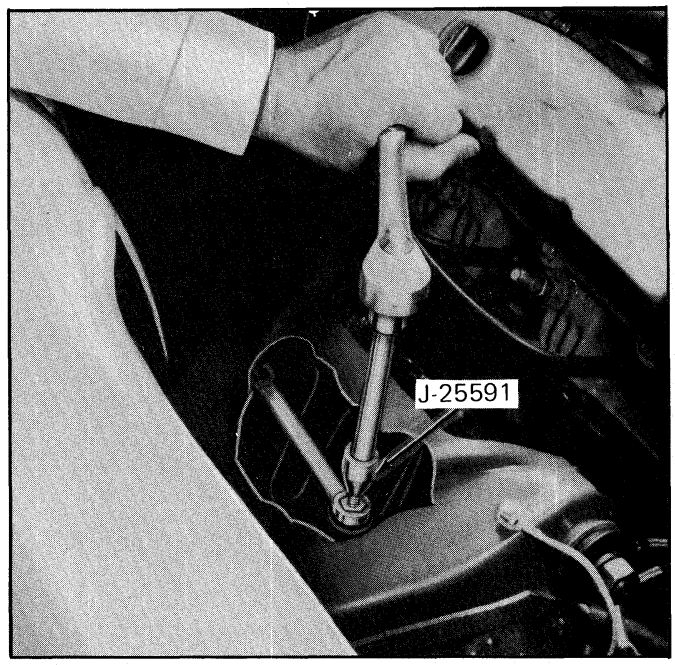


Fig. 3C-8 Removing Shock Absorber Upper Nut

bearing cup.

9. Install washer and spindle nut, tighten nut with fingers.

10. Install caliper.

11. Install wheel and tire assembly on hub and install wheel mounting nuts finger tight.

12. Adjust wheel bearings as in Part a.

13. Lower car and tighten wheel mounting nuts to 100 foot-pounds (130 foot-pounds on Eldorado).

CAUTION: *See "CAUTION" on page 3C-6 of this section.*

14. Install wheel disc.

Front Shock Absorbers (Fig. 3C-7)

a. Removal

1. Remove the two bolts securing shock absorber to the lower suspension arm.

2. Remove upper nut, retainer and grommet from shock absorber, Fig. 3C-8.

NOTE: Use a special socket such as J-25591 to aid in removal of the shock absorber upper nut. Hold the nut with a short box wrench, turn the shock absorber with the special socket and remove shock absorber from the car.

3. Remove shock absorber through bottom of lower arm.

b. Installation

1. Install grommet and retainer on shock absorber upper stem, and fully extend shock absorber rod.

2. Insert shock absorber assembly up into coil spring and guide stem through frame.

3. Install grommet and retainer over stem on top of frame and secure with nut (14 foot-pounds).

4. Using tool J-25591 and box wrench, tighten nut to end of threads (approximately 1-1/8" when measured from top of nut to top of shock upper mounting stud).

CAUTION: *See "CAUTION" on page 3C-6 of this section.*

5. Position lower shock absorber mount to lower suspension arm and secure with two screws. Torque to 22 foot-pounds (19 foot-pounds for Seville).

CAUTION: *See "CAUTION" on page 3C-6 of this section.*

Checking Front Shock Absorbers

1. Check all tire pressures.

2. Check shock absorber mounting torques.

3. If possible, road test car to determine the exact nature of the problem.

4. Quickly alternate pushing down and lifting left front corner of bumper. Repeat process for right front corner. The feeling of resistance should be equal between right and left. If so, it is unlikely that either shock requires replacement. If noticeable variation is felt, proceed to Step 6.

5. Visually inspect shock absorbers. If oil is detected, check for leaks in power steering system, transmission cooler lines, etc.

NOTE: A slight trace of shock fluid is not cause for replacement as the seal permits some seepage from fluid reserve for piston rod lubrication.

6. Raise car and remove one shock absorber.

7. Clamp shock absorber upside down in vise.

NOTE: Shock absorbers can be turned upside down because all internal vapor, inert gas instead of air, is contained in a pliacell envelope which prevents aeration of oil and prevents lag. If a lag is noticed when stroked, it means the pliacell envelope has been ruptured and the shock should be replaced.

8. Pump shock by hand at various rates of speed and observe resistance. Resistance should be smooth and constant.

NOTE: Rebound resistance is approximately twice as strong as that of compression.

9. Compare resistance felt with that of a unit known to be good. The following conditions are abnormal and require replacement of shock absorber:

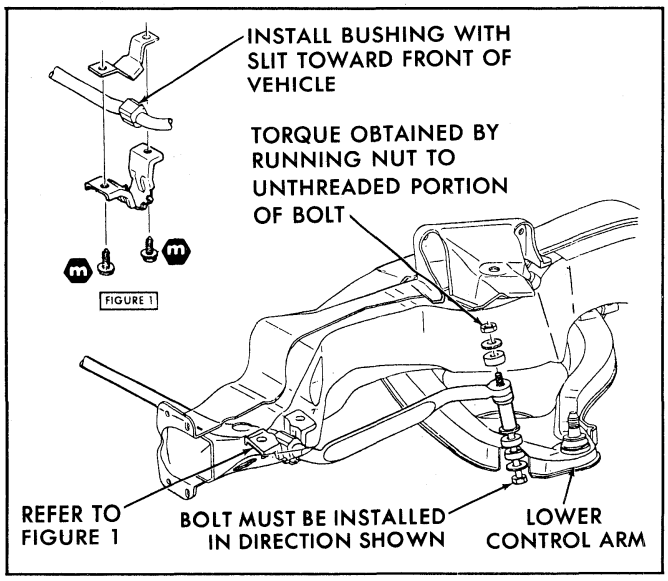


Fig. 3C-9 Front Stabilizer Bar

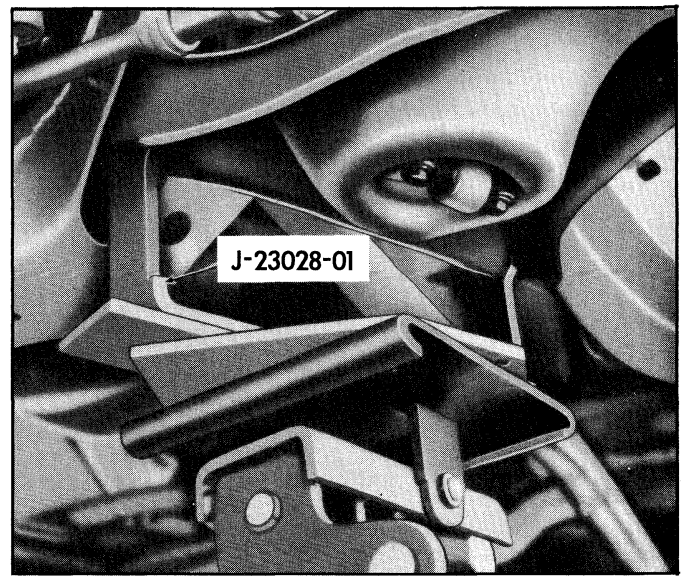


Fig. 3C-10 Removing Front Spring

a. A skip or lag at reversal near mid-stroke.

b. A seize (except at either extreme of travel).

c. A grunt or squeal after completion of one full stroke in each direction.

d. A clicking noise at fast reversal.

e. Fluid leakage.

A skip at full extension with shock absorber inverted, or a faint hiss ("orifice swish") are normal conditions and do not indicate necessity of shock absorber replacement.

Stabilizer Bar

a. Removal

1. Remove nuts, retainer, and grommet from bottom of each stabilizer link, Fig. 3C-9.

2. Remove bolts from mounting brackets that hold stabilizer to frame and remove mounting brackets.

3. Remove rubber bushings from stabilizer bar, and remove grommets, retainers, spacers, and links from ends of stabilizer bar.

4. Turn wheels to full stop and work stabilizer bar from car.

b. Installation

1. Position stabilizer bar under front frame side rails and slide rubber bushings in place, with slit forward.

NOTE: Stabilizer bar grommets and retainers are larger than those used on the shock absorbers. Replacement parts must be of this larger design.

2. Install mounting brackets over rubber bushings and secure with bolts, Fig. 3C-9. Tighten bolts to 24 foot-pounds (27 foot-pounds for Seville).

CAUTION: *See "CAUTION" on page 3C-6 of this section.*

3. Install grommets, retainers, links, and spacers on ends of stabilizer bar, making certain that retainers and grommets are arranged exactly as shown in Fig. 3C-9.

4. Install grommet retainer and nut. Tighten nuts to 12 foot-pounds.

CAUTION: *See "CAUTION" on page 3C-6 of this section.*

Front Spring (Fig. 3C-10)

a. Removal

1. Raise car on hoist.

2. Remove two shock absorber screws and push shock up through suspension arm and into spring.

3. With car supported so that suspension arms hang free, place Tool J-23028-01 into position cradling the inner bushings.

CAUTION: *Tool J-23028-01 should be secured to a suitable jack.*

4. Remove stabilizer to lower suspension arm attachment.

5. Raise jack to remove tension on lower arm pivot bolts. Install a chain around spring and through the lower arm as a safety measure. Remove nuts and bolts (remove rear bolt first).

6. Lower suspension arm by slowly lowering jack.

7. When all compression is removed from spring, remove safety chain and spring.

CAUTION: *Do not apply force on the lower suspension arm and spherical joint to remove spring. Proper maneuvering of the spring will allow for easy removal.*

b. Installation

CAUTION: *See "CAUTION" on page 3C-6 of this section regarding the fasteners referred to in steps 2 and 3.*

1. Properly position spring into frame and lift arm with Special Tool J-23028-01.

NOTE: Lower end of coil must cover all or part of one inspection hole in lower suspension arm. The second hole must be partly or completely uncovered as shown in Fig. 3C-11.

2. Position lower arm into frame and install pivot bolts (front bolt first) and nuts. Torque nuts to 120N·m (90 foot-pounds) or 130N·m (95 foot-pounds if car is Seville) and lower jack.

NOTE: On C-car, the rear bolt (front bolt on Seville) must be installed in the same direction as removed.

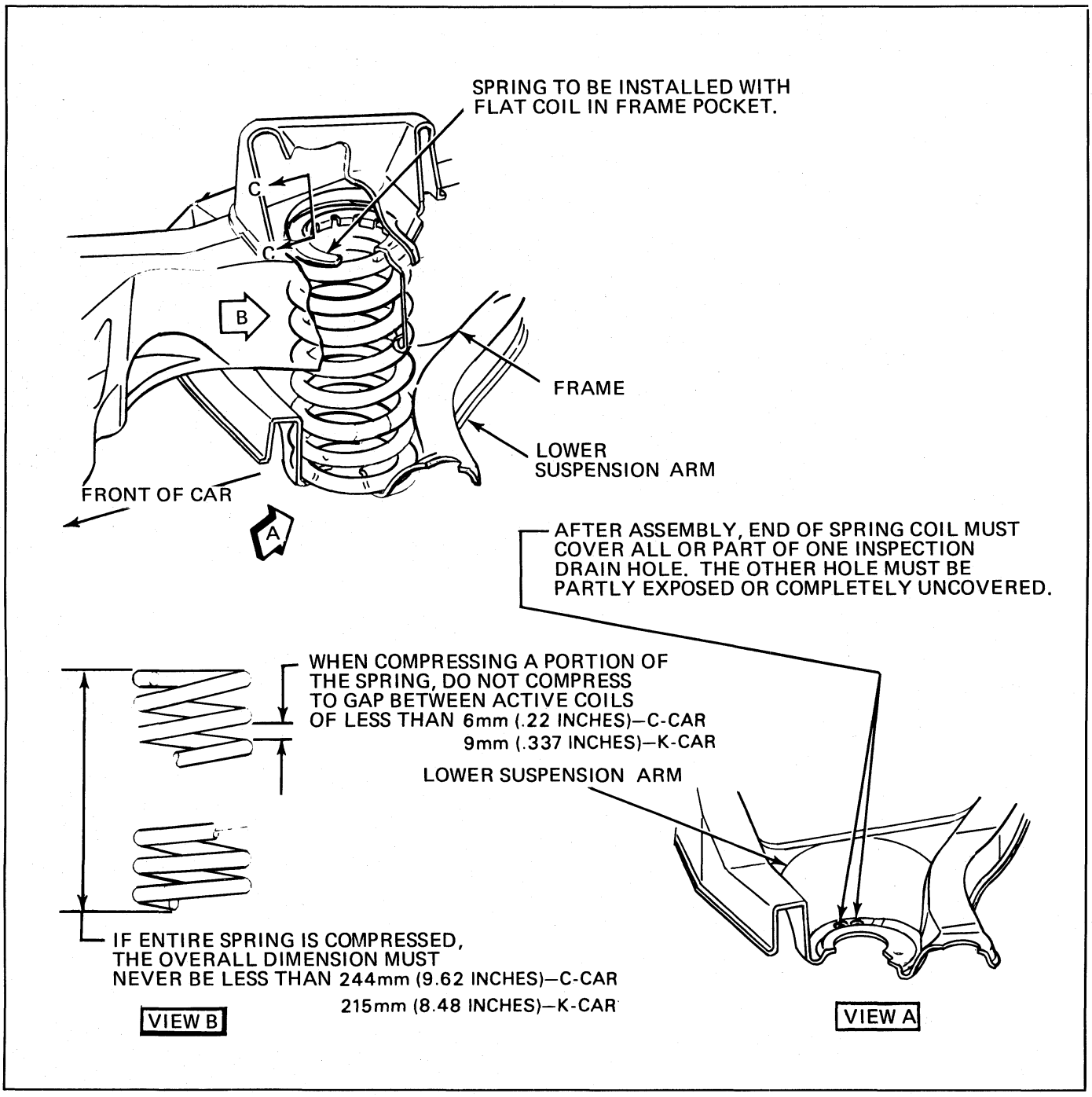


Fig. 3C-11 Coil Spring Positioning

3. Replace stabilizer bar link. Replace lower shock absorber screws and torque to 22 foot-pounds. (19 foot-pounds for Seville).

4. Lower car to floor.

5. Check front wheel alignment and reset if necessary.

Upper Spherical Joint (Fig. 3C-12)

a. Removal

1. Raise car on hoist.

2. Remove wheel and tire assembly.

3. Remove upper spherical joint stud cotter pin.

4. Remove caliper assembly and support with wire to frame so that brake hose does not kink or bend.

5. Loosen, but do not remove, stud nut (nut should be loosened not more than one turn).

6. Install Tool J-23742 between studs as shown in Fig. 3C-12 and turn threaded end of tool until stud is free of steering knuckle.

NOTE: If a hoist is not used for this operation, the lower suspension arm must be supported so the chassis spring cannot force the arm down.

7. Remove upper spherical joint stud nut and allow knuckle to swing out of way.

8. Lift upper arm up and place a block of wood between frame and upper arm to act as a support.

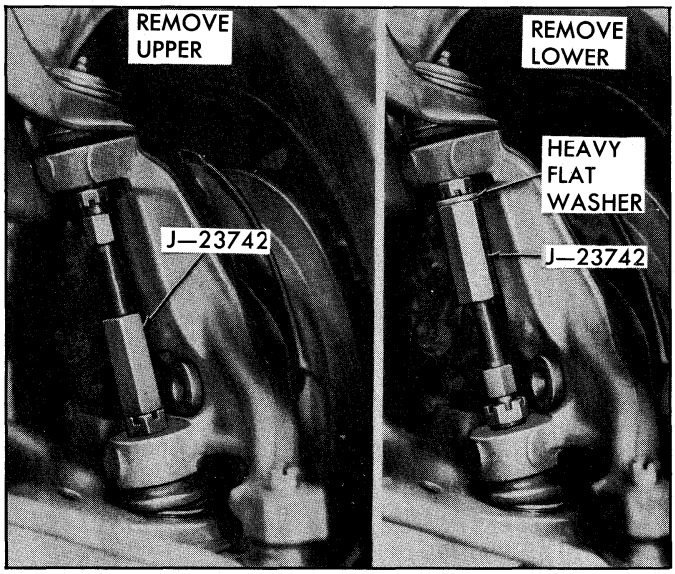


Fig. 3C-12 Removing Spherical Studs from Knuckle

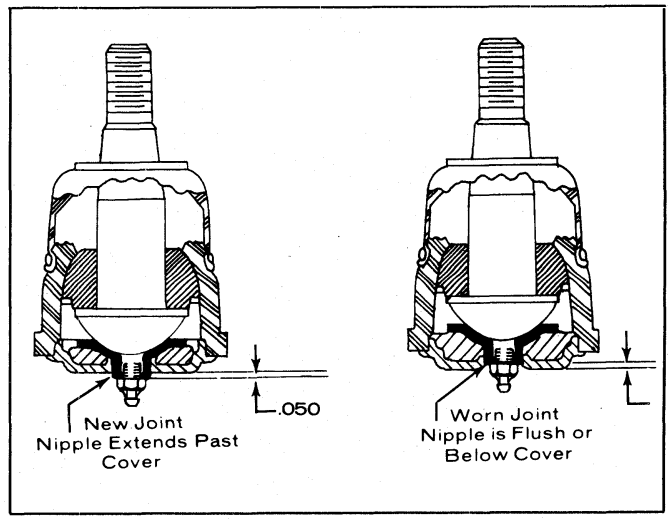


Fig. 3C-13 Checking Lower Spherical Joints

b. Inspection

The upper spherical joint is spring loaded in its socket. This minimizes looseness at this point and compensates for normal wear. If the upper stud has any perceptible lateral shake, or if it can be twisted in its socket with the fingers, the upper spherical joint should be replaced.

c. Removal

If replacement is necessary:

1. Remove rivets from upper suspension arm using a grinding wheel to grind off rivet heads and drive out with a punch.

CAUTION: *Care must be used not to damage the arm or spherical joint seat.*

d. Installation

CAUTION: *See "CAUTION" on page 3C-6 of this section regarding the fasteners referred to in steps 1, 4 and 7.*

1. Install new spherical joint in arm and attach with bolt and nut assemblies provided. Insert bolts from bottom with nuts on top. Torque to 25 foot-pounds.
2. Turn spherical joint stud cotter pin hole fore and aft.
3. Remove block of wood from frame and upper arm.

NOTE: Inspect the tapered hole in the steering knuckle. Remove any dirt and if any out-of-roundness, deformation or damage is noted, the knuckle MUST be replaced.

4. Mate upper arm stud to steering knuckle and install nut. Torque nut to 60 foot-pounds and install a new cotter pin.

NOTE: 100 foot-pounds maximum is allowed to align cotter pin slot, 1/6 turn max. Do not back off nut for cotter pin installation.

5. Install caliper assembly as outlined on page 5-13.
6. Lubricate spherical joint.
7. Install wheel and tire assembly. Torque nuts to 100 foot-pounds.
8. Lower car to ground.
9. Check front wheel alignment and reset if necessary.

Lower Spherical Joint

a. Inspection

Visual wear indicators are used on the lower spherical joint. The condition of the joint may be checked by the simple procedure that follows. Be sure to follow this procedure accurately to avoid unnecessary joint replacement.

The lower joints are inspected for wear by visual observation alone. Wear is indicated by the protrusion of the 1/2" diameter nipple into which the lubrication fitting is threaded. This round nipple projects .050" beyond the surface of the joint cover on a new, unworn joint. Normal wear will result in the surface of this nipple retreating very slowly inward.

To inspect, raise car on a hoist. Car must be supported on wheels or frame so that lower spherical joint is in a loaded condition.

To inspect for wear, wipe the lubrication fitting and nipple free of dirt and grease. Observe or scrape a screwdriver scale or fingernail across the cover. If the round nipple is flush or inside the cover surface, replace the joint. See Fig. 3C-13.

Stud tightness in knuckle boss can be checked by shaking wheel and observe or feel for movement of stud end and/or nut at knuckle boss, or by removing cotter pin to check torque. Looseness can mean a bent stud or an "opened up" hole in knuckle. Worn or damaged parts **must** be replaced.

b. Removal (Fig. 3C-14)

1. Raise car on hoist.
2. Remove wheel and tire assembly.
3. Remove lower spherical joint stud cotter pin.
4. Loosen but do not remove, stud nut (nut should be loosened not more than one turn).
5. Install tool J-23742 between studs and turn threaded end of tool until stud is free of steering knuckle.

CAUTION: *If a hoist is not used for this operation, the lower suspension arm must be supported so the chassis spring cannot force the arm down.*

6. Remove lower stud nut.
7. Pull outward on bottom of tire and at same time push wheel and tire assembly upward to free knuckle from spherical joint stud.
8. Lift up on upper suspension arm, with knuckle and hub assembly attached, and place a block of wood between

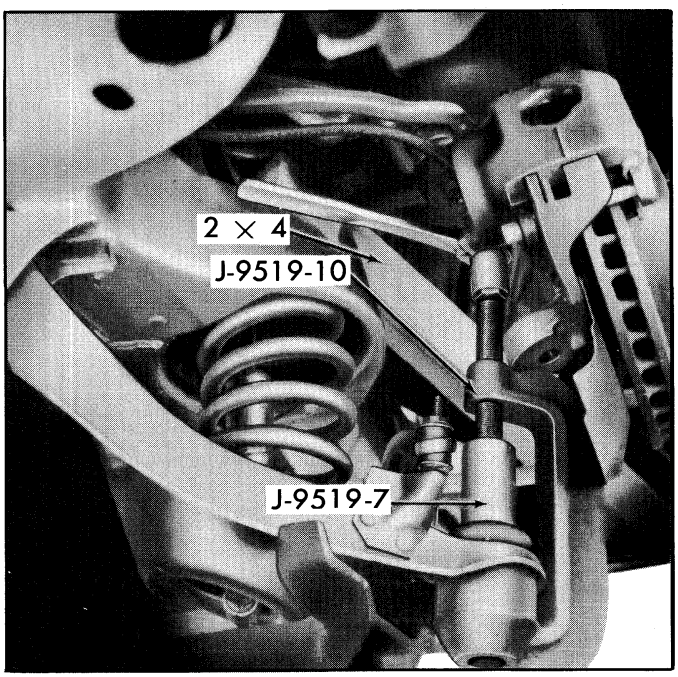


Fig. 3C-14 Removing Lower Spherical Joint (On Car)

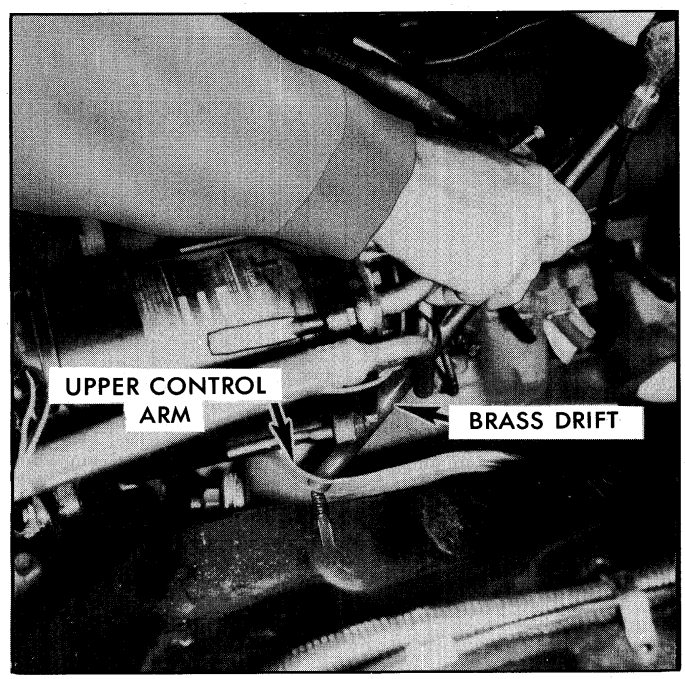


Fig. 3C-16 Loosening Upper Suspension Arm Bolts

frame and upper arm.

CAUTION: *Do not pull on the brake hose when lifting the knuckle and hub assembly.*

NOTE: Remove tie rod end from steering knuckle only if necessary.

9. Place tool J-9519-23 (optional tool J-9519-10) and J-9519-7 in position.

10. Turn hex bolt until lower spherical joint is pushed out of suspension arm and remove tools.

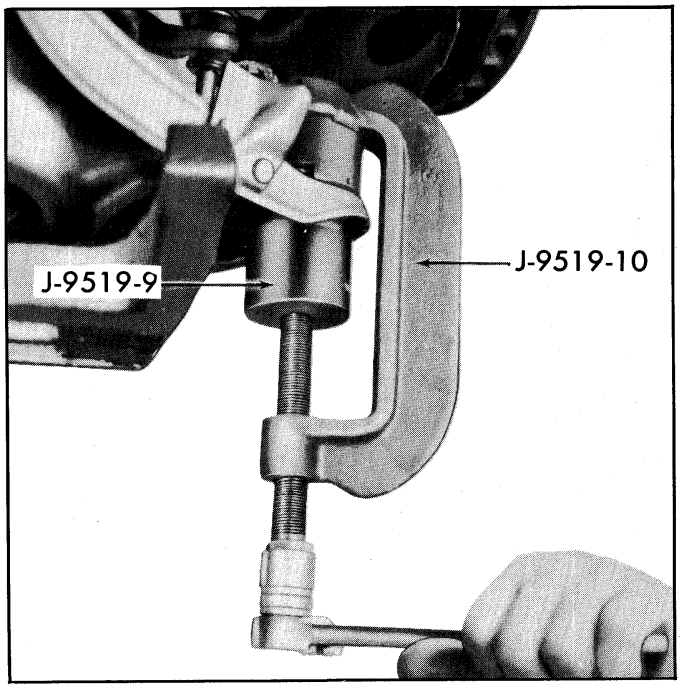


Fig. 3C-15 Installing Lower Spherical Joint (on Car)

c. Installation

CAUTION: *See "CAUTION" on page 3C-6 of this section regarding the fasteners referred to in steps 5, 7 and 8.*

1. Position spherical joint in lower suspension arm and install Tools J-9519-23 (optional Tool J-9519-10) and J-9519-9 (optional Tool J-9519-17) as shown in Fig. 3C-15.

NOTE: Position bleed vent in rubber boot of the new spherical joint facing inward.

2. Turn down on hex head bolt until new joint is seated in arm and then remove tools.

3. Turn joint stud cotter pin hole fore and aft.

4. Remove block of wood holding upper arm up out of way.

NOTE: Inspect the tapered hole in the steering knuckle. Remove any dirt and if any out-of-roundness, deformation, or damage is noted, the knuckle MUST be replaced.

5. Mate lower joint stud to steering knuckle and install stud nut. Torque nut to 80 foot-pounds (90 foot-pounds on limousines and commercial chassis), and install new cotter pin.

NOTE: 125 foot-pounds (140 foot-pounds on limousines and commercial chassis) maximum is allowed to align cotter pin slot, 1/16 turn max. Do not back off nut for cotter pin installation.

6. Lubricate spherical joint.

7. Install tie rod end if removed to steering knuckle, and torque nut to 35 foot-pounds. Install cotter pin.

NOTE: 50 foot-pounds maximum is permissible to align cotter pin slot, (1/6 turn max.). Do not back off nut for cotter pin insertion.

8. Install wheel and tire assembly. Torque nuts to 100 foot-pounds.

9. Lower car to floor.

10. Check front wheel alignment and reset if necessary.

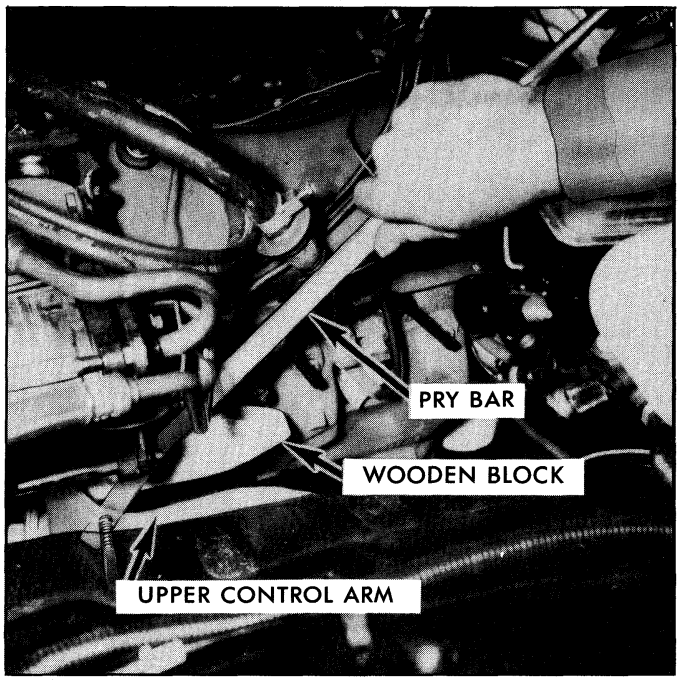


Fig. 3C-17 Removing Upper Suspension Arm Bolts

Front Upper Suspension Arm

a. Removal

1. Raise car on hoist.
2. Support lower suspension arm with a jack stand.
3. Remove wheel and tire assembly.
4. Separate upper arm spherical joint stud from steering knuckle. See page 3C-10.
5. Remove two nuts securing upper arm shaft to frame bracket and remove assembly.

NOTE: Tape the shims together and mark them for position from which they were removed.

Seville: It is necessary in some cases to remove the upper arm attaching bolts to allow clearance to remove the upper arm assembly. The attaching bolts are splined into the frame. To remove, proceed as follows:

a. Tap bolt down gently with brass drift as shown in Fig. 3C-16.

b. Using a box wrench, gently pry bolt up.

c. Remove nut and, using a suitable pry bar and block of wood, pry bolts from frame as shown in Fig. 3C-17.

d. Remove arm from car.

b. Installation

CAUTION: *See "CAUTION" on page 3C-6 of this section regarding the fasteners referred to in steps 5, 6 and 7.*

1. If removed, position new upper suspension arm attaching bolts loosely in frame. (For Seville only, install pre-alignment shim as shown in Fig. 3C-18. Thick area must be toward rear of car. Plate should be against shaft). Install suspension arm cross shaft on attaching bolts.
2. Using a free running nut instead of regular locknut, tighten both nuts until serrated bolts are reseated.
3. Remove free running nuts and install regular lock nuts.
4. Install same number of shims to each bolt that were removed and taped together.

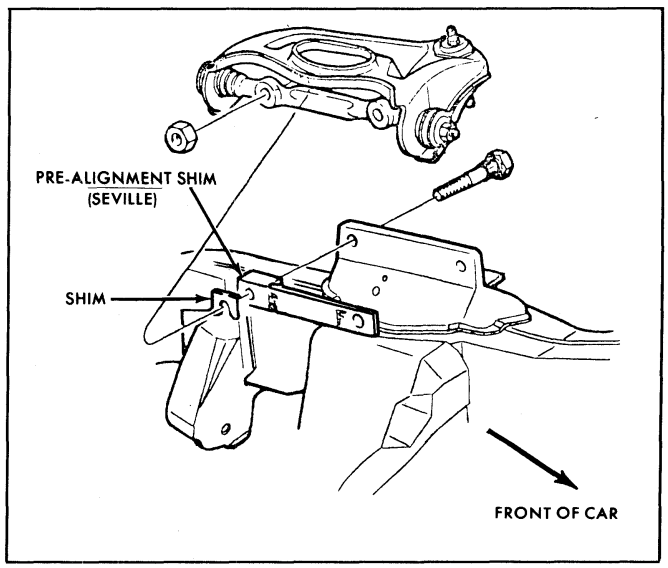


Fig. 3C-18 Pre Alignment Shim Installation

5. Torque mounting nuts to 75 foot-pounds.

NOTE: Tighten the nut on the thinner shim pack first for improved shaft-to-frame clamping force and torque retention.

6. Install spherical joint stud through knuckle, torque nut to 60 foot-pounds and install cotter pin.

NOTE: 100 foot-pounds maximum is allowed to align cotter pin slot, 1/6 turn max. Do not back off nut for cotter pin installation.

7. Install wheel and tire, torque wheel mounting nuts to 100 foot-pounds and lower car to floor.
8. Check front wheel alignment and reset if necessary. See Fig. 3A-10 or, Seville, Fig. 3A-11.

Front Suspension Upper Arm Shaft and Bushings

a. Removal

1. Remove arm as outlined in column 1 on this page.
2. Remove special bushing nuts and save for re-installation.
3. Using J-22269-5 (optional tool J-21885) and J-24770-2 as shown in Fig. 3C-19, tighten J-22269-5 (optional tool J-21885) sufficiently to insert J-24770-3 onto the shaft.
4. Tighten screw against J-24770-2 to remove bushing.
5. To remove bushing from other side, install J-24770-2 and J-22269-5 (optional tool J-21885) as shown in Fig. 3C-20 and turn the screw until the bushing is pushed out.

b. Installation

1. Install either bushing with J-22269-5 (optional tool J-21885) and J-24770-1 as shown in Figs. 3C-21 and 3C-22.
2. Install the support shaft and bushing on the other side of the suspension arm with J-22269-5 (optional tool J-21885) and Adapter J-24770-1 as shown in Fig. 3C-23.
3. Install special bushing nuts loosely.
4. Install upper suspension arm as outlined in column 1 on this page.

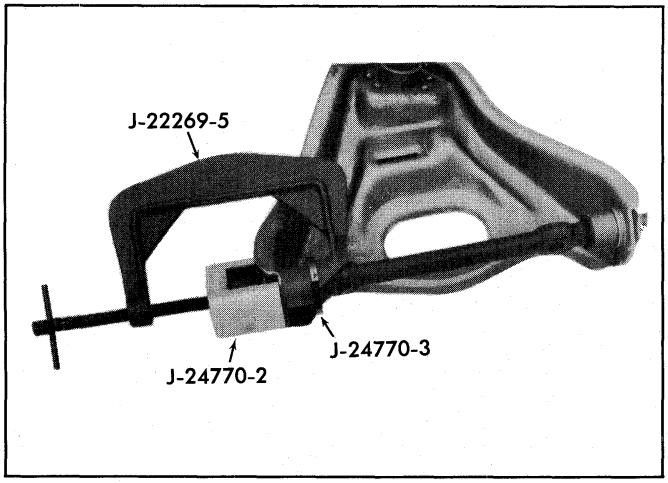


Fig. 3C-19 Removing First Upper Suspended Arm Bushing - Front or Rear

Front Lower Suspension Arm

a. Removal

1. Remove coil spring as outlined on page 3C-9.
2. Remove spherical joint stud from steering knuckle as outlined on page 3C-11.
3. Remove lower arm from car.

b. Installation

CAUTION: *See "CAUTION" on page 3C-6 of this section regarding the fasteners referred to in steps 1 and 3.*

1. Insert lower arm spherical joint stud into steering knuckle boss, install stud nut, torque to 80 foot-pounds and insert new cotter pin.

NOTE: 125 foot-pounds maximum is allowed to align cotter pin slot, 1/6 turn max. Do not back off nut for cotter pin installation.

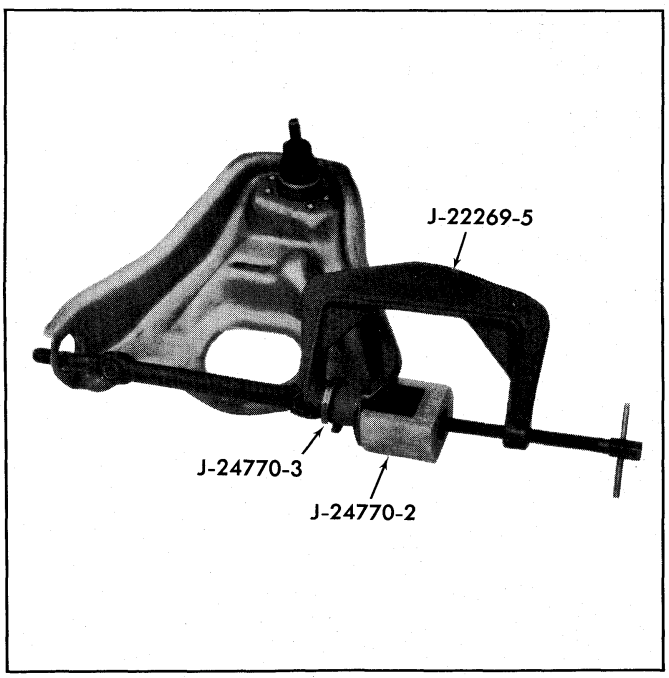


Fig. 3C-20 Removing Second Upper Suspension Arm Bushing - Front or Rear

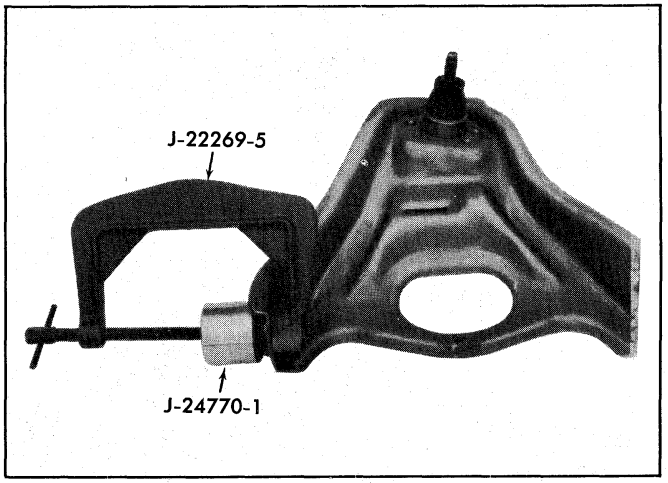


Fig. 3C-21 Installing Upper Suspension Arm - Front Bushing First

2. Install coil spring as outlined on page 3C-9.
3. Torque bushing bolts and nuts to 120 N·m (90 foot-pounds) or, if working on Seville, 130 N·m (95 foot-pounds).

NOTE: On C-car, the rear bolt (front bolt on Seville) must be installed in same direction as removed.

4. Lower car to floor.
5. Check front wheel alignment and reset if necessary.

Front Lower Suspension Arm Bushings

Rear Bushing

a. Removal

1. Raise car on hoist.
2. Support frame with floor stands so that lower arms hang free. Remove lower shock absorber bolts and push shock absorber up through coil spring.
3. Position tool J-23028-01 to a suitable jack and place under lower arm bushings so that bushings seat in grooves of tool.
4. Install a chain around lower arm and through coil of spring as a safety measure.
5. Remove lower arm pivot bolts and nuts. Remove rear bolt first.

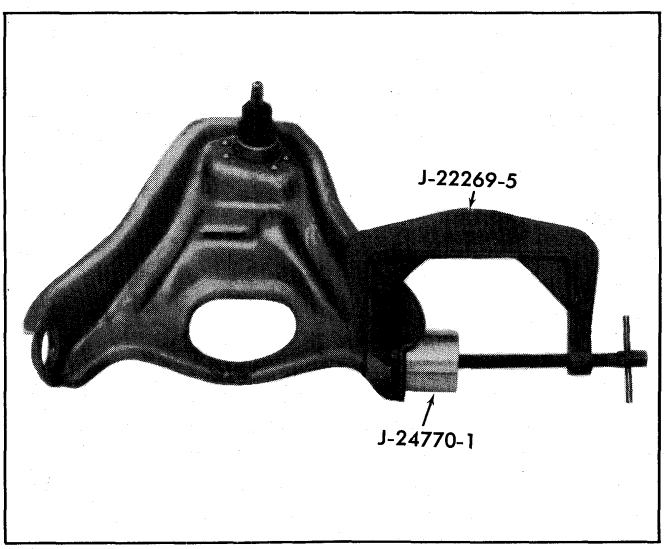


Fig. 3C-22 Installing Upper Suspension Arm Rear Bushing First

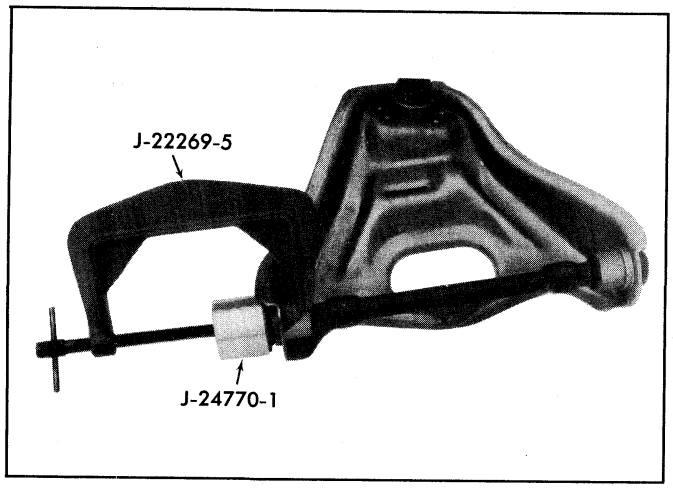


Fig. 3C-23 Installing Upper Suspension Arm Second Bushing

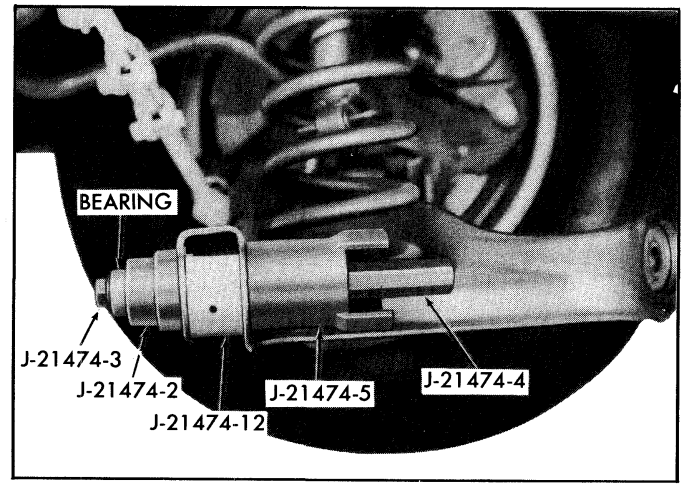


Fig. 3C-25 Installing Lower Suspension Arm Bushing (On Car)

NOTE: If bolts "hang up" between lower arm and frame, use a pry bar to move the arm so that bolts can be removed. Do not "hammer" bolts out.

6. Lower suspension arm by slowly releasing jack.

7. Install Spacer J-21474-12 as shown in Fig. 3C-24.

CAUTION: *Do not attempt to remove bushing without having the spacer in position. Distortion to the arm could result.*

8. Install remaining tools as shown in Fig. 3C-24 and turn hex bolt and nut until old bushing is removed.

9. Remove tools and discard bushing.

b. Installation

CAUTION: *See "CAUTION" on page 3C-6 of this section regarding the fasteners referred to in steps 5 and 6.*

1. Start a new bushing in place and position tools, as shown in Fig. 3C-25.

NOTE: Spacer J-21474-12 should still be in position.

2. Turn hex bolt and nut until new bushing is properly seated.

3. Remove tools.

4. Position tool J-23028-01 under bushings and install lower arm to frame.

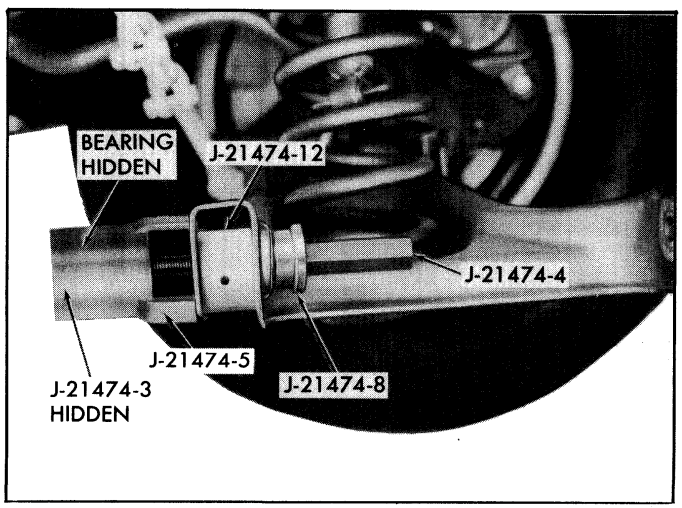


Fig. 3C-24 Removing Lower Suspension Arm Bushing (On Car)

5. Install pivot bolts (front bolt first) and nuts, and torque nuts to 120 N·m (90 foot-pounds) or, if working on Seville, 130 N·m (95 foot-pounds). Remove safety chain.

NOTE: On C-car, the rear bolt (front bolt on Seville) must be installed in the same direction as removed.

6. Pull shock absorber lower end through lower arm and install mounting bolts. Torque bolts to 22 foot-pounds (19 foot-pounds on Seville).

7. Remove tool J-23028-01 and position hoist under lower arms to accept weight of car.

8. Remove floor stands and lower car to floor.

9. Check front wheel alignment and reset if necessary.

Front Bushing

a. Removal

1. With lower arm off vehicle, remove flare by tapping on edge with hammer.

2. Install tools as shown in Fig. 3C-24. Be sure spacer is in place.

3. Turn down on hex nut until old bushing is removed.

b. Installation

CAUTION: *See "CAUTION" on page 3C-6 of this section regarding the fasteners referred to in step 4.*

1. Start new bushing and install tools as shown in Fig. 3C-24 to press new bushing into position.

2. Remove tool J-21474-5 and install flaring tool J-23915.

3. Turn on hex nut until new bushing is flared. See Figs. 3C-26 and 3C-27. Remove tools and inspect flare for good contact with arm.

4. Install arm on car. Torque bushing bolts and nuts to 120 N·m (90 foot-pounds) or, if working on Seville, 130 N·m (95 foot-pounds) and spherical joint stud nut to 80 foot-pounds and install new cotter pin.

NOTE: 125 foot-pounds maximum is allowed to align cotter pin slot, 1/6 turn max. Do not back off nut for cotter pin installation.

Steering Knuckle

It is recommended that the car be raised and supported on a twin-post hoist so that the front coil spring remains compressed, yet the wheel and steering knuckle assembly remain accessible. If a frame hoist is used, support the lower

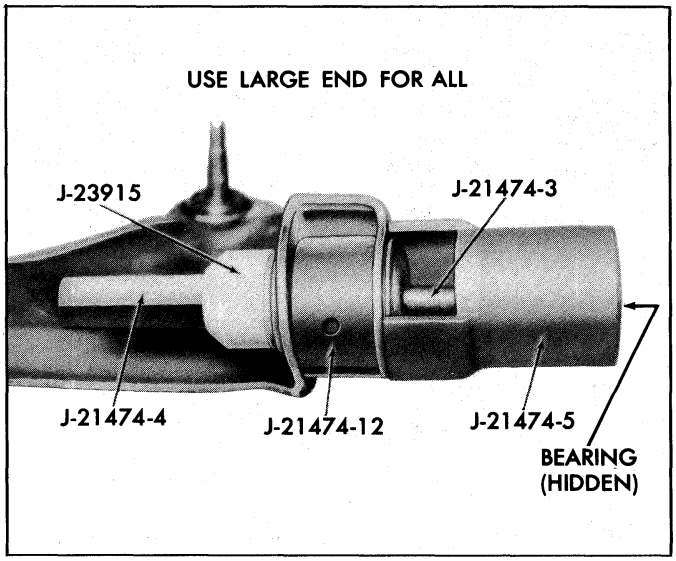


Fig. 3C-26 Forming Flare

suspension arm with an adjustable jack stand to retain spring in the curb height position.

a. Removal

1. Raise car on hoist and support lower suspension arm.
2. Remove wheel and tire assembly.
3. Remove tie rod end from steering knuckle using Puller J-24319-01.
4. Remove brake caliper and hub and rotor assembly. Use a piece of wire to attach caliper to upper suspension arm.

CAUTION: *Never allow caliper to hang from brake hose, as hose may be damaged.*

5. Remove splash shield.
6. Remove upper and lower spherical joint.
7. Remove studs from steering knuckle using Tool J-23742. See pages 3C-10 and 3C-11.

b. Installation

CAUTION: *See "CAUTION" on page 3C-6 of this section regarding the fasteners referred to in steps 2,3,5,6 and 7.*

1. Place steering knuckle into position and insert upper and lower spherical joint studs into knuckle bosses.
2. Install stud nuts and torque upper nut to 60 foot-pounds and lower nut to 80 foot-pounds and install cotter pins.

NOTE: 100 foot-pounds maximum upper nut and 125 foot-pounds maximum lower nut is allowed to align cotter pin slots, 1/6 turn max. Do not back off nut for cotter pin installation.

3. Install splash shield. Torque screws to 85 inch-pounds.
4. Install hub and rotor assembly.
5. Install outer bearing and spindle washer and nut and adjust bearing as outlined.
6. Install brake caliper as described on page 5-13.
7. Install wheel and tire assembly. Tighten nuts to 100 foot-pounds.
8. Lower car to floor.
9. Check front wheel alignment and reset if necessary.

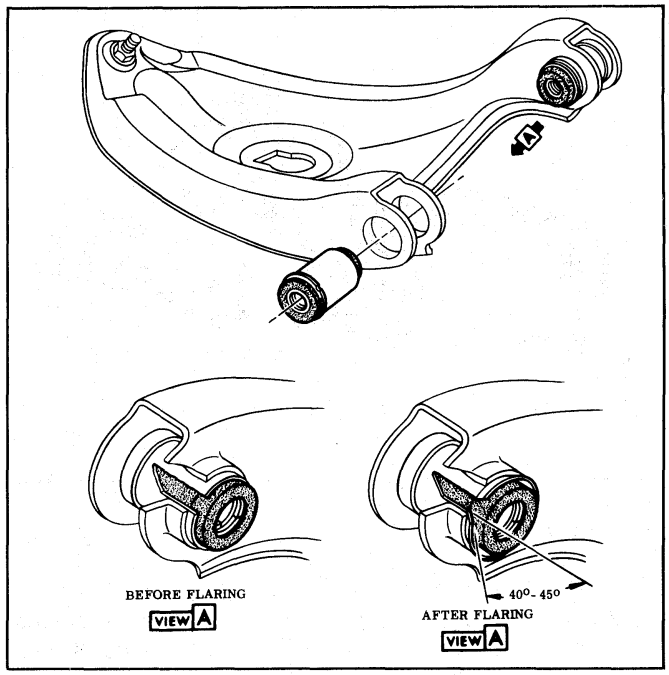


Fig. 3C-27 Suspension Arm Front Bushing Flaring

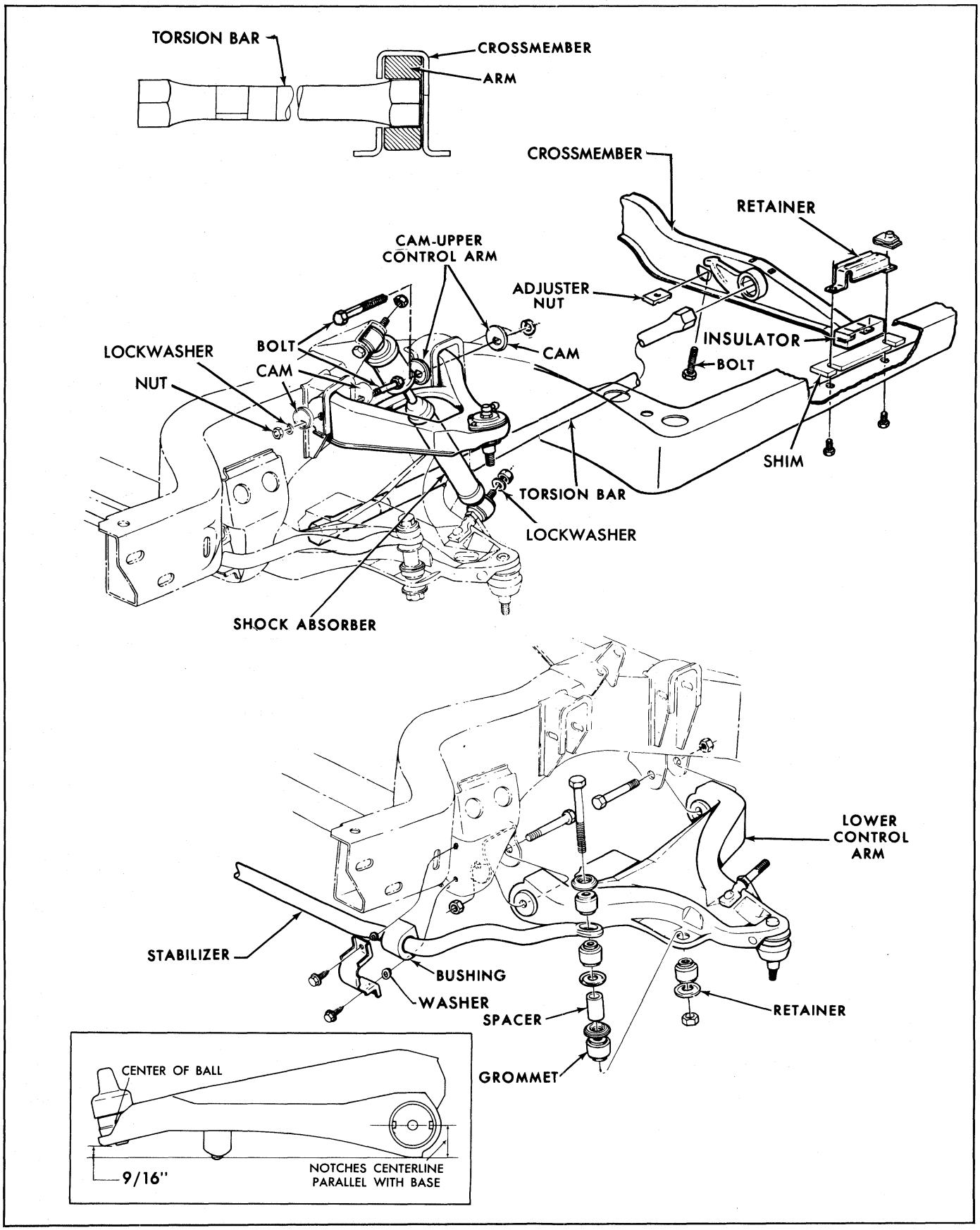


Fig. 3C-28 Front Suspension Disassembled (Eldorado)

ELDORADO FRONT SUSPENSION
GENERAL DESCRIPTION

The service information that follows pertains only to the Eldorado. All other service procedures and recommendations for the Eldorado are the same as those for the standard car, as given in the first part of this section.

The front suspension on the Eldorado consists of two upper and two lower suspension arms, a 28mm stabilizer bar, shock absorbers, and a right and left torsion bar, Fig. 3C-28. Torsion bars are used instead of coil springs. The front end of the torsion bar is attached to the lower suspension arm. The rear of the torsion bar is mounted into an adjustable arm in the torsion bar crossmember. The standing height of the car is controlled by the adjuster bolt and nut that positions the adjuster arm.

ON-CAR SERVICE

Front Shock Absorber

a. Removal

NOTE: Perform work on platform type hoist or garage floor so that vehicle weight is on the front suspension.

1. Disconnect shock absorber at upper and lower mount.
2. Compress shock absorber and work lower mount free from mount bolt using a screwdriver placed inside the mount inner sleeve for leverage.
3. Guide shock absorber down and toward rear of car, and remove from car.

b. Installation

1. Guide shock absorber up through upper suspension arm.
2. Position shock absorber on lower attaching stud, using screwdriver inside mount inner sleeve to facilitate bushing installation.
3. Extend upper shock absorber mount into frame attaching bracket using body weight on fender to compress suspension to assist in lining up mounting holes.
4. Install shock absorber upper attaching bolt and nut. Tighten nut to 75 foot-pounds.
5. Install lockwasher and lower attaching nut and tighten to 75 foot-pounds.

Stabilizer Bar

a. Removal

1. Place car on jack stands.
2. Remove link bolts, nuts, grommets, spacers, and retainers from lower suspension arm. Discard bolts and nuts.
3. Remove bracket to frame attaching bolts and remove stabilizer bar from car.

b. Installation

1. Position stabilizer bar in place on car.

NOTE: Stabilizer bar grommets and retainers are larger than those used in other applications. Replacement parts must be of this larger design.

2. Assemble grommets, spacers, and retainers on new link bolt as shown in Fig. 3C-29.
3. Position link bolt on lower suspension arm, and install remaining grommet, retainer, and nut.
4. Install stabilizer to frame brackets.
5. Tighten stabilizer link nuts to 12 foot-pounds.
6. Cut off or file link bolt threads flush with head of nut.

CAUTION: *Failure to cut off excess bolt threads could result in front tire damage under extreme operating conditions.*

Spherical Joint Checking Procedure

1. Raise car and position jack stands under lower suspension arms as near as possible to each spherical joint. Car must be stable and should not rock on floor stands.
2. Clamp self-locking pliers on hub to drive axle nut so that self-locking pliers are in horizontal position, Fig. 3C-30.
3. Construct a sturdy stand and install Dial Indicator, J-8001, so that indicator is horizontal and button contacts pliers, Fig. 3C-30. Set dial to 0.
4. Place a pry bar between lower suspension arm and drive axle outer race as shown in Fig. 3C-31, and pry down on bar. If reading exceeds .125" replace lower spherical joint. (Very little prying effort is necessary to make this check. Often, weight of pry bar itself is all that is required).

CAUTION: *When positioning pry bar, use extreme caution to avoid contact with drive axle seal, as seal*

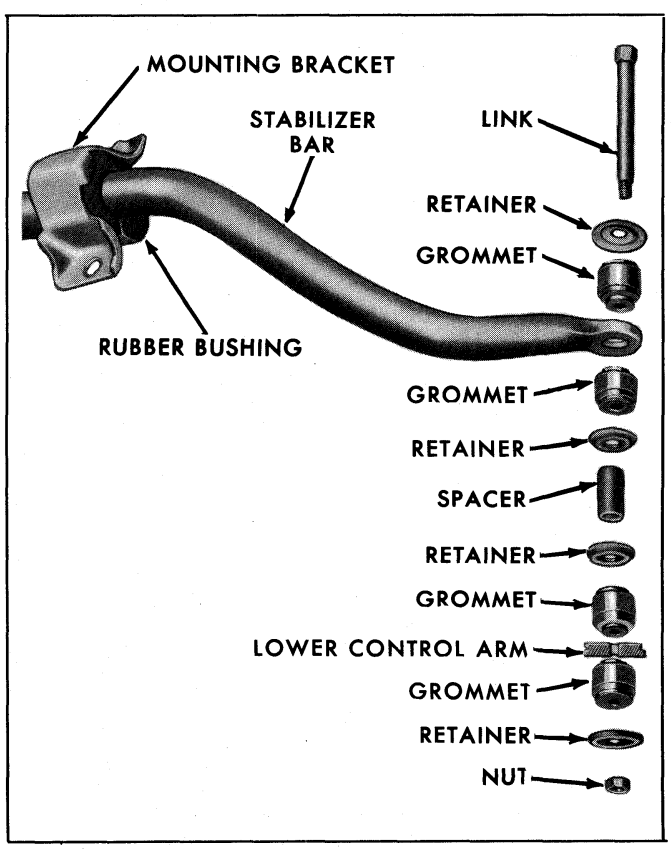


Fig. 3C-29 Front Stabilizer Linkage

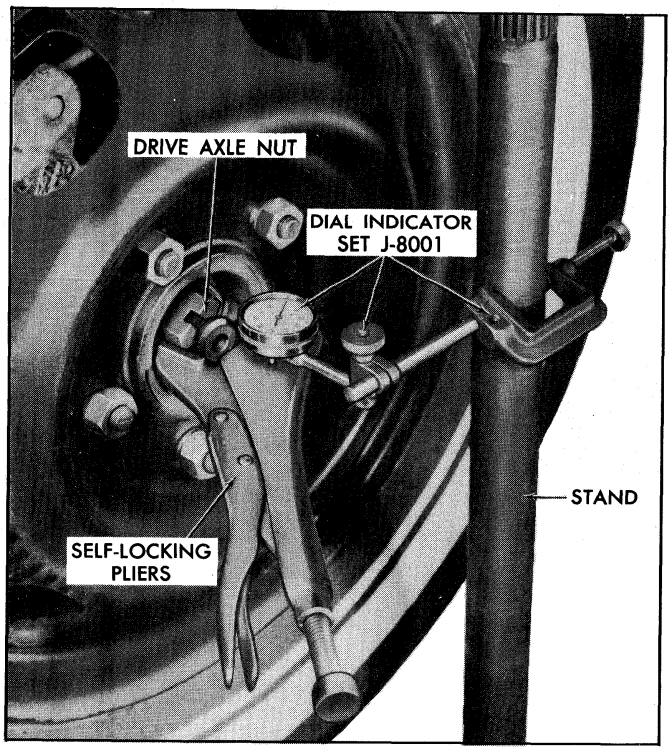


Fig. 3C-30 Checking Spherical Joint

may become damaged internally.

Upper Suspension Arm Bushing (On Car)

a. Removal

The upper suspension arm bushings can be removed and installed on or off the car.

1. Remove wheel disc.
2. Loosen wheel mounting nuts.
3. Raise car and remove wheel and tire.
4. Disconnect shock absorber at upper mount and remove nut and bolt.
5. Remove upper suspension arm cam assemblies and nuts.
6. Remove upper suspension arm from frame mounts.
7. Attach bushing removal tools as shown in Fig. 3C-32.

NOTE: Spray bushing with silicone lubricent to facilitate removal.

8. Remove bushings and remove tools.

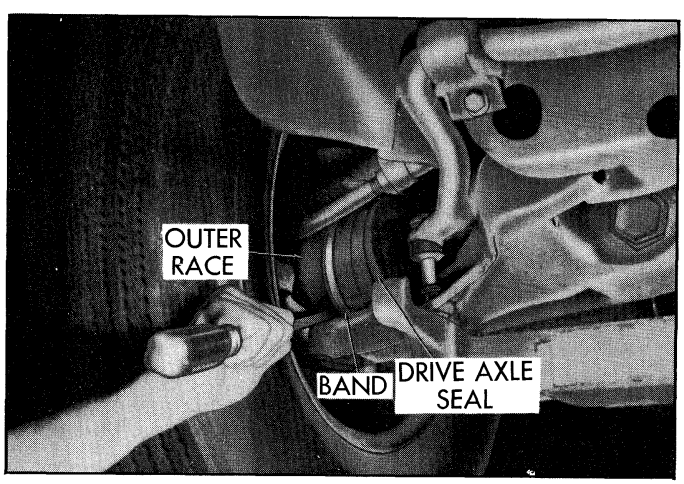


Fig. 3C-31 Prying Drive Axle

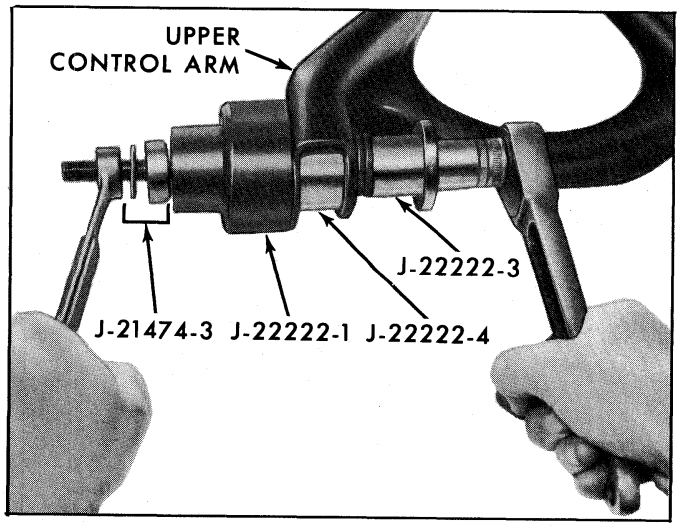


Fig. 3C-32 Removing Suspension Bushings

b. Installation

NOTE: Spray bushings with silicone lubricant to facilitate installation.

1. Place bushings in suspension arm.
2. Install tools as shown in Fig. 3C-33 and press bushings into suspension arm.
3. Remove bushing installation tools.
4. Guide upper suspension arm over shock absorber and install bushing ends into frame mounts.
5. Install cam assemblies as shown in Fig. 3A-15. Both front and rear cams should be mounted with bolt hole downward.
6. Install shock absorber in upper mount. Tighten nut to 75 foot-pounds.
7. Install wheel and tire.
8. Lower car and tighten wheel mounting nuts to 130 foot-pounds.

CAUTION: *See "CAUTION" on page 3C-6 of this section.*

9. Check standing height as described on page 3A-12 and adjust if necessary.
10. Adjust toe-in, caster, and camber as described on pages 3A-15, and 3A-13.
11. Install wheel disc.

Upper Suspension Arm

a. Removal

The upper suspension arm can be serviced either as an assembly, or by its component parts. If it is not necessary to replace the suspension arm as an assembly, there are two service packages available. One package contains bushings only, the other package consists of a spherical joint, two bolts, one nut, and a cotter pin.

1. Remove wheel disc.
2. Loosen wheel mounting nuts.
3. Raise car. Support on jack stands located under lower suspension arms as close to spherical joints as possible.
4. Remove wheel mounting nuts and remove wheel and tire.
5. Disconnect shock absorber at upper mount.
6. Remove cotter pin and nut on upper spherical joint.

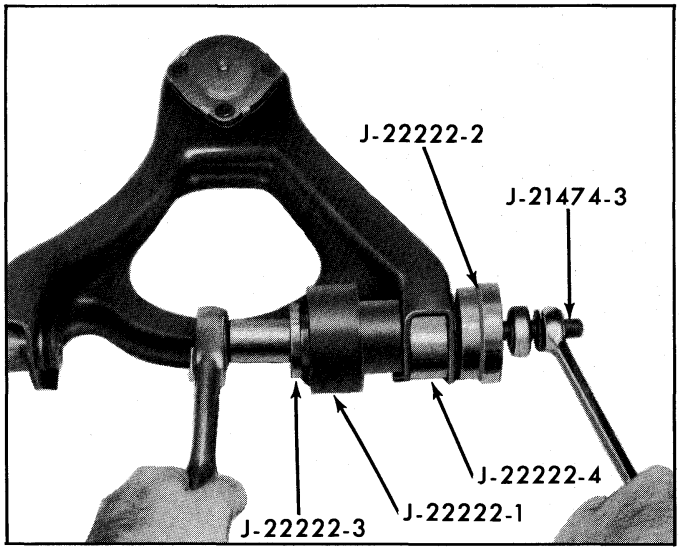


Fig. 3C-33 Installing Suspension Arm Bushings

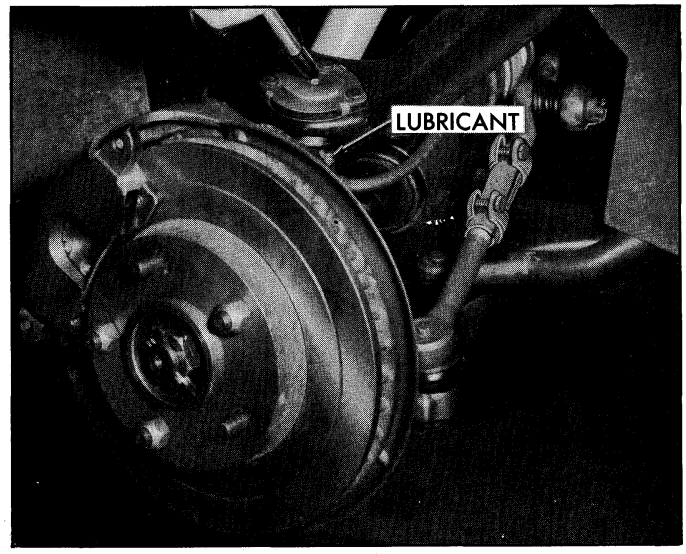


Fig. 3C-34 Repacking Upper Spherical Joint

7. Remove brake hose clip from spherical joint stud.

8. Remove two bolts securing brake caliper to steering knuckle and slide caliper off disc. Use a piece of wire to attach caliper to frame.

CAUTION: *Do not allow caliper to hang from brake line, as the line may be damaged.*

9. Disengage spherical joint stud and remove from steering knuckle.

10. Remove upper suspension arm cam assemblies and remove suspension arm from car.

b. Installation

1. Guide upper suspension arm over shock absorber and install bushing ends into frame mounts.

2. Install cam assemblies as shown in Fig. 3A-15. Both cams should be mounted with bolt hole downward.

3. Install shock absorber in upper mount. Tighten nut to 75 foot-pounds.

4. Install upper spherical joint into steering knuckle.

5. Install brake caliper following procedure on page 5-13.

CAUTION: *Do not twist brake hose on installation, as brake system damage may result.*

6. Install brake hose clip, nut, and cotter pin on upper spherical joint stud. Tighten nut to 60 foot-pounds.

CAUTION: *See "CAUTION" on page 3C-6 of this section.*

CAUTION: *Cotter pin must be crimped toward upper suspension arm to prevent damage to the outer constant velocity joint seal. If cotter pin cannot be installed in this position, tighten nut further until insertion is possible.*

7. Install wheel and tire. Tighten nuts to 130 foot-pounds.

CAUTION: *See "CAUTION" on page 3C-6 of this section.*

8. Raise car. Remove jack stands and lower car.

9. Check standing height as described on page 3A-12 and adjust.

10. Check caster, camber, and toe-in as described on pages 3A-13 and 3A-15 and adjust.

Upper Suspension Arm Spherical Joint

a. Removal

1. Remove upper suspension arm as described on page 3C-19.

2. Place upper suspension arm on workbench and grind the heads off three rivets.

3. Using a hammer and punch, drive on center of rivets until spherical joint can be removed from suspension arm.

b. Installation

1. Install new spherical joint in upper suspension arm.

2. Install four bolts in top side of suspension arm.

3. Install four nuts from underside of suspension arm. Tighten nuts to 25 foot-pounds.

4. Install upper suspension arm as described in column 1 on this page.

CAUTION: *See "CAUTION" on page 3C-6 of this section.*

5. Lubricate joint using special lubricant recommended for this application until lubricant escapes between seal and steering knuckle, Fig. 3C-34.

Torsion Bar

a. Removal

1. Raise car so that front suspension is allowed to hang at full rebound position.

2. Remove adjusting bolt from both torsion bar adjuster nuts.

3. Install Torsion Bar Remover and Installer, J-22517-01, on torsion bar crossmember, Fig. 3C-35.

NOTE: Install Torsion Bar Remover U-bolt on crossmember. If clearance is insufficient, pry between crossmember and underbody until tool falls in place, Fig. 3C-36. Next, install Torsion Bar Remover Base on U-bolt and install two locknuts on U-bolt. Make certain Base is installed flush with last thread on U-bolt and install center bolt.

4. Tighten center bolt until torsion bar adjusting arm is raised high enough to permit removal of adjuster nut. Remove adjuster nut.

5. Loosen remover tool center bolt until it is free of the adjusting arm.

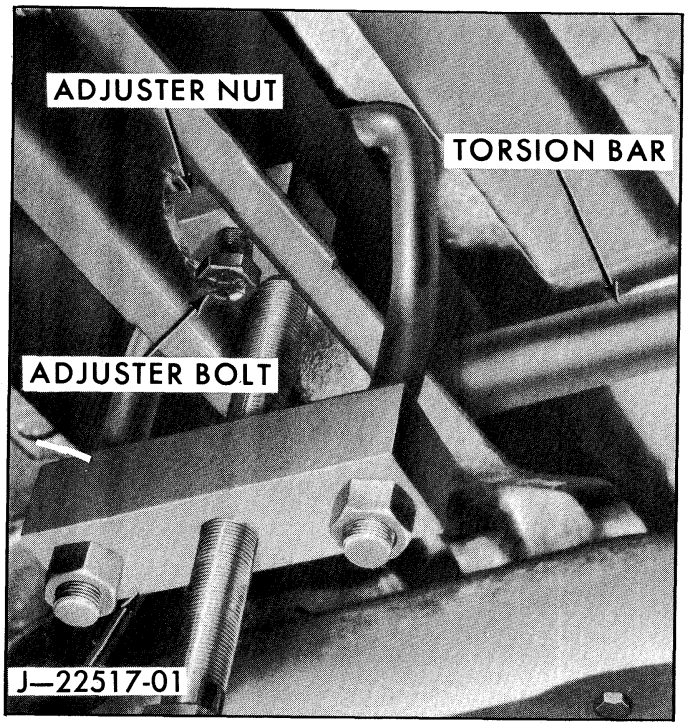


Fig. 3C-35 Removing and Installing Torsion Bar

6. Repeat Steps 3 and 4 on other end of crossmember and remove tool from crossmember.

7. Remove parking brake cable from guide at right side of underbody.

8. Remove torsion bar crossmember bolts, nuts, shim, and retainer from both ends of crossmember.

9. Move crossmember as far as possible toward the side **opposite** the side from which torsion bar is to be removed. One end of crossmember should now be clear of frame.

10. Lower end of crossmember from frame, then drive crossmember rearward until torsion bar is free of crossmember.

CAUTION: *Take care not to damage parking brake cable when lowering crossmember. If additional slack is required, loosen parking brake cable adjustment nut at equalizer.*

NOTE: Although it is possible to remove both torsion bars at this point, installation is easier if either left or right bar is mounted at all times.

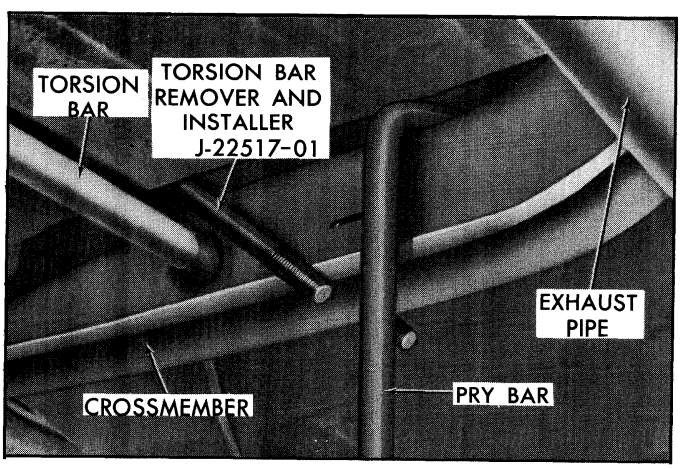


Fig. 3C-36 Prying at Crossmember and Underbody

11. Remove torsion bar from connector at lower suspension arm.

b. Installation

1. Check torsion bar for deep nicks, scratches, dents, or splits along the seam. If these conditions exist, torsion bar must be replaced.

2. Lubricate three inches of each end of torsion bar with special lubricant, Part No. 998 5092 or equivalent.

NOTE: Torsion bars are stamped with letters "L" for left and "R" for right. The stamped end is installed in the lower suspension arm connector.

3. Slide torsion bar all the way into lower suspension arm connector.

4. Position torsion bar adjusting arm in crossmember. Holding adjusting arm in place, slide torsion bar rearward until bar is seated in adjusting arm.

At this point, tape on torsion bar near lower suspension arm connector should be fully visible but within 1/4" of connector.

5. Position crossmember on frame.

NOTE: If both torsion bars are to be removed, remove opposite bar at this time following procedure of Part a, beginning with Step 9.

6. Install shim between crossmember and frame on each side, and install retainer over crossmember insulator.

7. Check both torsion bar adjusting arms for identical position with respect to torsion bar and crossmember. Install crossmember bolts and nuts, tightening to 10 foot-pounds.

8. Install parking brake cable through guide at right side of underbody. If cable was loosened at equalizer, adjust at this time, page 5-36.

9. Install Torsion Bar Remover and Installer, J-22517-01, Fig. 3C-35.

NOTE: When installing Torsion Bar Remover and Installer, J-22517-01 follow steps 3 and 4 of Part a of this procedure.

10. Tighten center bolt on Torsion Bar Remover and Installer, J-22517-01 until torsion bar adjusting arm is raised high enough to permit installation of adjuster nut. Install adjuster nut.

11. Remove Torsion Bar Remover and Installer, J-22517-01 and install on other end of crossmember.

12. Repeat steps 9 and 10 for other torsion bar.

13. Remove Torsion Bar Remover and Installer J-22517-01.

14. Using new torsion bar adjusting bolts, lubricate threads on bolts and install bolts into adjuster nuts on both sides of car.

15. Check standing height, page 3A-12, and adjust as required.

16. Check front wheel alignment, page 3A-12, and adjust if necessary.

Steering Knuckle and Inner Seal

a. Removal

1. Remove wheel disc.
2. Remove drive axle cotter pin and loosen nut.
3. Loosen wheel mounting nuts.
4. Raise car and place jack stands under lower suspension arms.

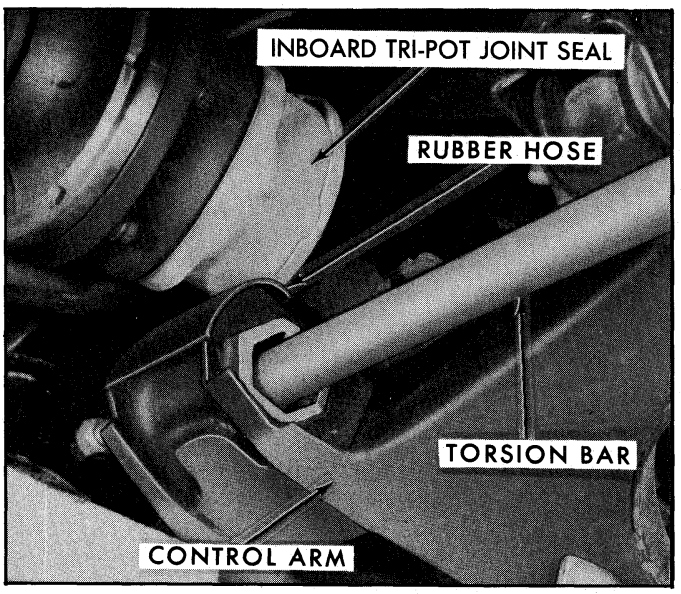


Fig. 3C-37 Rubber Hose Location

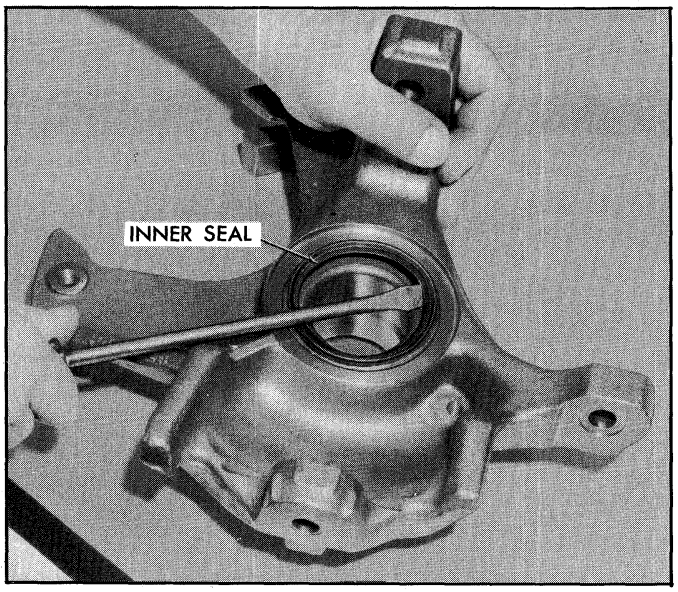


Fig. 3C-38 Removing Steering Knuckle Inner Seal

5. Remove drive axle to hub nut and washer and wheel mounting nuts.

6. Remove wheel and tire.

7. Remove upper spherical joint cotter pin and nut.

8. Remove brake line hose clip from upper spherical joint stud, but do not loosen spherical joint stud.

9. Install one or two wheel mounting nuts to prevent disc from falling off hub while removing caliper.

10. Remove two bolts securing caliper to knuckle and slide caliper off knuckle.

CAUTION: *Never suspend caliper by brake hose, as the brake hose may become damaged. Use a length of wire to attach caliper to frame.*

11. Remove nuts used to retain disc. Mark hub and disc for alignment on assembly and remove disc from hub.

12. Place a short length of rubber hose over the lower suspension arm torsion bar connector to avoid damage to inboard tri-pot joint seal lip, Fig. 3C-37.

13. Position brake hose out of way and, using hammer, strike steering knuckle in area of upper spherical joint and loosen upper spherical joint stud.

CAUTION: *Use care to prevent hammer from slipping and damaging brake hose or caliper.*

14. Remove cotter pin and nut from tie-rod end.

15. Remove tie-rod end from steering knuckle using Front Suspension Puller, J-24319.

16. Remove cotter pin and nut from lower spherical joint stud.

17. Using Front Suspension Puller, J-24319, disconnect lower spherical joint at steering knuckle.

18. Guide hub and knuckle assembly over end of drive axle and remove from car.

NOTE: If knuckle is being replaced, remove hub, bearings, cups, and seals as described on page 3C-25.

19. To remove steering knuckle inner seal, use a screwdriver, Fig. 3C-38.

b. Cleaning and Inspection

Inspect seal surface in the steering knuckle bore and the seal contact surface on the drive axle. Remove any rust present, using 400 grit "wet paper" and kerosene. When sanding, use a circular motion only, to avoid spiral marks on sealing surfaces.

c. Installation

NOTE: If knuckle is being replaced, install hub, bearings, bearing cups, and seals as described before on page 3C-25, before beginning this procedure.

1. Apply a moderate amount of high melting point lithium base grease between lips of steering knuckle inner

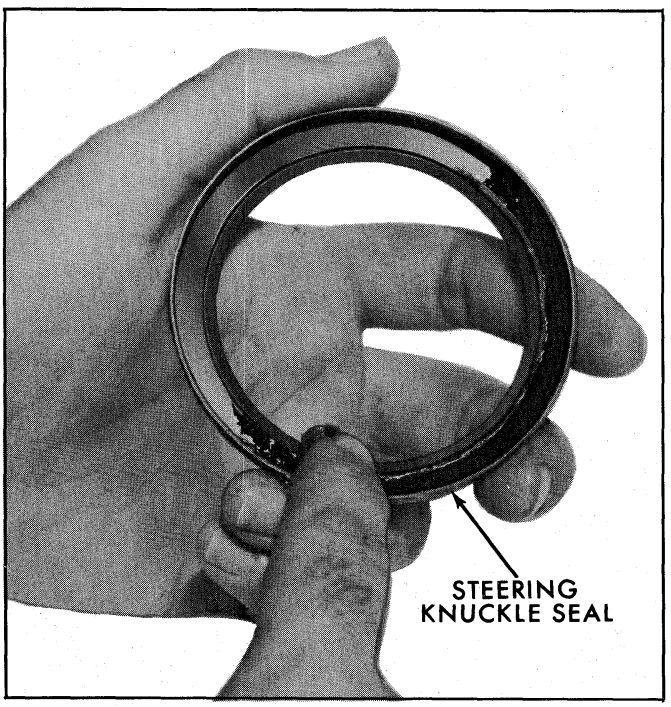


Fig. 3C-39 Lubricating Steering Knuckle Seal

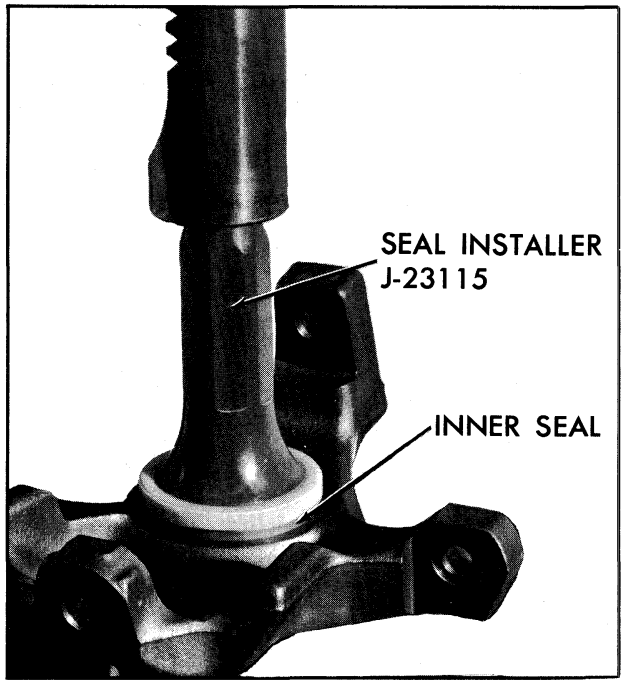


Fig. 3C-40 Installing Inner Seal

seal, Fig. 3C-39.

2. Undercut webbing on Seal Installer, J-23115, so that Installer will accept seal.

3. Install seal on Seal Installer, J-23115.

4. Position knuckle and hub assembly on arbor press, Fig. 3C-40.

NOTE: Support hub and knuckle assembly so that assembly is not supported by the wheel mounting studs.

5. Position seal and Seal Installer, J-23115, on knuckle and press seal into knuckle, Fig. 3C-40.

6. Align splines in hub with splines on drive axle and install hub and knuckle assembly on drive axle.

CAUTION: *Use care to avoid damaging the inner seal when installing the knuckle on the drive axle.*

7. Install lower sphierical joint stud into steering knuckle and attach nut. Do not tighten nut at this time.

8. Install tie-rod end stud into knuckle and attach nut. Do not tighten nut at this time.

9. Install upper spherical joint stud into knuckle and install upper spherical joint nut loosely.

10. Using alignment marks placed on hub and disc at time of disassembly, align and install disc on hub.

11. Loosely install two nuts on hub to prevent disc from falling off hub.

12. Install caliper as described on page 5-13.

CAUTION: *Do not twist brake hose during installation, as brake system damage may result.*

13. Remove upper spherical joint nut to install brake hose clip on stud.

14. Install upper spherical joint nut, tighten nut to 60 foot-pounds, and install new cotter pin. Bend cotter pin tight against flats on nut.

CAUTION: *See "CAUTION" on page 3C-6 of this section.*

NOTE: If cotter pin cannot be installed, tighten nut to next hole and install cotter pin.

CAUTION: *Cotter pin must be crimped tight against flat on nut to prevent interference with or damage to the drive-axle constant velocity joint or seal.*

15. Tighten tie-rod end nut to 40 foot-pounds and install new cotter pin.

CAUTION: *See "CAUTION" on page 3C-6 of this section.*

16. Tighten nut on lower spherical joint stud to 80 foot-pounds and install new cotter pin.

CAUTION: *See "CAUTION" on page 3C-6 of this section.*

NOTE: If cotter pin cannot be installed, tighten nut to next hole.

17. Remove rubber hose from lower suspension arm torsion bar connector, Fig. 3C-37.

18. Install drive axle washer and nut. Do not tighten nut at this time.

19. Install wheel and tire.

20. Install wheel mounting nuts snug tight. Do not torque nuts at this time.

21. Raise car, remove jack stands, and lower car.

22. Tighten wheel mounting nuts to 130 foot-pounds.

CAUTION: *See "CAUTION" on page 3C-6 of this section.*

23. Tighten drive axle to hub nut. After reaching 110 foot-pounds minimum, nut must always be tightened further, never backed off, to install cotter pin. Install new cotter pin.

CAUTION: *See "CAUTION" on page 3C-6 of this section.*

NOTE: If cotter pin cannot be installed, tighten nut to next hole.

24. Install wheel disc.

25. Check standing height and front end alignment and adjust as required.

26. With vehicle weight supported by front wheels, inspect front brake hose to be sure it is not twisted.

Lower Suspension Arm Spherical Joint Seal

The lower spherical joint seal can be installed with the lower suspension arm either on or off the car.

a. Removal (On Car)

1. Remove steering knuckle as described on page 3C-21.

2. Using a hammer, tap lightly on seal retainer.

3. Use a small screwdriver to work retainer off joint. Discard seal and retainer.

4. Wipe grease from spherical joint and stud.

b. Installation

1. Position new seal over spherical joint stud.

2. Lubricate jaws of Camber Adjusting Wrench, J-9231, and slide jaw between seal and retainer.

3. Tap lightly with hammer on end of Camber Adjusting Wrench, J-9231, until seal retainer is fully seated.

4. Install steering knuckle as described on page 3C-22.

5. Lubricate joint using special lubricant recommended for this application until lubricant escapes from valve inside of seal, Fig. 3C-41.

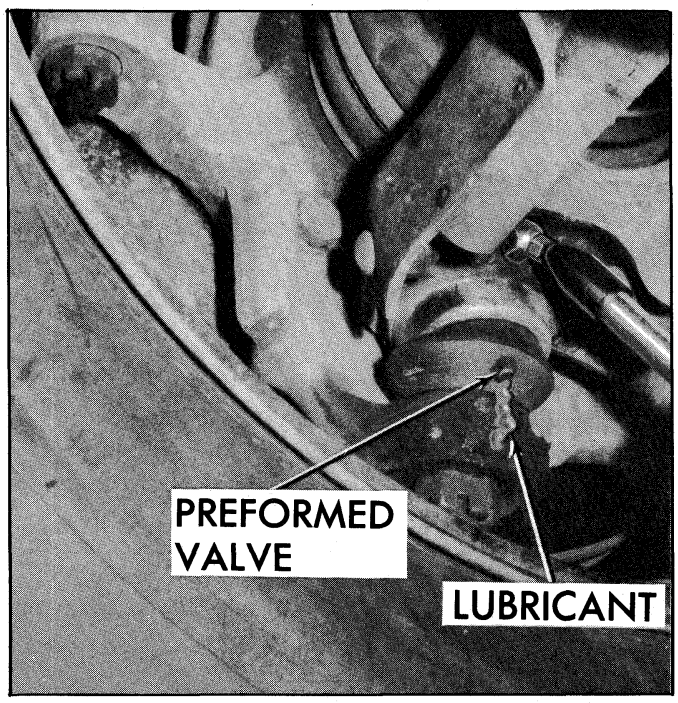


Fig. 3C-41 Repacking Lower Spherical Joint

Lower Suspension Arm

The lower suspension arm components are serviced as individual parts.

a. Removal

Remove wheel disc.

2. Loosen wheel mounting nuts.
3. Remove hub cotter pin and loosen nut.
4. Raise car.
5. Remove wheel and tire.
6. Remove torsion bar as described on page 3C-20.
7. Remove hub nut and washer.
8. Remove brake hose clip(s) attached to frame.

NOTE: Right side of car has two frame attaching clips.

9. Remove cotter pin, nut, and brake hose clip from upper spherical joint stud.

10. Using a hammer, strike knuckle in area of upper spherical joint and remove joint from steering knuckle.

CAUTION: *Use care to prevent hammer from slipping and damaging brake hose.*

11. Disconnect shock absorber at lower mount, then work shock off mount using a screwdriver to pry bushing off stud.

12. Using Front Suspension Puller, J-24319, disconnect tie rod end at steering knuckle.

13. Disconnect stabilizer bar and disconnect nut and link bolt.

14. Using Front Suspension Puller, J-24319, disconnect lower spherical joint.

15. Disengage hub, knuckle, and disc as an assembly from drive axle and secure assembly to upper suspension arm with a piece of wire.

CAUTION: *Take care to avoid damaging brake hose.*

16. Remove lower suspension arm to frame attaching nuts and bolts.

17. Disengage lower suspension arm from frame mounts and remove suspension arm.

b. Installation

1. Remove wire and install hub, disc, and knuckle assembly on drive axle.

2. Install lower suspension arm into mounts in chassis. **Do not** tighten nuts at this time.

3. Install lower suspension arm spherical joint into steering knuckle. Tighten nut to 80 foot-pounds and install new cotter pin. (If pin cannot be installed, tighten nut to next hole and install cotter pin).

CAUTION: *See "CAUTION" on page 3C-6 of this section.*

4. Tighten lower suspension arm inner mount bolts to 80 foot-pounds.

CAUTION: *See "CAUTION" on page 3C-6 of this section.*

5. Lift up upper suspension arm and install shock absorber on lower suspension arm mount. Tighten nut to 75 foot-pounds.

6. Install upper suspension arm spherical joint into steering knuckle.

7. Install brake hose clip on upper spherical joint stud. Tighten nut to 60 foot-pounds and install new cotter pin.

CAUTION: *See "CAUTION" on page 3C-6 of this section.*

NOTE: If pin cannot be installed, tighten nut to next hole. Cotter pin must be crimped tight against flats on nut to prevent cotter pin from interfering with outer constant velocity joint seal.

8. Install brake hose clip(s) to frame. (Right side of car has two frame attaching slips).

9. Install tie rod end in steering knuckle. Tighten nut to 40 foot-pounds, and install new cotter pin.

CAUTION: *See "CAUTION" on page 3C-6 of this section.*

NOTE: If pin cannot be installed, tighten nut to next hole.

10. Install stabilizer bar on suspension arm as described on page 3C-18.

11. Install washer and nut securing hub to drive axle.

12. Install torsion bar as described on page 3C-21.

13. Install wheel and tire.

14. Lower car and examine brake lines to be sure they are not twisted.

15. Tighten drive axle nut. After reaching 110 foot-pounds minimum, nut must always be tightened further, never backed off, to install cotter pin. Install new cotter pin.

CAUTION: *See "CAUTION" on page 3C-6 of this section.*

NOTE: If cotter pin cannot be installed, tighten nut to next hole location and install cotter pin.

16. Tighten wheel nuts to 130 foot-pounds.

CAUTION: *See "CAUTION" on page 3C-6 of this section.*

17. Adjust standing height and front wheel alignment as described on page 3A-12 and 3A-12.

18. Install wheel disc.

Lower Suspension Arm Bushings

a. Removal

1. Remove lower suspension arm as described in column 1 on this page.

NOTE: Spray bushings with silicone lubricant to

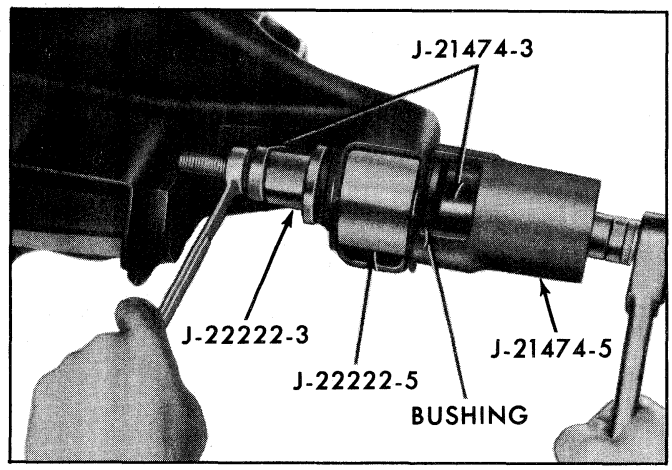


Fig. 3C-42 Removing Suspension Arm Bushings

facilitate removal.

2. Install tools as shown in Fig. 3C-42 and press bushings out of suspension arm.

b. Installation

NOTE: Dual rate bushings, which must be oriented in the arm at installation, are used in the lower suspension arms.

1. Invert the arm on a flat table surface. A 9/16" height difference must be obtained between the spherical joint end of the arm, Fig. 3C-28 and the flat table surface.

2. Position the bushings so the centerline of the notches in the bushings are parallel with the flat table surface on which the arm rests, Fig. 3C-28.

NOTE: Spray bushings with silicone lubricant to facilitate installation.

3. Install tools as shown in Fig. 3C-43 and press bushings into lower suspension arm.

4. Install lower suspension arm as described on page 3C-24.

5. Check standing height and front wheel alignment and adjust as necessary, pages 3A-12 and 3A-12.

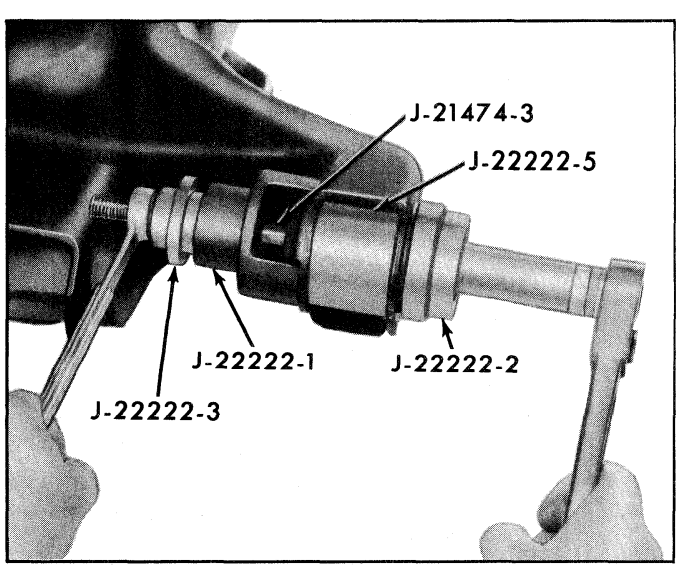


Fig. 3C-43 Installing Suspension Arm Bushings

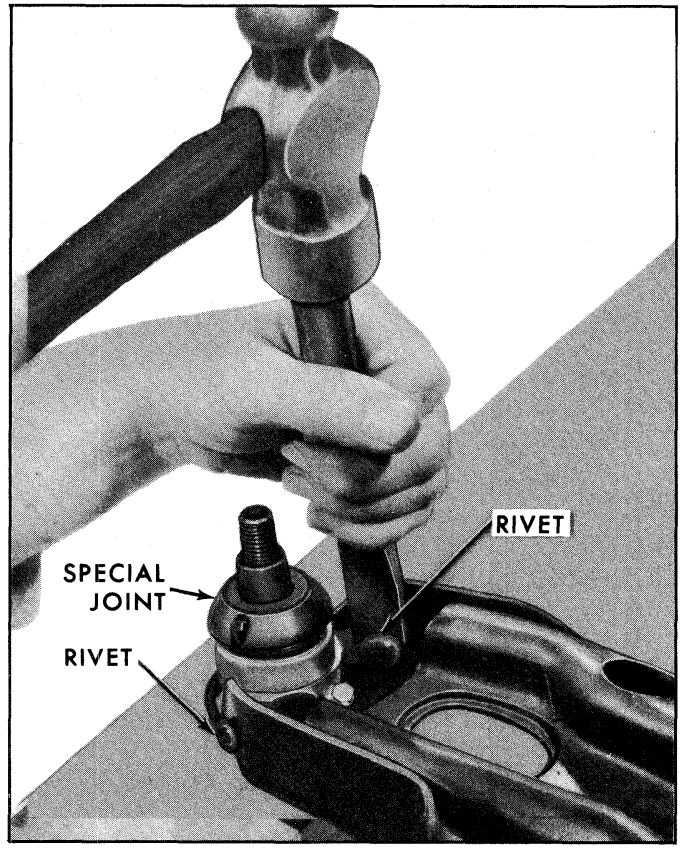


Fig. 3C-44 Removing Lower Spherical Joint

Lower Suspension Arm Spherical Joint

a. Removal

1. Remove lower suspension arm as described on page 3C-24.

2. Place lower suspension arm on bench with spherical joint stud up.

3. Using a chisel, cut two rivet heads off as shown in Fig. 3C-44.

4. Place lower suspension arm right side up and grind large rivet head off as shown in Fig. 3C-45.

5. Using a hammer and punch, drive on center rivet of joint until joint is out of suspension arm.

b. Installation

1. Install service spherical joint into suspension arm as shown in Fig. 3C-46 and tighten bolts and nut.

2. Install lower suspension arm as described on page 3C-24.

Hub Bearing, and Knuckle Assembly (Fig. 3C-47)

a. Removal

1. Remove wheel disc.
2. Loosen wheel mounting nuts.
3. Remove drive axle cotter pin.
4. Loosen drive axle nut.
5. Raise car and place jack stands under lower suspension arms.
6. Remove drive axle nut, washer, and wheel mounting nuts, and remove wheel and tire.
7. Remove upper spherical joint cotter pin and loosen nut. Remove nut and brake hose clip from stud, then re-install nut.

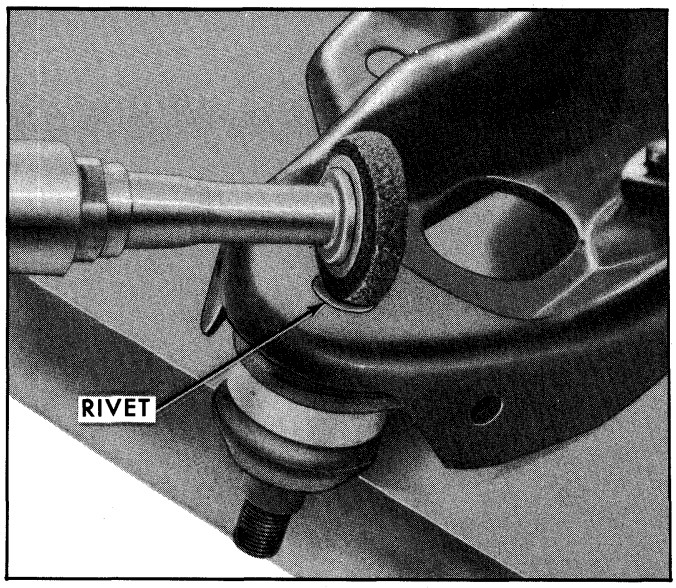


Fig. 3C-45 Grinding Spherical Joint Rivet

8. Remove two bolts securing caliper to knuckle and slide caliper off disc.

9. Position brake hose and caliper out of way.

CAUTION: *Do not allow caliper to hang from the brake hose, as the brake hose may become damaged.*

10. Mark hub and disc for alignment on assembly and remove disc.

11. Strike steering knuckle in area of upper spherical joint until upper spherical joint is loose.

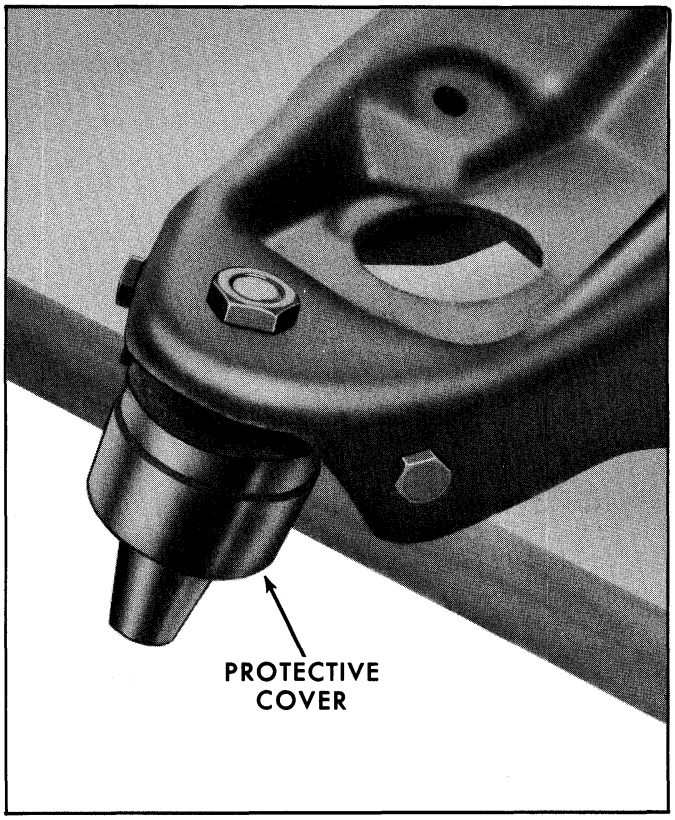


Fig. 3C-46 Lower Spherical Joint Installed

CAUTION: *Use extreme care to prevent hammer from slipping and damaging brake hose.*

12. Install a short length of rubber hose over the lower suspension arm torsion bar connector to avoid damage to inboard tri-pot joint seal when hub and knuckle are removed, Fig. 3C-37.

13. Remove tie rod end cotter pin and nut.

14. Using Front Suspension Puller, J-24319, disconnect tie rod end at steering knuckle.

15. Remove lower spherical joint cotter pin and nut.

16. Using Front Suspension Puller, J-24319, disconnect lower spherical joint.

17. Remove upper spherical joint nut.

18. Remove upper spherical joint stud from steering knuckle.

19. Remove hub and knuckle as an assembly.

b. Disassembly

1. Remove three screws and washers securing spacer and bearing retainer to steering knuckle and remove spacer.

2. Remove steering knuckle inner seal, Fig. 3C-38 and discard seal.

CAUTION: *Use care when removing seal to prevent damage to the seal mating surface on the steering knuckle.*

3. Install Small Bushing, part of set J-22214-10, in upper end of steering knuckle, Fig. 3C-48.

4. Install Large Bushing, part of set J-22214-10, in lower end of steering knuckle, Fig. 3C-48.

5. Install Large Pilot, J-22214-8, on inner end of hub, Fig. 3C-48.

6. Install Knuckle Remover, J-22214-5, between upper and lower ends of steering knuckle, Fig. 3C-48.

7. Secure Knuckle Remover to steering knuckle by installing two Small Bolts, J-22214, through bushings previously installed.

8. Secure Knuckle Remover, J-22214-5, in a vise, with knuckle assembly attached, Fig. 3C-49.

9. Coat Large Bolt, J-22214, with chassis lubricant and install bolt in Knuckle Remover, J-22214-5.

10. Tighten Large Bolt, J-22214-4, until hub, bearing, retainer, spacer, steering knuckle outer seal, and bearing assembly are pressed out of steering knuckle.

11. Remove spacer.

12. Pry outer seal away from bearing package, Fig. 3C-50.

NOTE: A simple tool such as the one described in Fig. 3C-4 is ideal for this prying operation. This can be made from an old screwdriver or a piece of cold rolled steel.

13. Use a hammer and a 3/8" chisel to cut through outer seal. Then remove seal from bearings, Fig. 3C-50.

CAUTION: *When chiseling, hold hammer and chisel in a strictly vertical position to avoid damaging hub.*

14. Place assembly in arbor press so that hole in Press Plate, J-23997, lines up with hole in anvil. Press bearings from hub, Fig. 3C-51.

c. Assembly

The front wheel bearings are supplied as matched assemblies and must be serviced as complete assemblies.

Inspect the steering knuckle bore and the steering knuckle seal contact surface on the drive axle. Remove any rust present using #400 grit "wet" paper and kerosene. When sanding, use a circular motion only to avoid spiral

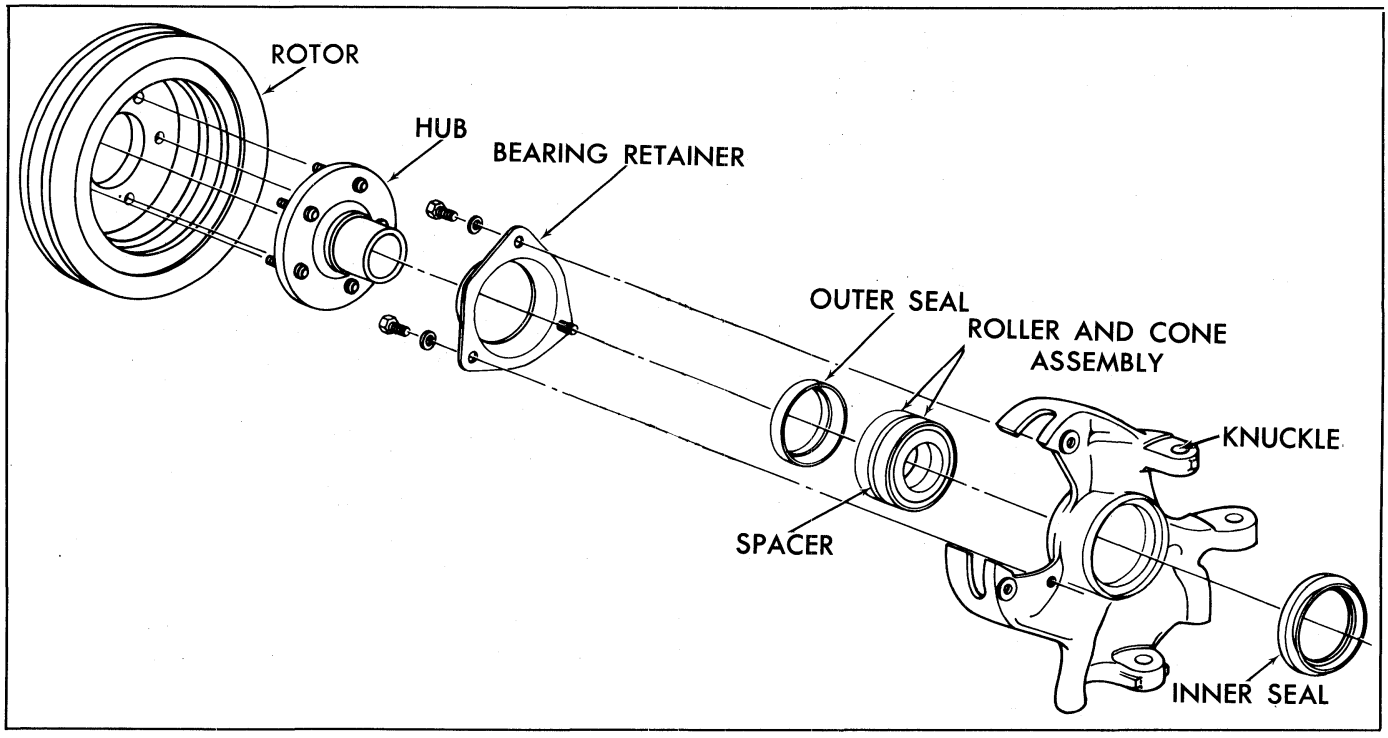


Fig. 3C-47 Front Hub Bearing and Knuckle Disassembled

marks on sealing surface.

1. Position steering knuckle on arbor press with outboard face of knuckle facing up.

2. Using special lubricant provided in bearing package, apply lubricant to hub shaft and between lips of both steering knuckle seals, Fig. 3C-35.

NOTE: One tube of lubricant will service one complete hub and knuckle assembly.

3. Install outer steering knuckle seal on Seal Installer, J-23114.

4. Position seal and seal installer on bearing package and position package in steering knuckle bore.

CAUTION: *Do not remove disposable sleeve in bearing package at this time, as sleeve is used as a*

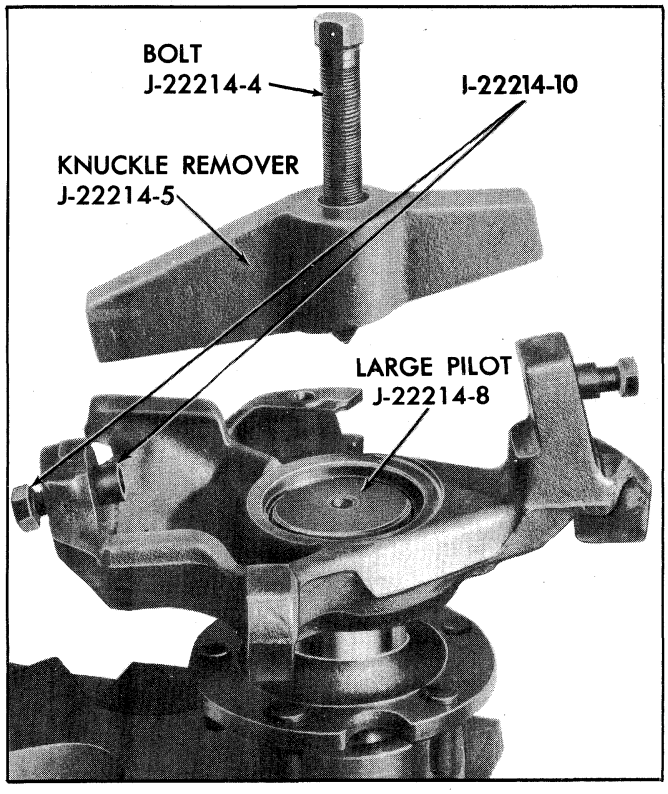


Fig. 3C-48 Hub and Bearing Removal Tools

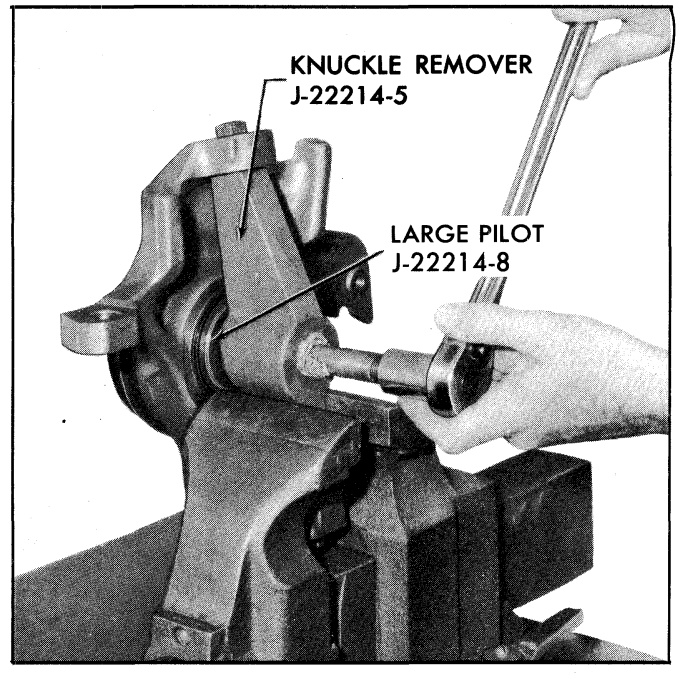


Fig. 3C-49 Removing Hub and Bearing

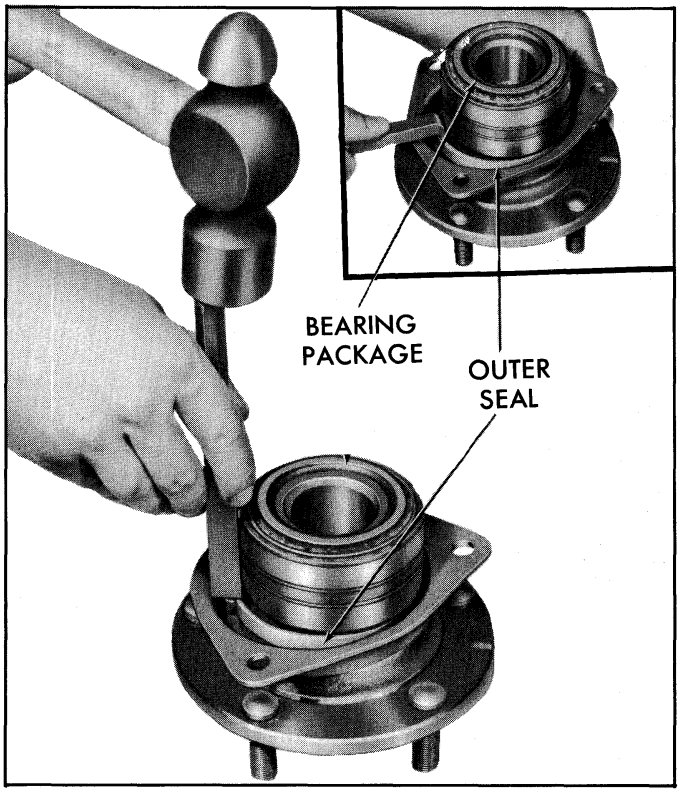


Fig. 3C-50 Removing Outer Seal

retainer to prevent bearings from being mispositioned in cups, or damaged during installation, Fig. 3C-52.

5. Press bearing package and outer seal into steering knuckle, Fig. 3C-53. Bearing package and outer seal are installed when inner bearing cup bottoms out on shoulder in steering knuckle bore.

6. Position spacer on outer face of steering knuckle.

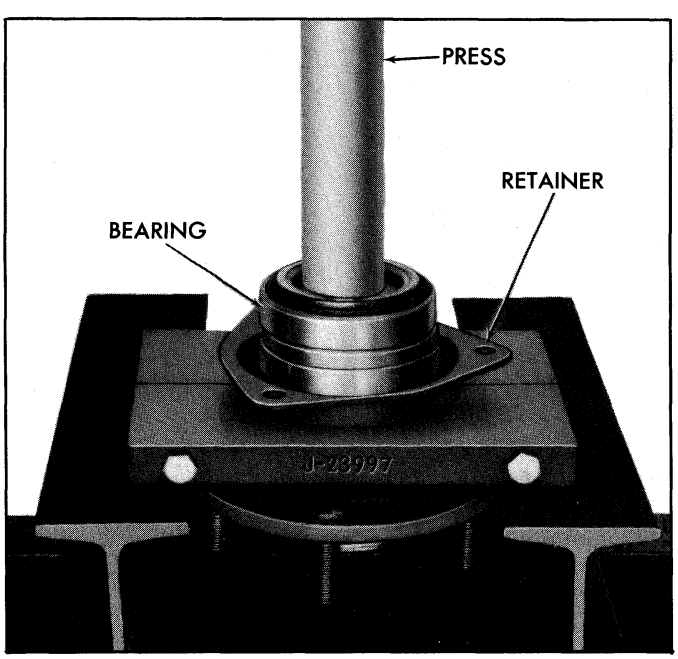


Fig. 3C-51 Removing Bearings

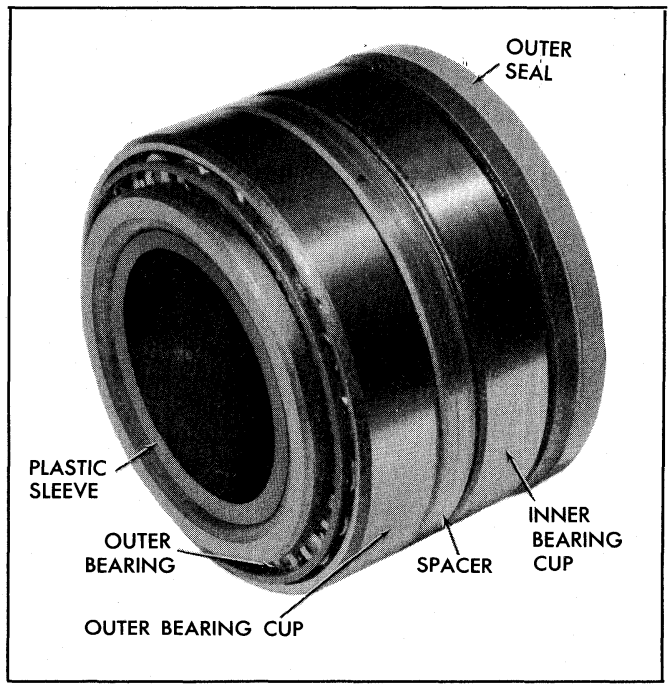


Fig. 3C-52 Bearing Package

7. Position bearing retainer over spacer and secure bearing retainer and spacer to steering knuckle with three screws and washers. Tighten screws to 30 foot-pounds. Remove knuckle assembly from press.

8. Remove disposable sleeve from bearing package previously installed in steering knuckle.

9. Working from inner face of steering knuckle, use remainder of special lubricant to coat inner race of bearings before installing hub in knuckle and bearing assembly.

10. Position hub on arbor press with stud end down.

CAUTION: *To avoid damaging the mounting studs, support hub so that hub is not supported by the wheel mounting studs.*

11. Position knuckle and bearing assembly on hub.

12. Install Large Pilot, J-22214-8, through steering knuckle so that pilot seats on bearing, Fig. 3C-54, and press knuckle assembly on hub.

13. Install inner seal on Seal Installer, J-23115, and press inner seal into steering knuckle, Fig. 3C-34.

NOTE: Webbing of Seal Installer, J-23115, may have to be undercut before tool will accept seal.

d. Installation

1. Guide knuckle assembly over drive axle, install lower spherical joint stud into knuckle, and attach nut. Do not tighten nut at this time.

CAUTION: *Use care to avoid damaging inner seal when guiding the knuckle over the drive axle.*

2. Install tie-rod end stud into knuckle and attach nut. Do not tighten nut at this time.

3. Install upper spherical joint stud into knuckle and install upper spherical joint stud nut loosely.

4. Using alignment marks placed on hub and disc at time of disassembly, align disc with hub and install disc on hub.

5. Install one or two nuts on hub to prevent disc from falling or being knocked off hub.

6. Install caliper as described on page 5-13.

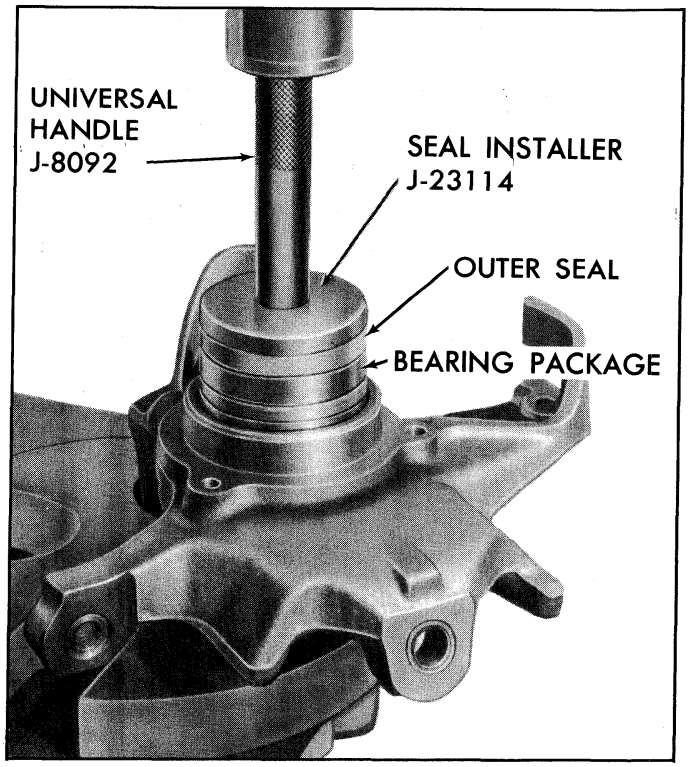


Fig. 3C-53 Installing Bearing Package

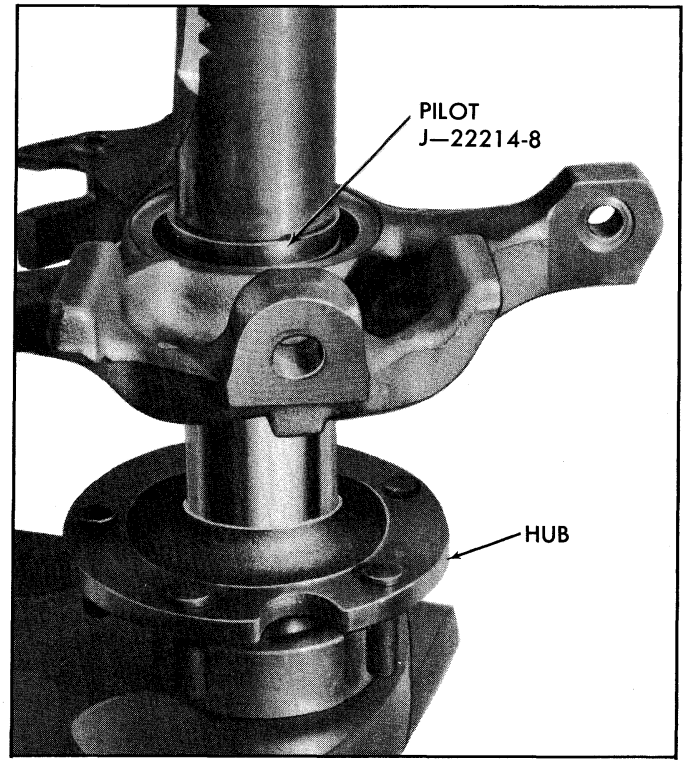


Fig. 3C-54 Installing Hub in Knuckle

NOTE: Remove upper spherical joint nut to install brake hose clip on stud. Take care not to twist brake hose during caliper installation.

7. Install upper spherical joint nut, tighten nut to 60 foot-pounds and install new cotter pin. Bend cotter pin tight against flats on nut.

CAUTION: *See "CAUTION" on page 3C-6 of this section.*

NOTE: If cotter pin cannot be installed, tighten nut to next hole and install cotter pin. Cotter pin must be crimped tight against flats on nut to prevent interference with or damage to the drive axle constant velocity joint or seal.

8. Tighten tie-rod end nut to 40 foot-pounds and install new cotter pin.

CAUTION: *See "CAUTION" on page 3C-6 of this section.*

NOTE: If pin cannot be installed, tighten nut to next hole.

9. Tighten nut on lower spherical joint stud to 80 foot-pounds and install cotter pin.

CAUTION: *See "CAUTION" on page 3C-6 of this section.*

NOTE: If pin cannot be installed, tighten nut to next hole.

10. Remove rubber hose from lower suspension arm torsion bar connector.

11. Install drive axle washer and nut. Do not tighten nut at this time.

12. Remove nuts used to hold disc on hub, and install wheel and tire.

13. Install wheel mounting nuts snug tight. Do not torque nuts at this time.

14. Raise car, remove jack stands, and lower car.

15. Inspect front brake hose to make sure it is not twisted.

16. Tighten wheel mounting nuts to 130 foot-pounds.

CAUTION: *See "CAUTION" on page 3C-6 of this section.*

17. Tighten drive axle nut. After reaching 110 foot-pounds minimum, nut must always be tightened further, never backed off, to install cotter pin. Install new cotter pin.

CAUTION: *See "CAUTION" on page* 3C-6 *of this section.*

NOTE: If pin cannot be installed, tighten nut to next hole.

18. Check standing height and front end alignment and adjust as required, pages 3A-12 and 3A-12.

19. Install wheel disc.

Front Wheel Stud Replacement

a. Removal

1. Raise car and remove front wheel.

2. Remove two bolts which hold caliper to steering knuckle.

NOTE: It is not necessary to remove brake hose from caliper when removing disc for service.

3. Remove cotter pin, loosen joint upper ball nut and slip brake hose collar out of its clip. The slack gained will permit removal of caliper without pulling hose.

4. Slide caliper off disc and support by a hook-shaped wire fastened to upper suspension arm.

CAUTION: *Do not allow caliper to hang from brake hose as this could result in possible damage to hose.*

5. Mark a wheel stud and a corresponding place on the disc to assist in installation.

6. Remove the disc by sliding it off the hub.

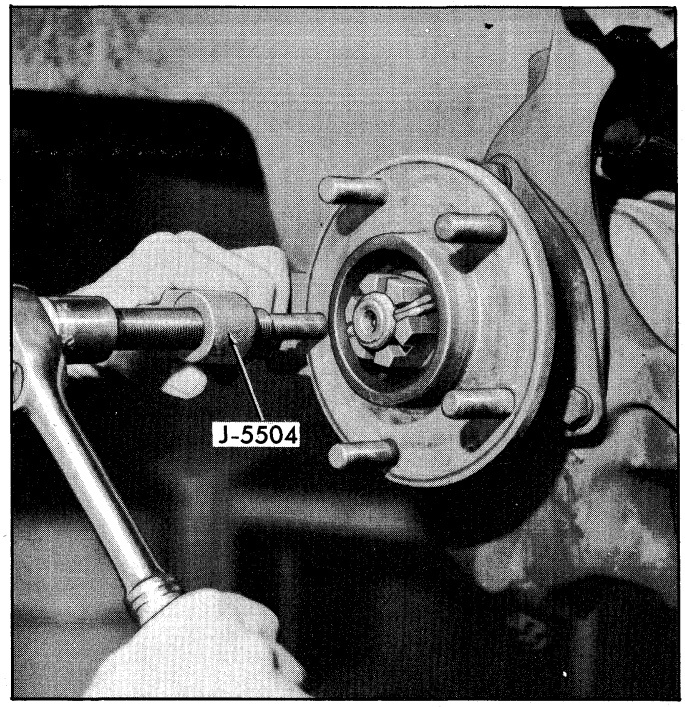


Fig. 3C-55 Removing Wheel Stud

7. Install tool J-5504 on damaged stud and press stud from hub, Fig. 3C-55.

NOTE: Optional tool J-22292-1 may be used for this application. Either tool must be modified by cutting 1/4" off the end of each leg.

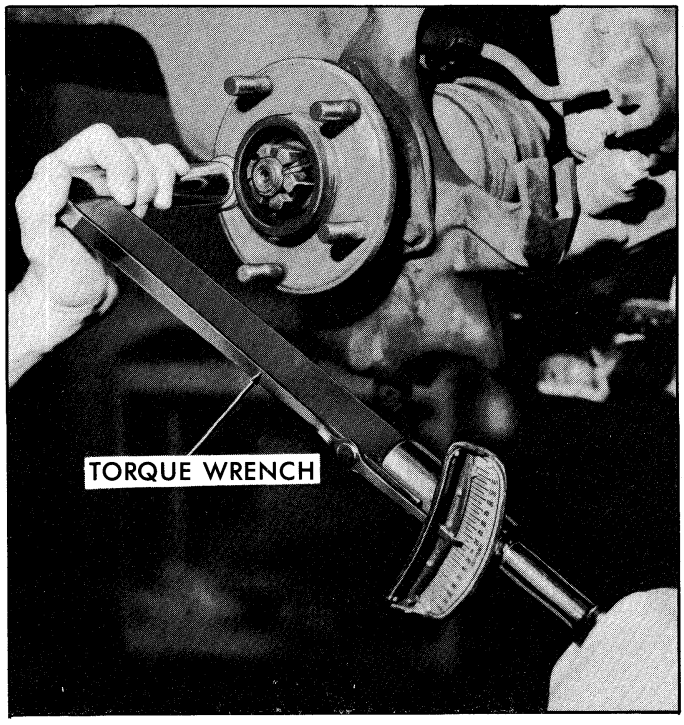


Fig. 3C-56 Installing Wheel Stud

b. Installation

1. Install a new stud from back side of hub.

2. Install two flat washers on stud and wheel nut, flat side toward washers, and tighten nut with fingers.

3. Torque nut to 140 foot-pounds, Fig. 3C-56.

4. Remove nut and washers from stud and discard.

5. Visually inspect stud threads and stud head for being properly seated on hub flange.

6. Inspect hub flange and disc mating surfaces to make sure that they are free of dirt and other foreigh material. Clean as required.

7. If reinstalling original disc, align index marks on hub and disc and slide disc over hub pilot diameter, making sure that disc is seated against hub flange.

NOTE: If disc replacement is necessary, the new disc may be assembled to the hub in any position. It is not necessary to replace both discs if one is all right.

8. Position caliper on disc and line up holes in caliper ears with holes in steering knuckle. Make sure brake hose is not twisted, as its natural curvature is essential to maintain proper hose-to-suspension clearance through full movement of suspension and steering parts.

9. Wipe all dirt and corrosion from the caliper mounting bolts. **Do not use abrasives,** as they will remove protective plating. Lubricate smaller ends of bolts with silicone lubricent.

10. Start either bolt into the inboard ear of the caliper and into the steering knuckle. At this point it is necessary to be sure that the bolt passes **under** the retaining ear on the inboard shoe to maintain the shoe in position in the caliper.

11. Pass the bolt on through the outboard ear on the caliper until the threads on the bolt can be started into the steering knuckle.

12. Repeat steps 10 and 11 in placing remaining bolt into caliper assembly.

CAUTION: *See "CAUTION" on page 3C-6 of this section when performing steps 13, 17 and 18.*

13. Tighten caliper mounting bolts to 30 foot-pounds.

14. Pump brake pedal to seat lining against rotors.

15. Clinch upper ears of outboard shoe by positioning 12" pliers with one jaw on top of upper ear and one jaw in notch on bottom of shoe, opposite upper ear.

NOTE: After clinching, there should be no radial clearance between the shoe ears and caliper housing.

16. If radial clearance exists, repeat clinching procedure.

17. Center brake hose collar in clip and tighten ball joint nut to 60 foot-pounds. Install cotter pin.

18. Install wheels, tighten wheel mounting nuts to 130 foot-pounds and lower car.

19. Allow car weight to be supported on front wheels and inspect from brake hoses for twisted condition. Correct if necessary.

20. Before moving the vehicle, pump the brake pedal two or three times to insure firm pedal.

21. Drive car around several blocks making left hand and right hand turns.

22. Re-torque wheel mounting nuts to 130 foot-pounds.

23. Install wheel disc.

TORQUE SPECIFICATIONS

Material No.	Application	Size	Foot-Pounds	
	C-CAR AND SEVILLE			
6010M	Front Shock Absorber to Lower Arm Bolt-C-Car	5/16 - 18	22*	
6010M	Front Shock Absorber to Lower Arm Bolt-Seville	5/16 - 18	19*	
SAE 1113	Front Stabilizer Link Nut	5/16 - 18	12*	
301M	Service Replacement Spherical Joint to Upper Arm Nut	5/16 - 18	25*	
301M	Spherical Joint to Knuckle (Lower)	9/16 - 18	80*	
301M	Spherical Joint to Knuckle (Upper)	1/2 - 20	60*	
275M	Splash Shield to Steering Knuckle Screws	1/4 - 20	85*	
6010M	Stabilizer Bracket to Frame Attaching Screws — C- Car	3/8 - 16	24*	
6010M	Stabilizer Bracket to Frame Attaching Screws — Seville	3/8 - 16	27*	
286M	Suspension Arm Shaft Attaching Nuts (At Bushings)	3/4 - 16	75*	
301M	Suspension Arm Shaft to Frame Nuts (Upper)	1/2 - 13	75*	
286M	Tie Rod Adjuster Clamp Nuts	3/8 - 24	14*	
301M	Tie Rod Pivots to Steering Knuckle	7/16 - 20	35*	
	Eldorado			
280M	Bearing Retainer to Knuckle Screw	3/8 - 16	30	
6010M	Bearing Retainer to Support Plate Screw	5/16 - 18	10	
301M	Lower Spherical Joint Nut	9/16 - 18	80*	
300M	Lower Suspension Arm Bushing Bolts	1/2 - 13	80*	
301M	Nut-Upper Suspension Arm Cam to Frame	1/2 - 20	95*	
301M	Shock Absorber (Lower) Nut	9/16 - 12	75	
301M	Shock Absorber (Upper) Nut	9/16 - 12	75	
6010M	Stabilizer Bracket to Frame Screw	3/8 - 16	35	
SAE 1020-1022	Stabilizer Link Bolt Nuts	5/16 - 18	12	
286M	Tie Rod Adjuster Clamp Nuts	3/8 - 24	14*	
286M	Tie Rod to Knuckle Nut	1/2 - 20	40*	
286M	Torsion Bar Crossmember Bolt Nuts	5/16 - 18	10	
301M	Upper Spherical Joint Nut	1/2 - 20	60*	
300M	Upper Suspension Arm Bushing Bolts	1/2 - 20	95*	
301M	Upper Suspension Arm Spherical Joint to Arm Nut	5/16 - 18	25*	
			N · m	
510M	Suspension Arm to Frame (Lower) C-Car	14.0 x 2.0	120*	90*
510M	Suspension Arm to Frame (Lower) Seville	14.0 x 2.0	130*	95*

***CAUTION:** *These fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. Each must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.*

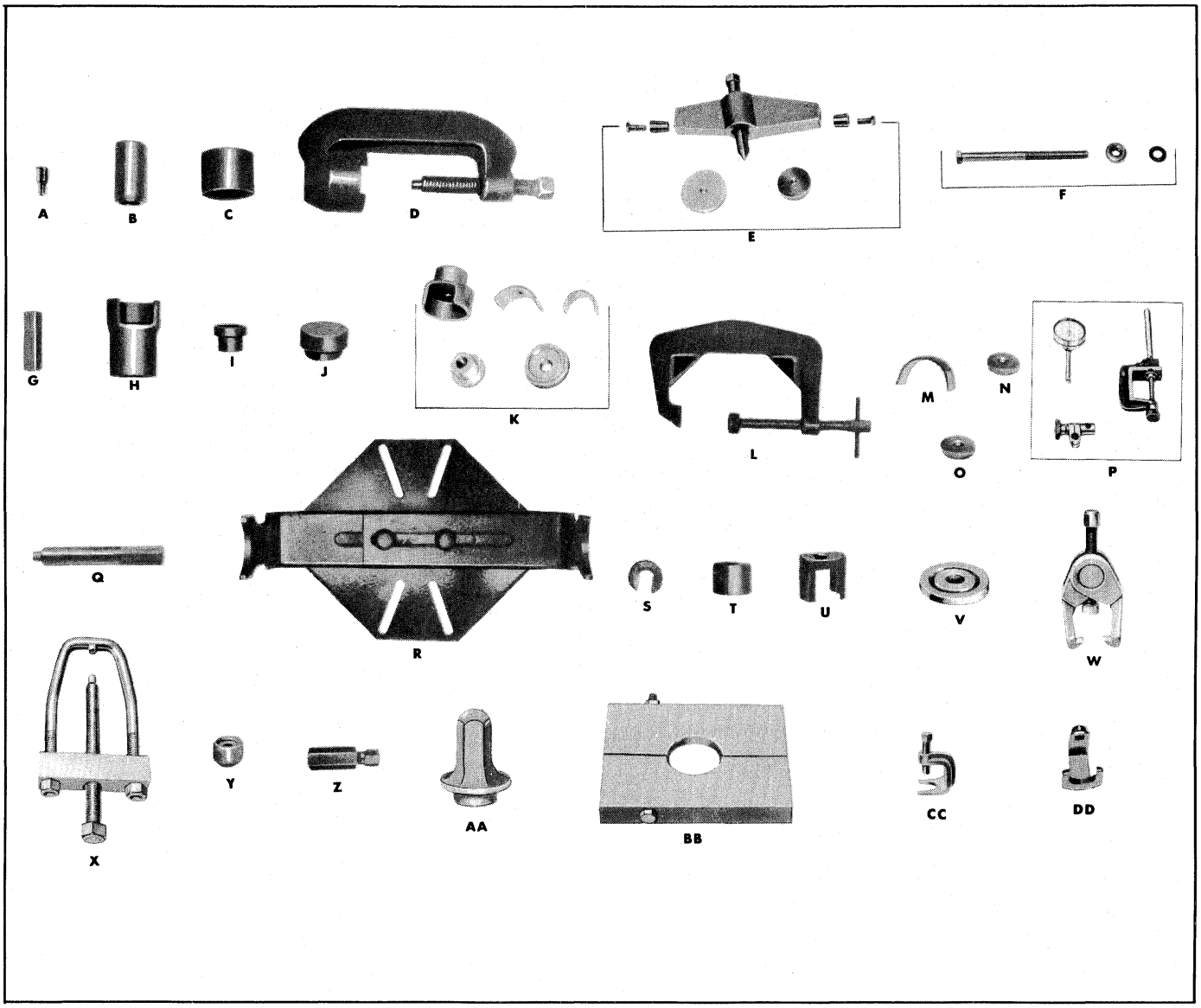


Fig. 3C-57 Special Tools

Key	Tool No.	Name	Key	Tool No.	Name
A	J-25591	Socket-Front Upper Shock Absorber Remover & Installer	P	J-8001	Dial Indicator
			Q	J-8092	Universal Drive Handle
B	J-9519-7	Spherical Joint Remover	R	J-23028-01	Front Spring Remover and Installer
C	J-9519-9	Spherical Joint Installer	S	J-24770-3	Upper Arm Bushing Remover and Installer
D	J-9519-10	Spherical Joint Clamp	T	J-24770-1	Upper Arm Bushing Remover and Installer
E	J-22214	Knuckle and Bearing Remover (Eldorado)	U	J-24770-2	Upper Arm Bushing Remover and Installer
F	J-21474-3	Bolt and Bearing	V	J-23114	Front Knuckle Outer Seal Installer (Eldorado)
G	J-21474-10	Bolt and Bearing Nut	W	J-24319	Front Suspension Puller (Eldorado)
H	J-21474-5	Bushing Receiver	X	J-22517	Torsion Bar Remover and Installer (Eldorado)
I	J-21474-8	Bushing Remover	Y	J-23915	Lower Arm Front Bushing Flarer
J	J-21474-2	Bushing Installer	Z	J-23742	Spherical Joint Stud Remover
K	J-22222	Bushing Remover and Installer Set (Eldorado)	AA	J-23115	Front Knuckle Inner Seal Installer (Eldorado)
L	J-22269-5	Bushing Remover and Installer	BB	J-23997	Bearing Remover Press Plate (Eldorado)
M	J-21474-12	Spacer	CC	J-5504	Stud Remover
N	J-8849	Inner Bearing Cup Installer	DD	J-9231	Camber Adjusting Wrench (Eldorado)
O	J-8850	Outer Bearing Cup Installer			

REAR SUSPENSION

TABLE OF CONTENTS

Automatic Level Control 3D-16
Checking Rear Shock Absorbers 3D-4
Checking Rear Standing Height 3D-2
Diagnosis - ALC 3D-17
General Description 3D-2
On-Car Service - ALC 3D-20
Rear Shock Absorbers 3D-3
Rear Suspension - "C" Car 3D-2
Rear Suspension - Eldorado 3D-8
Rear Suspension - Seville 3D-12
Special Tools 3D-28
Torque Specifications 3D-27

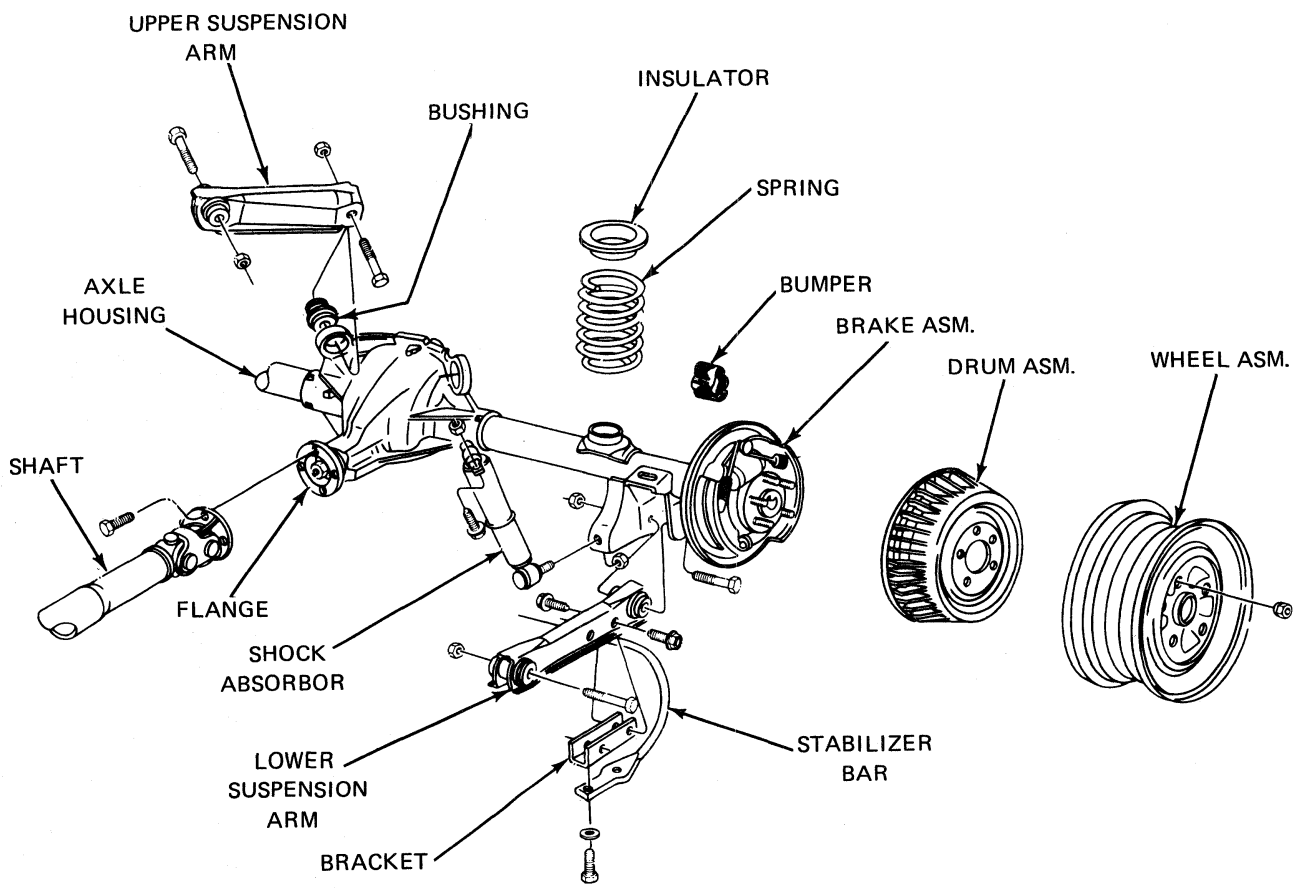


Fig. 3D-1 Rear Suspension Disassembled (C-Car)

GENERAL DESCRIPTION

For additional information pertaining to Eldorado and Seville rear suspension, refer to the latter portion of this section.

A four link rear suspension system, Fig. 3D-1, consisting of two upper and two lower control arms, steel coil springs, and shock absorbers is used on all C-cars, Limousines, and Commercial Chassis.

Two upper control arms are attached at their rear ends to inboard brackets on the rear axle housing and at their front ends to brackets on the rear suspension crossmember. Two lower control arms are attached at their rear ends to outboard brackets on the rear axle housing and on their front ends to brackets on the frame side rails.

The rear shock absorbers are mounted at the upper ends to the rear suspension crossmember. The lower ends are attached to mounting brackets on the axle housing.

A 16mm (5/8") diameter rear stabilizer bar is mounted to the lower control arm on cars equipped with Automatic Level Control. Also, with ALC, bumper height adjustment is automatic.

ON-CAR SERVICE

CAUTION: *When raising rear of car, support vehicle weight at underbody lift points or axle or both. Never use control arms as contact points for hoist or jack stands as damage may result.*

CAUTION: *If any mispositioning, incorrect assembly, or failure of components in the area of the brake system pipes, hoses, or cylinders is observed, be sure to check for any brake damage that may have resulted from such a condition and correct as required. Components that could damage the brake system due to mispositioning, incorrect assembly, or failure include the exhaust system, shock absorbers, springs, stabilizer bar and suspension control arms.*

The following caution applies to certain steps in the assembly procedure of components in this section. The critical fasteners to which this caution applies are identified by the terminology:

CAUTION: *See "CAUTION" on page 3D-2 in this section.*

CAUTION: *This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.*

Checking Rear Standing Height

Before checking standing (spring) height, make sure that trunk is empty except for spare tire and jack and that there is a full tank of gasoline, as all specifications are based on this observed weight. If car is equipped with Automatic Level Control, deflate system using service valve, then disconnect air line from superlift port on control valve. Deflation of the system is necessary when determining the standing height on the basis of springs alone. When checking standing height to determine the proper functioning and adjustment of the Automatic Level Height Control Valve, the system must be connected and the reservoir charged with 689-965 kPa (100-140 psi), and the shocks inflated by loading down the rear, then allowing to deflate by removing the load. See page 3D-17. Normalize position of springs by bouncing bumper up and down, gradually reducing force applied, to permit car to assume its normal position.

a. Rear Springs

Measure distance from frame to axle, Fig. 3D-2. (For Seville, measure closest distance from axle bump stop bracket on underbody to top of axle, Fig. 3D-3). Rear standing heights should be equal within 1/2 inch from side to side. Spring that checks below specifications must be replaced.

b. Ride Complaints

In case of hard riding, the first items to investigate are tire pressures, standing heights, and shock absorbers.

If these are correct, the amount of friction in the rear suspension system should be checked.

The procedure for checking excessive friction in the rear suspension system is as follows:

1. Disconnect rear shock absorbers.
2. With aid of a helper, lift up on the rear bumper and raise car as high as possible. Slowly release the bumper and allow the car to assume normal standing height. Measure distance from floor to center of bumper. Then push down on bumper, release slowly, and allow car to assume normal standing height. Measure distance from floor to center of

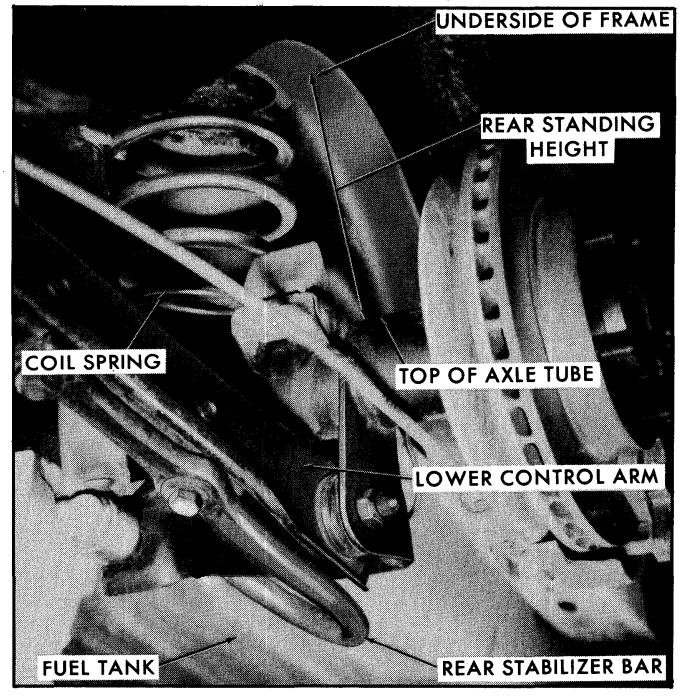


Fig. 3D-2 Measuring Rear Standing Height (C-Car)



Fig. 3D-3 Measuring Rear Standing Height (Seville)

bumper.

3. The difference between the two measurements should be less than 1/2 inch. If the difference exceeds the limit, inspect the upper and lower control arms for damaged or worn parts. On Seville, inspect the spring front bushings or rear shackles for damaged or worn parts.

Rear Shock Absorbers

CAUTION: *Be careful not to damage brake pipes or hoses throughout procedure.*

a. Removal

1. Raise car so that both frame and axle are supported.

2. If car is equipped with Automatic Level Control, remove the air line fittings at shock absorbers.

WARNING: THE SHOCK ABSORBERS ACT AS REBOUND STOPS FOR THE REAR SUSPENSION. UNDER NO CIRCUMSTANCES SHOULD REAR END OF CAR EVER BE RAISED SO THAT REAR SUSPENSION IS IN REBOUND POSITION WHILE DISCONNECTING SHOCK ABSORBER UNLESS BOTH REAR AXLE AND FRAME ARE SUPPORTED, AS THIS COULD CAUSE INJURY OR DAMAGE.

3. Remove shock absorber upper retaining bolts and nuts (nuts not used on Seville). It may be necessary to fashion a simple tool for this operation. Bend a 1/2 inch box end wrench to a 45° angle at a point one inch from the center of the box end diameter, Fig. 3D-4. Use this to hold each upper mounting nut at rear frame kick-up while removing mounting bolts.

4. Remove shock absorber lower retaining nut (and bolt if Seville). Except Seville, it will be necessary to hold stem next to grommet to keep stem from turning, while removing nut with second wrench.

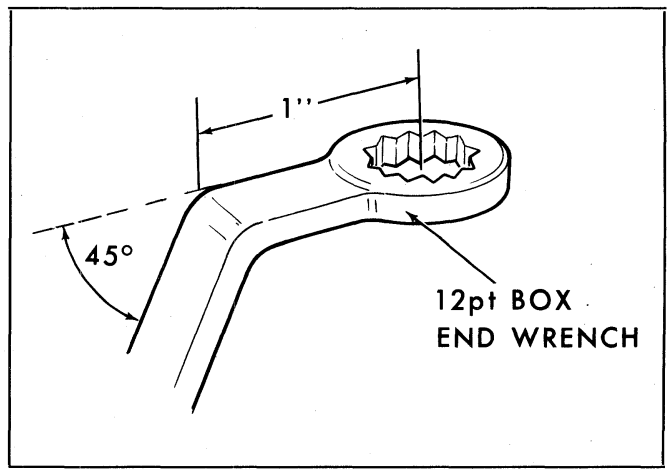


Fig. 3D-4 Rear Shock Absorber Wrench (Exc. Seville)

5. Remove shock absorber from its mounts.

b. Installation

NOTE: Except Eldorado: If equipped with ALC - left hand shock absorber has two line connections, right hand shock absorber has only one line connection. On Eldorado, the right hand shock has two line connections and the left hand shock has one.

1. Position the cross bar of the upper mount to the frame (under body if Seville) so that the shock absorber angles naturally toward the lower mount.

NOTE: On Seville, install RH shock absorber with air line fitting toward rear of car; LH shock absorber toward front of car.

2. Install upper retaining nuts and bolts (nuts not required on Seville). Except Seville, use special box wrench used in step 3a to hold nut while tightening bolt with a second wrench, tightening to 20 foot-pounds (18 foot-pounds on Seville).

3. Guide shock absorber lower stud into mounting bracket and install retaining nut (and bolt if Seville), tightening to 60 foot-pounds (45 foot-pounds if working on Seville).

4. If car is equipped with Automatic Level Control, perform the following steps:

a. Install air line fittings at shock absorbers, tightening tube nuts to 30-40 inch-pounds.

b. Inflate reservoir through service valve to 965 kPa (140 psi) (or maximum pressure available).

c. Disconnect overtravel lever at axle bracket (underbody bracket if Seville) and push arm up, allowing air to enter superlift.

CAUTION: *Do not put car weight on shock absorbers until they have been inflated as damage may result.*

d. Return overtravel lever to normal position and reconnect arm to axle bracket (underbody bracket if Seville).

5. Lower car.

6. If car is equipped with Automatic Level Control, check system for proper operation as described on page 3D-17.

Checking Rear Shock Absorbers

a. On-Car Checks

1. Raise car on hoist.

2. Check for correct mounting and condition of mounting bushings. Correct as required.

3. Check for oil leakage. If wet oil (shock fluid) is observed on the outside of the shock reservoir, remove and replace shock.

4. Disconnect lower shock mount. Extend shock absorber and pump shock absorber up and down by hand as fast as possible. If a skip is felt at end of stroke, remove shock absorber for bench check.

5. As another check, completely extend shock absorber and pull hard. If spring tension is felt, shock absorber should be replaced.

b. On Bench Checks - Standard Shock Absorbers

1. When performing a bench check for any suspected shock absorber, clamp shock absorber upside down in a vise.

NOTE: Cadillac standard shock absorbers can be turned upside down because all internal vapor (inert gas instead of air) is contained in a pliacell envelope which prevents aeration of oil and prevents lag. If a lag is noticed when stroked, it means the pliacell envelope has been ruptured and the shock should be replaced.

2. Pump shock absorber by hand at various rates of speed to find if shock absorber is defective. If a skip is felt at full extension when the shock is inverted, this is normal. A skip on reversal of direction in mid-travel indicates a ruptured pliacell envelope. If smooth resistance is felt throughout length of the stroke, however, the shock absorber need not be replaced. A faint hiss ("orifice swish") is considered normal, but a gurgling noise denotes air bubbles in the fluid, and the shock absorber should be replaced.

c. On Bench Checks - Automatic Level Control Shock Absorbers

1. Clamp lower mounting ring in vise in vertical position.

2. Extend and collapse shock completely several times to discharge air out of the working chamber.

3. Pump unit by hand at different rates of speed. Smooth resistance should be felt throughout the length of the stroke. Since the shock absorber is normally presurized, the sound of air bubbles or a gurgling noise is normal.

Rear Springs (Fig. 3D-5) C-Car

a. Removal

1. Raise car on hoist so that rear axle is supported.

2. Remove shock absorbers as described on page 3D-3.

WARNING: SHOCK ABSORBERS ACT AS REBOUND STOPS ON THE REAR SUSPENSION SYSTEM. DO NOT PERFORM THIS STEP UNLESS BOTH AXLE AND FRAME ARE FIRMLY SUPPORTED AS INJURY OR DAMAGE COULD RESULT.

3. If equipped with Automatic Level Control, remove two bolts and washers each side of car securing stabilizer bar to lower control arms and remove stabilizer bar.

CAUTION: *Under no circumstances is the axle to be lowered to the point at which brake hoses become taut, as damage may result.*

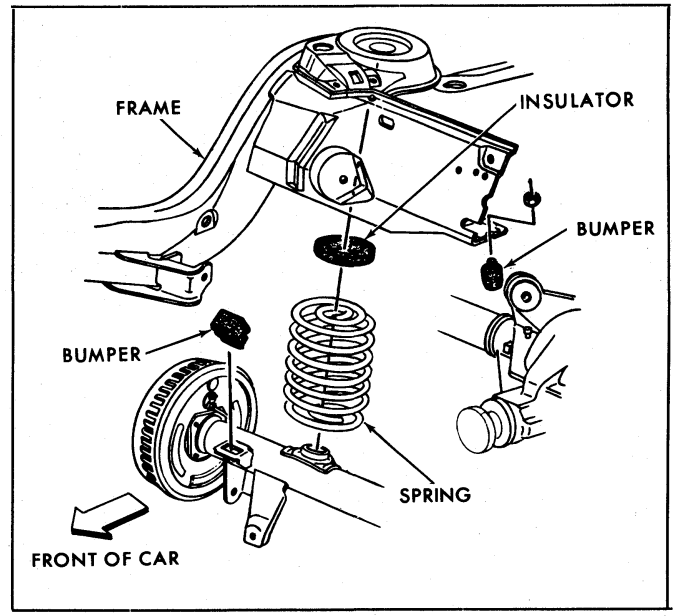


Fig. 3D-5 Rear Springs (C-Car)

4. Remove one bolt securing junction block to top of differential and disconnect brake lines from clips on axle.

5. If equipped with Automatic Lever Control, disconnect link from leveling valve arm.

6. Place jackstand under nose of carrier to relieve tension on lower control arm to axle bolts and remove bolts.

7. Disconnect drive shaft from pinion flange and support drive shaft with wire. See Fig. 4A-5.

8. Remove jack stand from under nose carrier.

9. Remove upper arm pivot bolts at axle, Fig. 3D-7.

10. Disconnect left hand parking brake cable at equalizer and disconnect cable at frame near No. 4 body bolt location by removing clip. Slide cable through hole.

11. Remove cable from clip at center of rear crossmember and disconnect cable at "C" connector located at left of frame between No. 2 and No. 3 body bolt locations.

12. Support both rear frame rails at rear of frame. Lower axle to point where springs can be pryed out, being careful not to stretch brake line or cable and remove springs.

WARNING: IF AXLE IS ALLOWED TO WIND UP AS IT IS LOWERED, SPRINGS MAY SNAP FROM THEIR SEATS AND COULD CAUSE INJURY OR DAMAGE. USE EXTREME CAUTION TO PREVENT WIND-UP CONDITION.

b. Installation

1. Tape upper rubber insulator to top of spring and position spring so that end of top of spring is pointing to left of car. (This applies to both right and left springs). See Fig. 3D-6.

2. Seat bottom of spring on rear axle.

3. Raise rear axle, being careful to engage axle in upper control arms and install pivot bolts. Tighten nuts securing control arm to rear axle to 75 foot-pounds.

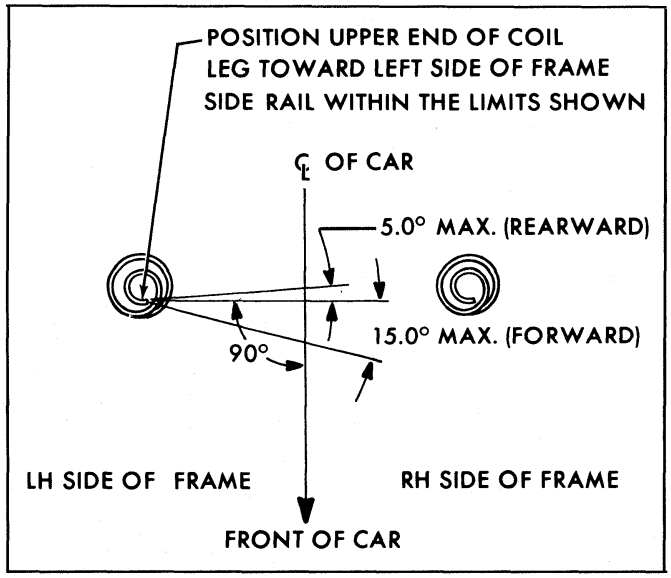


Fig. 3D-6 Coil Indexing (C-Car)

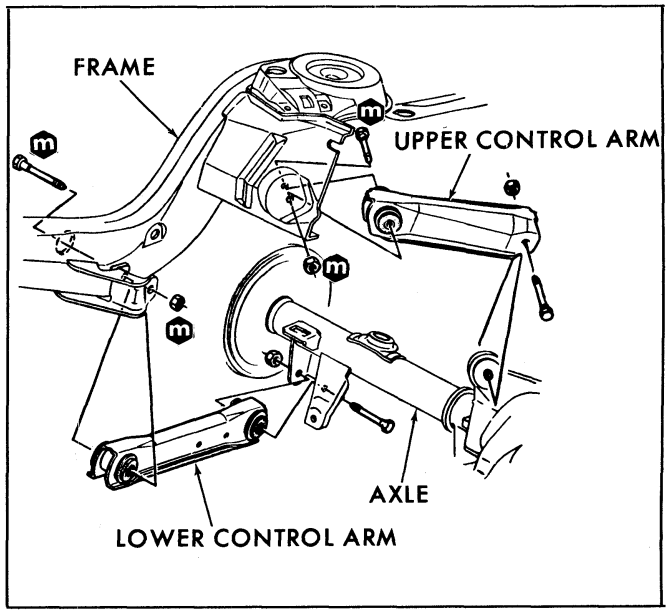


Fig. 3D-7 Rear Upper and Lower Control Arms

4. Install cable in clip at center of rear crossmember and connect cable to "C" connector.

5. Slide cable through hole and connect left hand parking brake cable to equalizer and install clips. Refer to Section 5 for parking brake adjustment.

6. Place jack stand under nose carrier.

7. Remove wire from drive shaft and connect shaft to pinion flange.

8. Install lower control arm to axle bolts and tighten to 122 foot-pounds.

9. If equipped with Automatic Level Control, connect link to leveling valve arm.

10. Install one bolt securing junction block to top of differential and secure brake lines in clips on axle.

11. If equipped with Automatic Level Control, position stabilizer bar on car and install two bolts and washers each side of car securing stabilizer bar to lower control arms. Tighten bolts to 55 foot-pounds.

CAUTION: *See "CAUTION" on page 3D-2 of this section.*

12. Install shock absorbers as described on page 3D-1.

13. Remove supports under frame rails at rear of frame.

14. Remove jack stand from under nose carrier.

15. Lower car.

Rear Lower Control Arm (Fig. 3D-7) C-Car

CAUTION: *If both control arms are to be replaced, remove and replace one control arm at a time to prevent the axle from rolling or slipping sideways as this might occur with both lower control arms removed, making replacement difficult.*

CAUTION: *Be careful not to damage brake piping on axle housing throughout this procedure.*

a. Removal

1. Raise rear end of car.

2. If equipped with Automatic Level Control, remove two bolts and washers securing stabilizer bar to the lower control arm which is being removed.

3. Remove front and rear lower control arm nuts.

4. Place jack under front of differential to relieve tension on lower control arm bolts.

5. Remove front and rear lower control arm bolts and remove arm. (Neither front or rear bushing in the lower control arms are serviceable).

b. Installation

1. Slide lower control arm into position with the slotted hole in top of arm toward rear of car; flanged ends of bushings must face right side of car. Install front bolt from outboard side, and rear bolt from inboard side. Adjust jack under front of differential as necessary to install bolts.

2. Lower car.

3. Install front and rear lower control arm nuts, tightening control arm to frame nuts to 110N·m (80 foot-pounds) and control arm to rear axle nuts to 122 foot-pounds.

CAUTION: *See "CAUTION" on page 3D-2 of this section.*

CAUTION: *Pivot bolts in control arms must always be torqued when full normal load is applied to axle. If not, the ride rate may be adversely affected.*

Rear Upper Control Arm (Fig. 3D-7) C-Car

CAUTION: *If both control arms are to be replaced, remove and replace one control arm at a time to prevent the axle from rolling or slipping sideways as this might occur with both upper control arms removed, making replacement difficult.*

a. Removal

1. Raise rear end of car.

2. If car is equipped with Automatic Level Control, remove attaching nut that secures height control valve link to right upper control arm. Position overtravel lever in center position.

3. Place jack stand under differential pinion retainer.

4. Remove both front and rear mounting nuts from control arm bolts.

5. Remove both control arm pivot bolts and remove control arm. (Neither front or rear bushings in the upper control arms are serviceable).

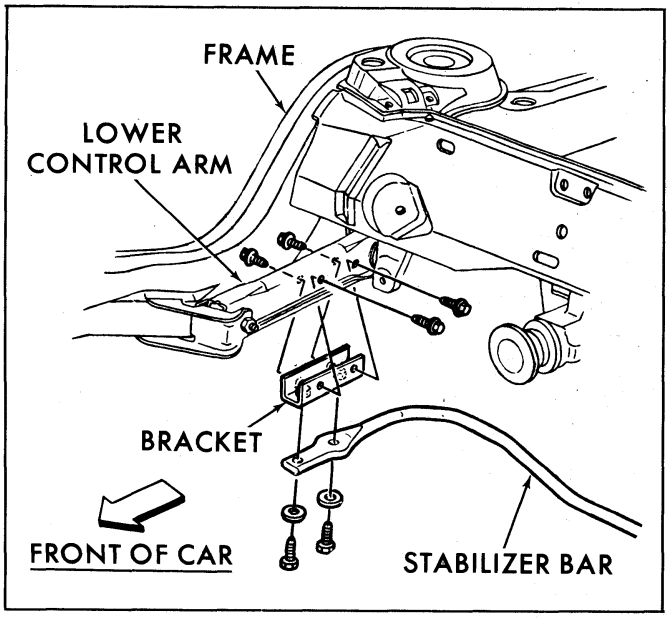


Fig. 3D-8 Rear Stabilizer Bar (C-Car)

b. Installation

1. Install control arm with flanged surfaces of bushings inboard.
2. Loosely install front pivot bolt and nut.
3. Loosely install rear pivot bolt and nut in axle bracket.
4. Lower car.
5. Tighten control arm to frame nuts to 115 N·m (85 foot-pounds) and control arm to rear axle nuts to 75 foot-pounds.

CAUTION: *See "CAUTION" on page 3D-2 of this section.*

CAUTION: *Pivot bolts in control arms must always be torqued with curb vehicle weight applied to axle. If not, the ride rate may be adversely affected.*

6. If car is equipped with Automatic Level Control, secure link to right upper control arm with attaching nut. Inflate reservoir to 965 kPa (140 psi) or maximum pressure available through compressor service valve.

Rear Stabilizer Bar - ALC Only (Fig. 3D-8) C-Car

a. Removal

1. Raise car on a frame or drive-on hoist.
2. Remove two bolts and washers securing stabilizer bar to bracket on lower control arm.
3. Repeat step two on other side of car and remove stabilizer bar.

b. Installation

1. Position stabilizer bar on car and install two bolts and washers securing stabilizer bar to lower control arm.
2. Repeat step one on other side of car and tighten fasteners to 55 foot-pounds.

CAUTION: *See "CAUTION" on page 3D-2 of this section.*

3. Lower car.

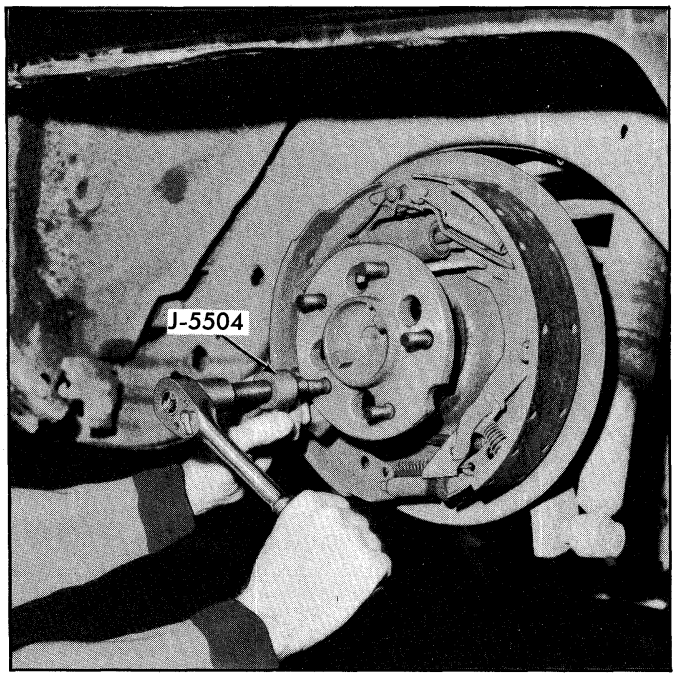


Fig. 3D-9 Removing Wheel Stud

Rear Wheel Stud Replacement (C-Car and Seville)

a. Removal

NOTE: Optional tool J-22292-1 may be used for this application. Either tool must be modified by cutting 6mm (1/4") off the end of each leg.

1. Remove rear wheel disc.
2. Loosen wheel mounting nuts.
3. Raise rear end of car.
4. Remove wheel mounting nuts and remove wheel.
5. Remove push nut securing brake drum to axle shaft flange.

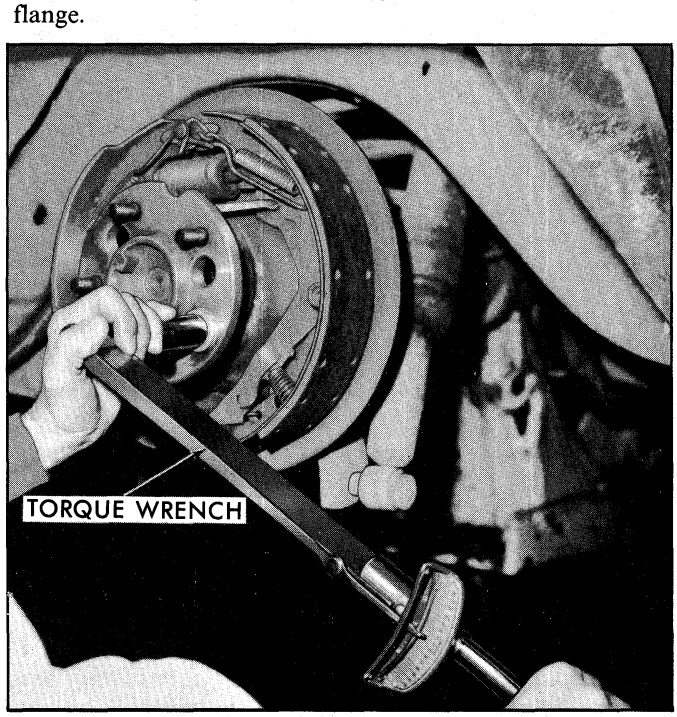


Fig. 3D-10 Installing Wheel Stud

6. Remove brake drum.

7. Install tool J-5504 on damaged stud and press stud from axle shaft flange, Fig. 3D-9.

b. Installation

CAUTION: *See "CAUTION" on page 3D-2 of this section regarding the fasteners referred to in Steps 3, 8, and 10.*

1. Insert new stud from back side of axle shaft flange.

2. Install two flat washers on stud and wheel nut, flat side toward washers, and tighten nut with fingers.

3. Torque nut to 120 foot-pounds, Fig. 3D-10.

4. Remove nut and washers from stud and discard.

5. Visually check stud threads. Inspect stud to make certain the head is properly seated on inside of axle shaft flange.

6. Install brake drum.

7. Install wheel and secure with five wheel mounting nuts.

8. Lower car, and tighten wheel mounting nuts to 100 foot-pounds.

CAUTION: *See "CAUTION" on page 3D-2 of this section.*

9. Drive car around several blocks making left and right turns.

10. Re-torque wheel mounting nuts to 100 foot-pounds.

11. Install wheel disc.

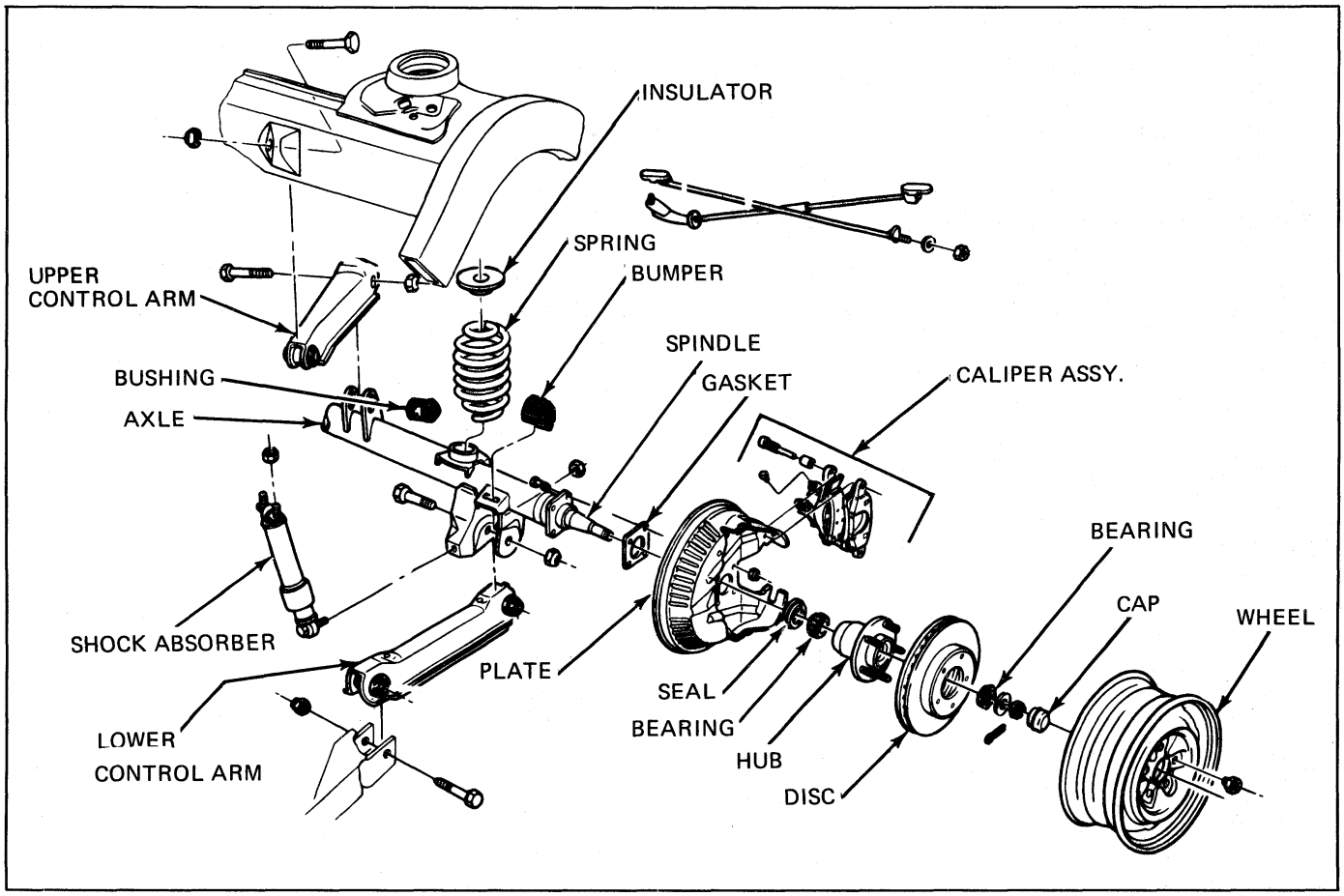


Fig. 3D-11 Rear Suspension Disassembled (Eldorado)

ELDORADO REAR SUSPENSION

NOTE: The following information is applicable only to the Eldorado. All other descriptions, service procedures and recommendations for the Eldorado are the same as those for other cars as given in the first part of this section.

A four link, coil spring rear suspension system is used on Eldorado series cars, Fig. 3D-11. It consists of two upper and lower control arms, coil springs, stabilizer bar, and Automatic Level Control shock absorbers.

Automatic Level Control is provided as standard equipment on the Eldorado and functions the same as on other series cars. The height control valve is located on the right side of the frame crossmember above the right upper control arm. Consequently, the right shock absorber has a double port, Fig. 3D-23.

Rear Upper Control Arm (Fig. 3D-12)

a. Removal

1. Raise car on hoist and position jack stands at rear frame side members. Car is now supported at both frame and rear axle.

2. Disconnect Automatic Level Control system overtravel link at right upper control arm axle bracket and place overtravel lever at its centered position.

3. Disconnect shock absorber at its lower mount and position out of way.

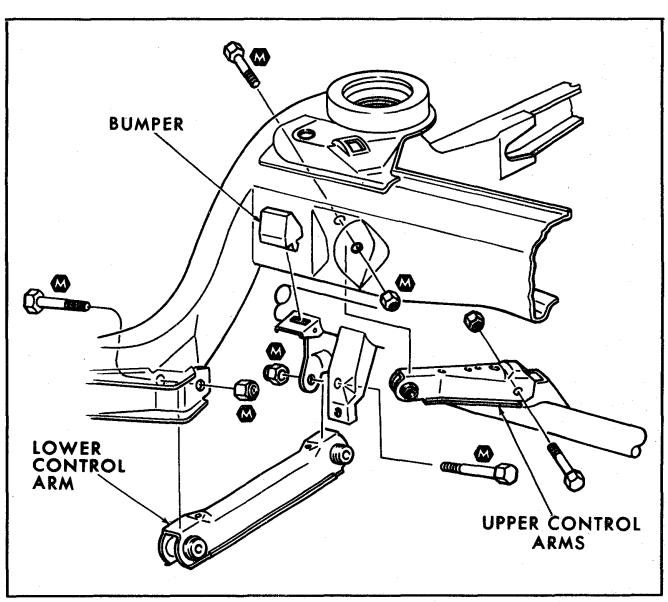


Fig. 3D-12 Upper and Lower Control Arms (Eldorado)

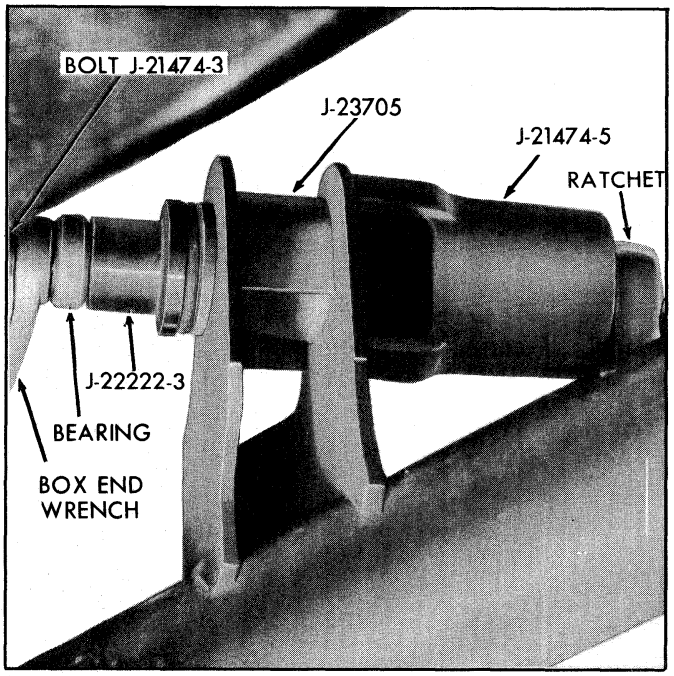


Fig. 3D-13 Removing Upper Control Arm Bushing from Axle (Eldorado)

4. Raise axle on hoist to relieve tension on upper control arm.

5. Remove bolt and nut securing upper control arm to rear axle bracket.

6. Remove bolt and nut securing upper control arm to frame crossmember and remove arm.

b. Installation

1. Install control arm in its mounting brackets.

2. Loosely install bolts and nuts securing control arm in mounting brackets, adjusting height of axle as necessary. Do not torque bolts at this time.

3. Guide shock absorber lower stem into lower mount, adjusting height of axle if necessary, and secure with retaining nut. Tighten to 50 foot-pounds.

4. Raise axle and remove jack stands.

NOTE: When tightening nut and holding bolt, a lower torque is used than when tightening bolt and holding nut.

5. Torque upper control arm bolts while holding nuts, at frame crossmember to 190 N·m (142 foot-pounds) and torque upper control arm bolts at axle bracket to 110 foot-pounds.

CAUTION: *See "CAUTION" on page 3D-2 of this section.*

CAUTION: *Pivot bolts in control arms must be torqued when full normal load is on axle. If not, the ride rate may be adversely affected.*

6. Secure Automatic Level Control overtravel lever to right upper control arm bracket with nut. Lower car. Inflate reservoir to 965 kPa (140 psi) or maximum pressure available through service valve.

7. Inspect brake hose and lines for any damage that may have occurred during this operation, and repair as necessary.

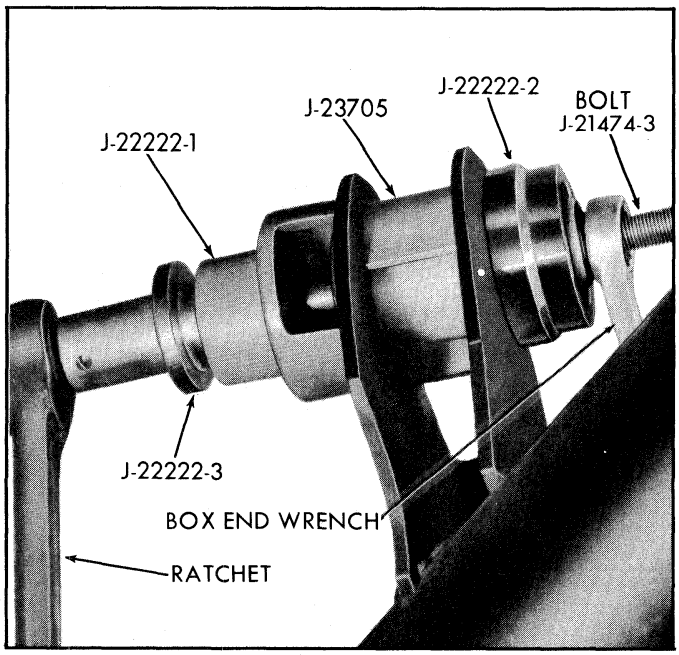


Fig. 3D-14 Installing Upper Control Arm Bushing in Axle (Eldorado)

Rear Upper Control Arm Bushing

Only the rear upper control arm rear bushings (those pressed into the axle bracket) are serviced separately. All other bushings in the Eldorado rear suspension are serviced only with their respective control arms, as assemblies.

a. Removal

1. Remove rear upper control arm as described on page 3D-8.

2. Move control arm away from bushing.

3. Install tools as shown in Fig. 3D-13 and press bushing from axle bracket.

b. Installation

1. Insert bushing into axle bracket with flanged side on outboard side of bracket.

2. Install tools as shown in Fig. 3D-14, and press bushing into axle bracket.

3. Install upper control arm as described in column 1 on this page.

4. Lower car.

Lower Control Arm (Fig. 3D-12)

a. Removal

1. Raise car on hoist.

2. Remove bolts and nuts securing lower control arm to axle and frame side member brackets and remove control arm.

b. Installation

1. Position lower control arm in frame side member and axle brackets and insert bolts and nuts. Do not torque at this time.

2. Inspect brake lines and hose for any damage that may have occurred during this operation, and repair as required.

3. Lower car.

4. Tighten control arm bolts to 190 N·m (142 foot-pounds) while holding nuts stationary.

CAUTION: *See "CAUTION" on page 3D-2 of this section.*

CAUTION: *Pivot bolts in control arms must be*

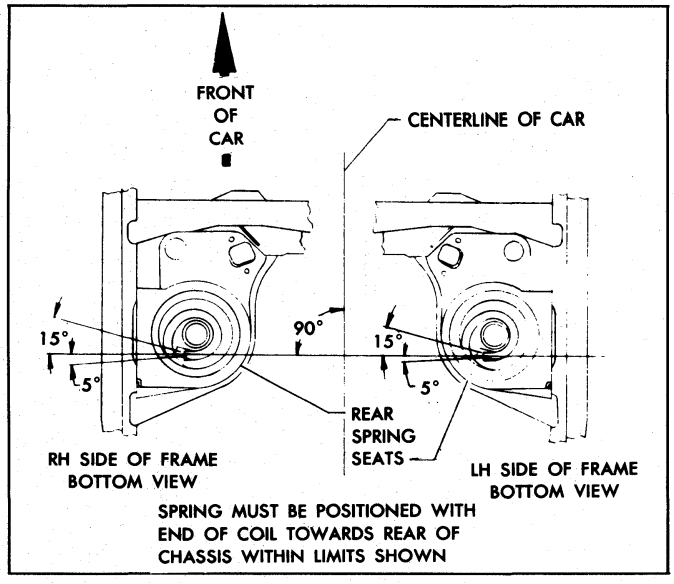


Fig. 3D-15 Coil Spring Indexing (Eldorado)

torqued when axle is under normal load. If not, the ride rate may be adversely affected.

Rear Springs

a. Standing Height

Rear standing heights should be equal within 13mm (1/2 inch) from side to side (see Fig. 3A-13). If rear height is out of specified range, set front standing height to mean specification and recheck rear heights. Spring that checks below specification must be replaced.

b. Removal

1. Perform procedure on page 3D-8 to remove both rear upper control arms from axle brackets and page 3D-3 to remove both shock absorbers from their lower mounts.
2. Disconnect brake hose and cap brake system to minimize leakage.
3. Lower axle carefully until springs can be removed manually.

WARNING: IF AXLE IS LOWERED BEYOND FULL REBOUND POSITION, SPRINGS MAY SNAP FROM SPRING SEATS AND CAUSE INJURY OR DAMAGE. FOR THIS REASON, LOWER AXLE TO A POSITION JUST SHORT OF FULL REBOUND, THEN COMPRESS SPRING BY HAND AND REMOVE FROM SPRING SEATS.

c. Installation

1. Inspect rubber insulator in upper spring mounts for damage and proper position.
2. Insert springs and raise axle until springs are fully seated, and upper end of springs positioned within limits shown in Fig. 3D-15.
3. Install upper control arms, shock absorbers, and connect Automatic Level Control, as described on pages 3D-8 and 3D-3.
4. Connect brake hose and bleed brakes as described on page 5-9.

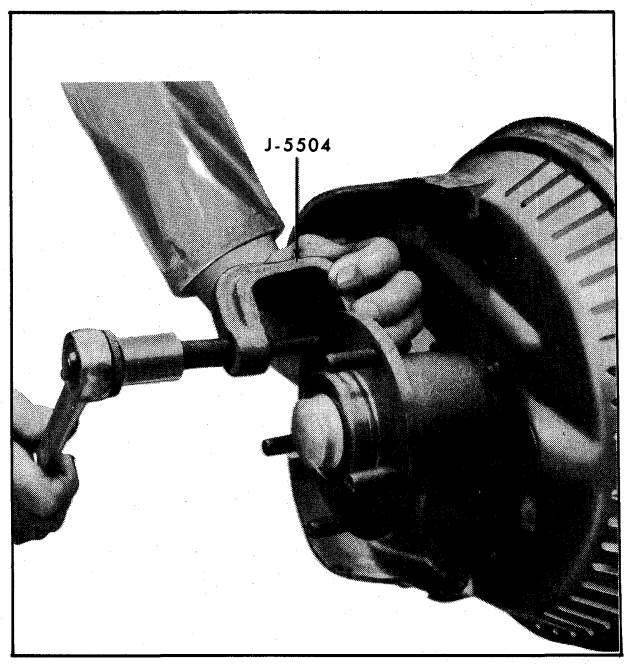


Fig. 3D-16 Removing Stud (Drum Typical of Rear Disc)

Rear Wheel Stud Replacement Test-On Car

a. Removal

1. Remove wheel disc and loosen wheel mounting nuts.
2. Raise rear end of car.

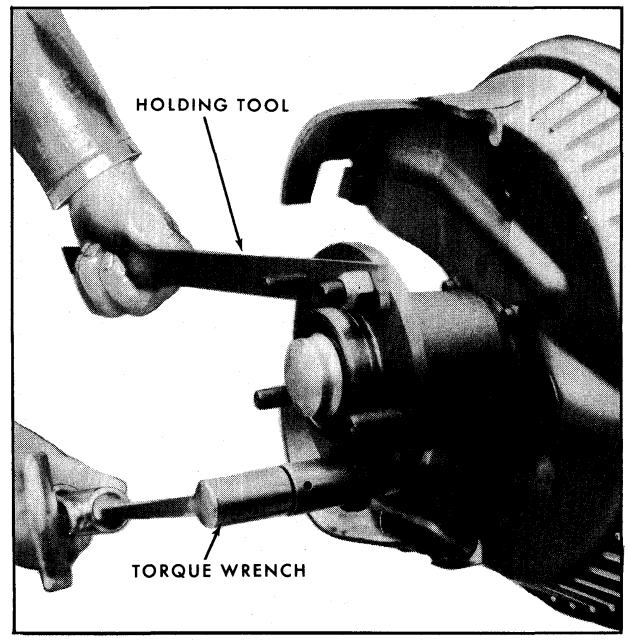


Fig. 3D-17 Installing Stud (Drum Typical of Rear Disc)

3. Remove wheel and tire assembly and brake drum.

4. Install tool J-5504 on damaged stud and press stud from hub, Fig. 3D-16.

NOTE: Optional tool J-22292-1 may be used for this application. Either tool must be modified by cutting 6mm (1/4 in.) off the end of each leg.

b. Installation

1. Install a new stud, Fig. 3D-17 from back side of hub.

2. Install two flat washers on stud and wheel nut, flat side toward washers, and tighten nut with fingers.

3. Torque nut to 140 foot-pounds.

4. Remove nut and washers from stud and discard.

5. Visually check stud threads and stud to make certain they are properly seated on inside of hub.

6. Install rear brake drum.

7. Position wheel assembly on hub, installing wheel mounting nuts finger tight.

8. Lower car.

9. Tighten wheel mounting nuts to 130 foot-pounds.

CAUTION: *See "CAUTION" on page 3D-2 of this section.*

10. Drive car around several blocks making left hand and right hand turns.

11. Re-torque wheel mounting nuts to 130 foot-pounds.

12. Install wheel disc.

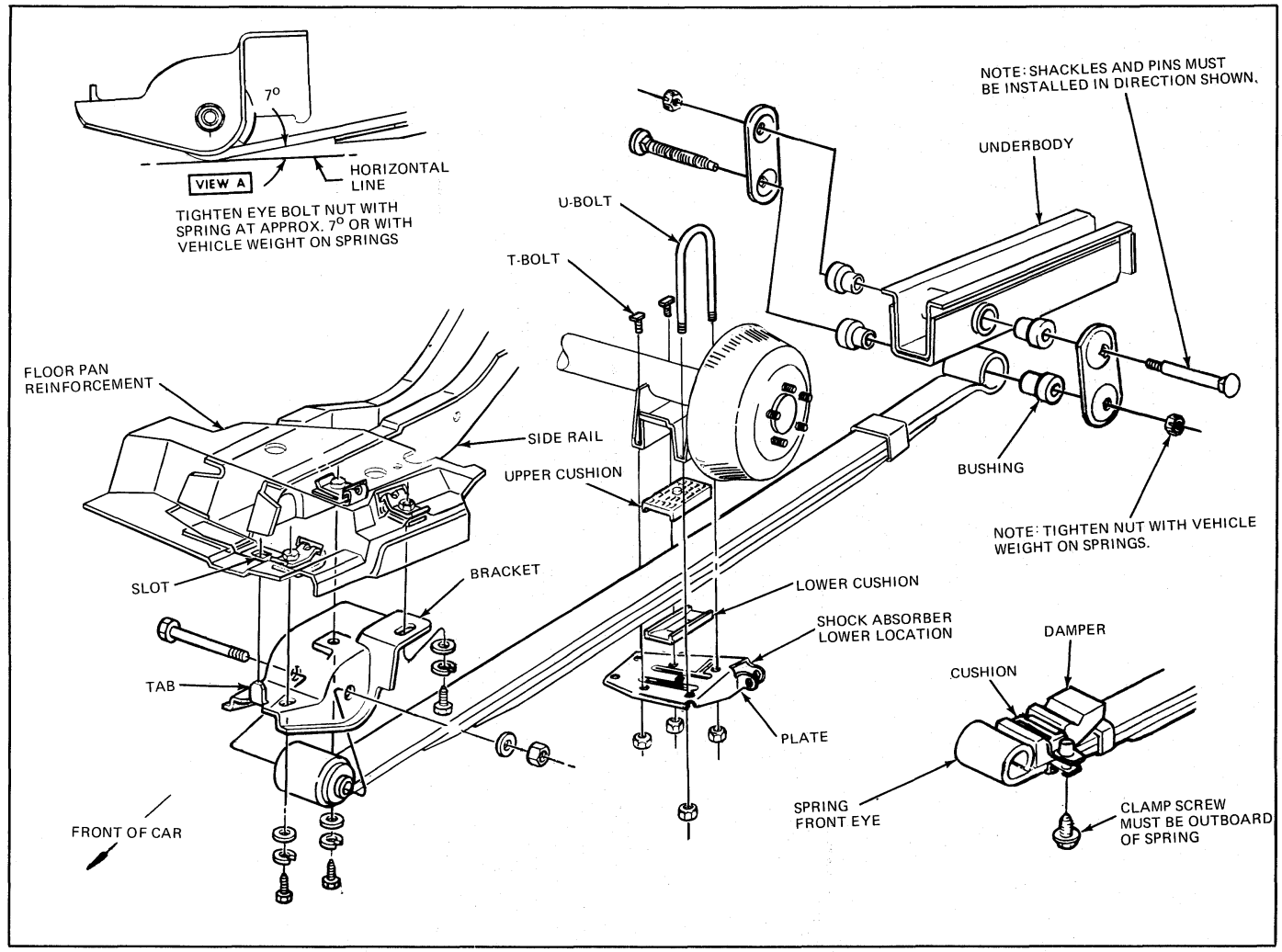


Fig. 3D-18 Rear Suspension Disassembled (Seville)

SEVILLE REAR SUSPENSION

NOTE: The following information is applicable only to the Seville.

The rear suspension consists of semi-elliptical multi-leaf springs and Superlift shock absorbers, Fig. 3D-18.

The rear axle assembly is attached to the springs with 2 "U" bolts and 4 "T" bolts. The spring front eyes are attached to the underbody at the front hangers, through rubber bushings. The rear ends of the springs are attached to the underbody by the use of rubber bushed shackles which allow the spring to "change its length" while the vehicle is in motion.

Direct double-acting Superlift shock absorbers are attached to the underbody with two bolts at the top and a bolt and nut to the leaf-spring lower mounting bracket at the bottom. The right hand shock absorber is mounted ahead of the axle tube while the left hand is mounted behind.

Rear Leaf Spring -Right or Left (Fig. 3D-18)

a. Removal

1. Raise car on hoist.
2. Support car so axle can be raised or lowered.
3. Raise axle assembly so that all tension is removed from spring.
4. Disconnect rear leveling valve overtravel lever from link.
5. Hold lever down in exhaust position to deflate shock absorbers.
6. Remove lower shock absorber nut and bolt and position shock absorber out of way.
7. Loosen parking brake adjustment at equalizer and remove parking brake cable clip out of spring front retaining bracket, and remove cable clamps from bottom side of springs.
8. Loosen spring front eye bushing to retaining bracket bolt.
9. Remove screws securing spring front bracket to underbody.
10. Lower axle assembly sufficiently to permit access to spring front eye bolt and remove bracket from spring.

NOTE: Spring front eye bushing can be replaced without completely removing spring from car.

11. Remove "U" bolt and "T" bolt nuts securing lower spring plate to axle and stabilizer bar brackets.
12. Remove upper and lower rubber spring pads and spring plate.

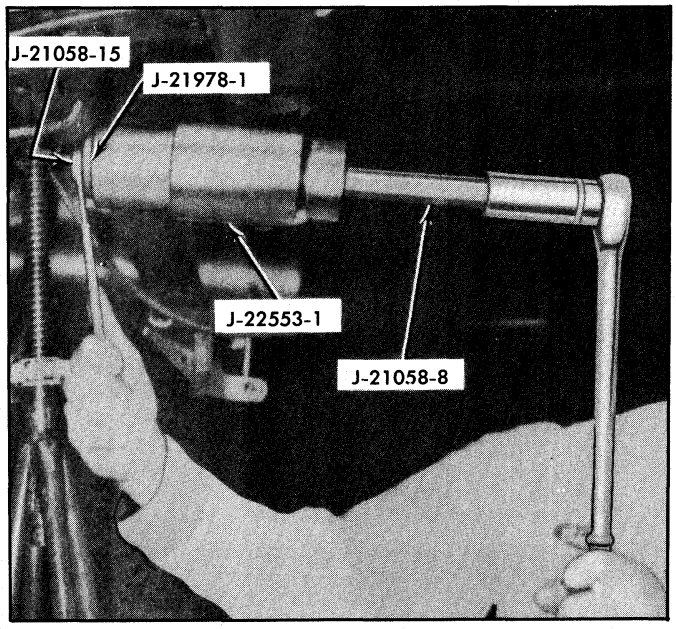


Fig. 3D-19 Removing Spring Front Bushing (Seville)

13. Support spring with jack stand and remove both nuts from rear shackle.

14. Separate shackle and remove spring from car.

NOTE: If spring is being replaced, remove spring damper for installation on replacement spring, as outlined in column 2 on this page.

b. Installation

NOTE: After spring is completely installed, torque bolts and nuts to specifications given in each individual step.

CAUTION: *See "CAUTION" on page 3D-2 of the section regarding the fasteners referred to in Steps 1,2,3,5,7,8 and 9.*

1. Position spring front mounting bracket to spring front eye. Spring attaching bolt must be installed so that head of bolt is toward center of car. Torque is 105 foot-pounds.

NOTE: Make sure 3/16" flat washer is used under prevailing torque nut.

2. Position spring shackle upper bushings in frame. Position shackles to bushings and loosely install bolt and nut. Torque is 50 foot-pounds.

3. Install bushing halves in spring rear eye, position spring in shackles and loosely install shackle lower bolt and nut. Torque is 50 foot-pounds

4. Raise front end of spring and position bracket to underbody. Guide spring into position so that it will index in the axle bracket and also make sure that tab on spring bracket is indexed in slot provided in underbody.

5. Loosely install screws securing spring front bracket to underbody. Torque is 30 foot-pounds.

6. Position spring upper cushion between spring and axle bracket so that spring cushion ribs align with axle bracket locating ribs.

7. Place lower mounting plate over locating dowel on spring lower pad and loosely install retaining nuts. Torque is 45 foot-pounds.

8. Position stabilizer bar brackets to lower spring plate and install bolts and nuts. Torque is 30 foot-pounds.

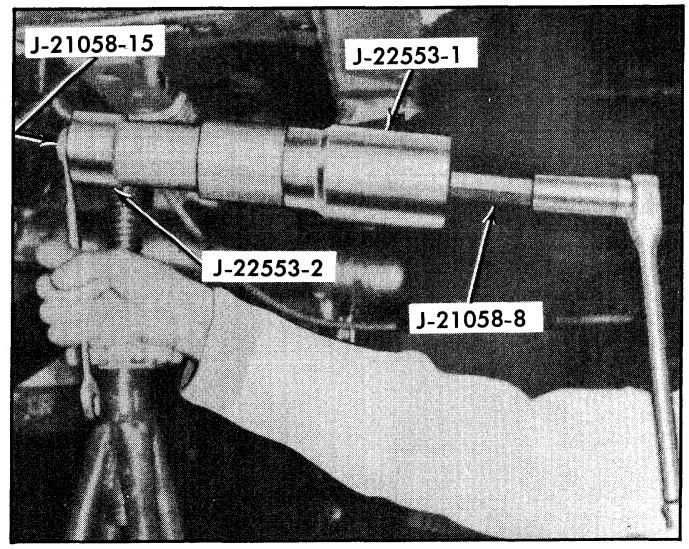


Fig. 3D-20 Installing Spring Front Bushing (Seville)

9. Position shock absorber lower mounts in lower spring bracket and secure with bolt and nut. Torque is 45 foot-pounds.

10. Route parking brake cable under leaf spring and secure to front of spring with wier retainer. Replace clamp to secure cable to underside of leaf spring.

11. Check parking brake adjustment and correct if necessary as outlined on pages 5-36 and 5-37.

12. Hold rear leveling valve overtravel lever in UP position to inflate shock absorbers.

13. Connect overtravel lever to link.

14. Install spring damper, if removed, as outlined below.

NOTE: At this time torque bolts and nuts to specifications.

15. Lower car and remove from hoist.

Rear Spring Damper

NOTE: Damper is used to quiet axle "drive" noise. It normally does not help axle "coast" noise.

a. Removal

1. Raise car on hoist.

2. Remove 5/16" clamp bolt and bend bottom half of clamp down about two inches.

3. Slide clamp rearward over damper and remove damper from spring.

b. Installation

1. Position damper on spring as shown in Fig. 3D-18. The damper must be 1/8" away from the spring front eye.

2. With clamp open, slide clamp forward over damper and place clamp at the second leaf of the spring.

NOTE: Clamp nut must face upward and nut must be on outboard side of spring.

3. With damper and clamp properly positioned, install clamp bolt pointing upward. Torque bolt to 20 foot-pounds.

4. Lower car to floor.

Rear Spring Front Bushing

a. Removal

NOTE: Partially remove spring as necessary to

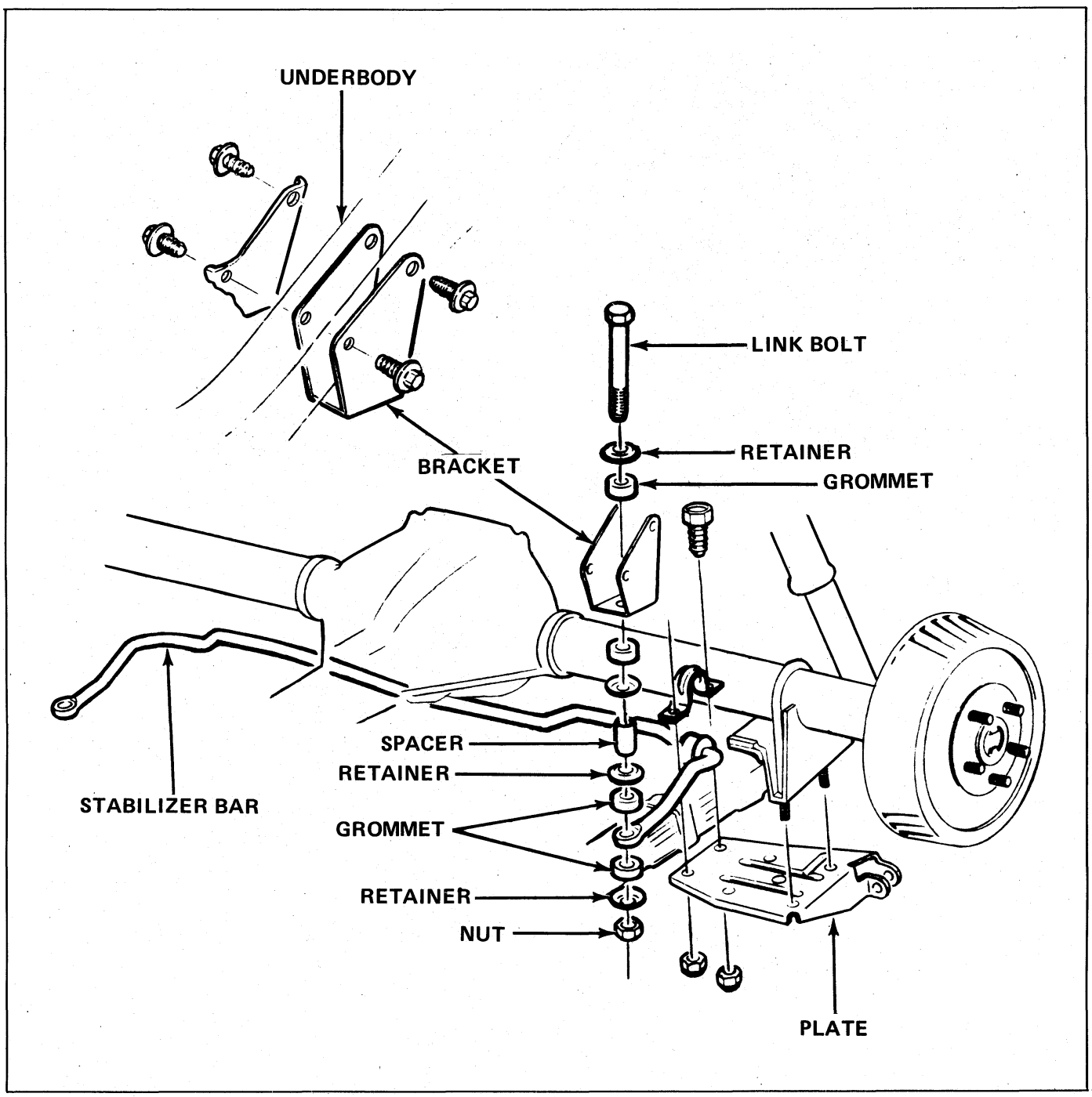


Fig. 3D-21 Rear Stabilizer Bar (Seville)

accommodate tools, page 3D-12. Damper may have to be moved rearward.

1. Position remover adapter J-21978-1 over puller screw J-21058-15 so that adapter is against head of puller screw, Fig. 3D-19.

2. Position puller screw through eye of bushing so that remover adapter J-21978-1 is against unflanged side of bushing.

3. Position large end of barrel J-22553-1 over puller screw and seat barrel against spring eye.

4. Position thrust bearing on puller screw; then install and tighten nut J-21058-8 against thrust bearing.

5. Check to make sure that all puller parts are properly aligned; then proceed to tighten nut until bushing is pulled free of spring eye - disassembly puller tool.

b. Installation

1. Position installer adapter J-22553-2 over flange end of bushing; then position puller screw J-21058-15 through installer adapter and bushing, Fig. 3D-20.

2. Position puller screw through spring eye until bushing contacts spring. Install small end of barrel J-22553-1 over puller screw and seat barrel against spring.

3. Install thrust bearing and nut J-21058-8. Check puller

tools and bushing for proper alignment; then tighten nut to pull bushing into spring.

NOTE: Do not apply additional torque to nut J-21058-8 after bushing flange contacts spring. Unnecessary torque applied after flange is seated will tend to distort flange and reposition bushing in spring.

4. Disassemble bushing installation tools and remove from spring.

5. Reinstall spring as necessary, as outlined on page 3D-13.

Rear Spring Tip Liners

Replacement rear spring tip liners are available for installation between the spring leaves when original liners wear at the outer ends.

To install these replacement tip liners, it is necessary to use a hardwood wedge 63mm (2-1/2 inches) wide, 127mm (5 inches) long, and tapered from 3mm to 19mm thick (1/8 inch to 3/4 inch) thick in 51mm (2 inches) of length. Proceed as follows:

1. Remove spring damper as outlined on page 3D-13.

2. Raise car on hoist and remove spring rebound clip nearest to tip liner being replaced.

3. Raise rear of car until springs are in full rebound position.

4. Insert hardwood wedge between leaves, along side of tip liner being replaced.

5. Drive wedge in just far enough to remove tip liner and remove liner.

CAUTION: *It is necessary to protect the spring leaf because a small nick in the leaf from a steel wedge could cause a point of fatigue that might result in spring replacement. Use a hardwood wedge whenever possible.*

6. Install new tip liner flat side up, and snap in place. Work out wedge keeping tip liner in position.

7. Raise axle fully so weight of car is on rear springs.

8. Position new spring rebound clip over spring and clamp in place horizontally with "C" clamp.

9. Using small hammer, bend new clip into position on spring, bending locking tang over through end of clip to secure in position.

10. Install spring damper as outlined on page 3D-13.

11. Lower car to floor.

Rear Stabilizer Bar (Fig. 3D-21)

a. Removal

1. Raise car on hoist.

2. Remove nuts and bolts securing stabilizer bushings and brackets to lower spring plates.

3. Remove link nuts from link bolts and remove washers and grommets.

4. Remove stabilizer bar from car and bushings and brackets from bar.

b. Installation

1. Install bushings (slit facing forward) on stabilizer bar and position bar on car with "U" shaped section down and rearward in installed position.

2. Place mounting brackets over bushings and position on lower spring plates.

3. Loosely install bolts and nuts.

4. With stabilizer bar eye ends over link bolts, position bushings and washers and loosely install retaining nuts.

5. Torque mounting bracket nuts to 30 foot-pounds and lower car.

6. Place weight of car on wheels and torque link nuts to 150 inch-pounds. (Run nut to last thread, approximately 25mm (1") of thread showing beyond nut).

NOTE: After nut is tightened, cut bolt off 6mm (1/4") maximum from nut.

AUTOMATIC LEVEL CONTROL

GENERAL DESCRIPTION

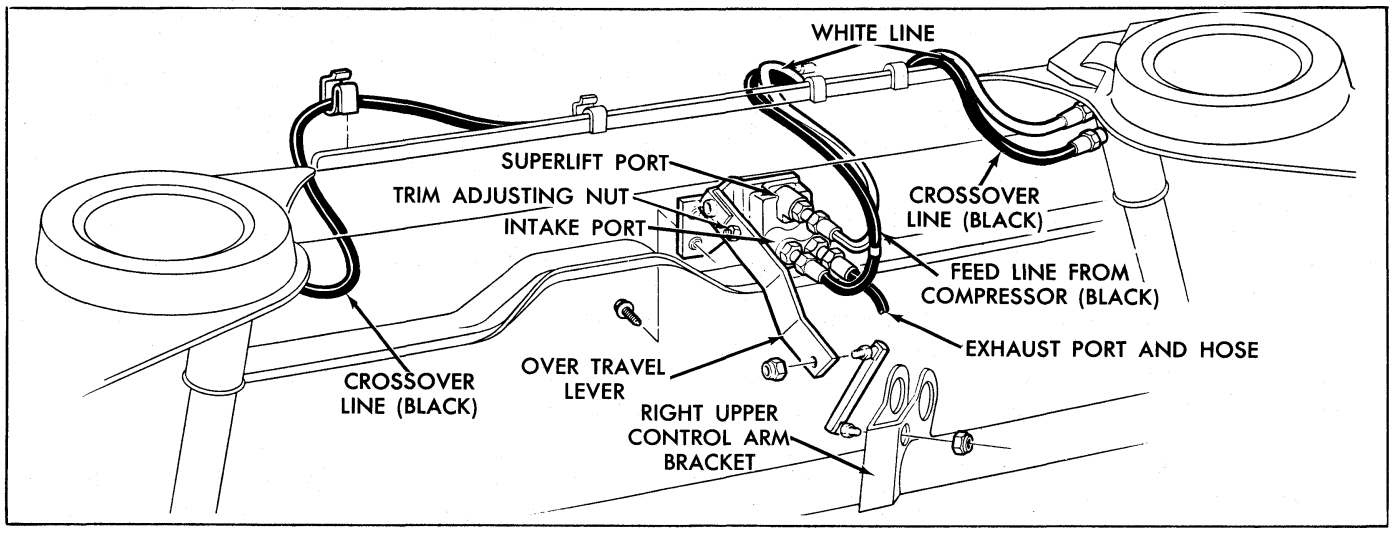


Fig. 3D-22 Typical Location of ALC Components (Eldorado)

System

Automatic Level Control (ALC) is provided as standard equipment on the Eldorado, Seville, Fleetwood Brougham, Fleetwood Limousine, and the Commercial Chassis, and is optional on DeVilles. The system consists of an air compressor and tank assembly, pressure regulator, control valve and link, two superlift rear shock absorbers, and flexible air lines.

After completion of work on this system, or when servicing other parts of the car requiring system discharge, recharge the reservoir to 965 kPa (140 psi) or maximum pressure available, by applying dry air through the compressor service valve located on the pressure regulator.

CAUTION: *It is essential that no oil is fed into system. Do not use an air source that utilizes an oil mist for lubrication as it may contaminate the system.*

Compressor and Reservoir

The compressor operates on the difference between (1) engine manifold vacuum, supplied to the compressor by a line, and (2) a high pressure air at or near atmospheric pressure, available through an air supply line at the air cleaner.

Balance pressure will depend upon the prevailing manifold vacuum at the carburetor insulator and prevailing atmospheric pressure. Both are affected by altitude above or below sea level. Balance pressure will vary from approximately 1034 kPa to 1896 kPa (150 psi to 275 psi).

Pressure Regulator

A pressure regulator is attached to the output side of the reservoir. It regulates shock absorber pressure to approximately 862 kPa (125 psi).

Control Valve and Link

The rear standing height is automatically maintained at a nearly constant position by a control valve attached to the rear suspension crossmember (on Seville, to the underbody, just to the left side of car centerline).

On all styles except the Eldorado and Seville, the attaching point is on the right rear upper control arm. On the Eldorado, the link attaches to the right rear upper control arm axle bracket; and the right superlift, rather than the left, has a double port, Fig. 3D-22. On Seville, the link attaches to the axle assembly.

Superlift Rear Shock Absorber (Fig. 3D-23)

The superlift shock absorber is essentially a conventional shock absorber enclosed in an air chamber. A pliable nylon reinforced neoprene boot seals the dust tube (air dome) to the reservoir tube (air piston). The unit will extend when inflated

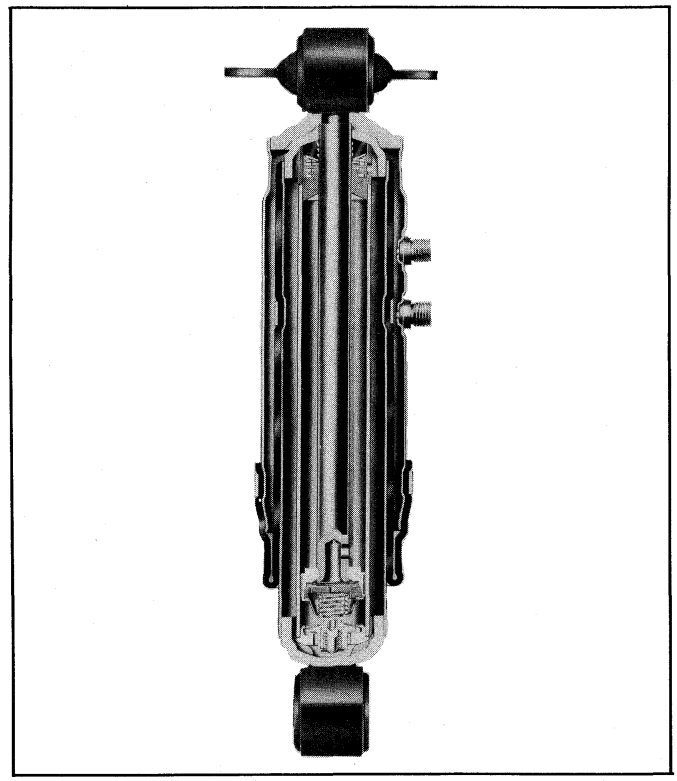


Fig. 3D-23 Rear Shock Absorber (ALC)

and retract when deflated by the control valve. The units are connected by a flexible air line which equalizes the air pressure in the two shock absorbers.

Lines and Fittings

Flexible air lines of 1/8 inch diameter tubing are used throughout the system. Each fitting consists of a rubber seal, metal sleeve, and nut. These parts are designed specifically for the 1/8 inch diameter line and must be used to effect a reliable seal.

Dealer Installation

As a dealer-installed option, the Automatic Level Control system may be installed either by retaining standard suspension springs or by changing to the optional spring, as the customer desires.

DIAGNOSIS

Quick Check of Automatic Level Control System

If check is performed when car is cold (-9°C/15°F or less), time delay may be as much as 30 seconds.

1. Measure rear standing height of empty car (measured from center of rear bumper to ground).
2. Add weight equivalent to two passenger load to rear of car. Car should begin to level in 4-18 seconds and final position should be within 19mm (3/4 inch) of dimension measured in Step 1. (If gas tank is nearly empty, a third passenger's weight may be needed). See Section 3A for compensating weights.
3. Remove weight. After 4-18 seconds car should begin to settle. Final unloaded position should be within approximately 13mm to 19mm (1/2 to 3/4 inch) of loaded measurement.

Compressor Output Test - On Car

1. Remove high pressure line at regulator adapter fitting and connect Test Gage, J-22124, Fig. 3D-24.
2. Inflate reservoir to 483kPa (70 psi) through service valve.
3. Observe Test Gage for evidence of compressor air leak.
4. If compressor is leaking, proceed to leak test compressor reservoir and regulator as described. If not leaking, continue this test.
5. With engine running at slow idle and reservoir pressure at 483 kPa (70 psi), observe reservoir build-up for five minutes. Reservoir pressure should build-up to a minimum of 689 kPa (100 psi) at 381mm (15 inch) vacuum. A minimum of 356mm (14 inches) of vacuum must be available, or test may not be reliable.

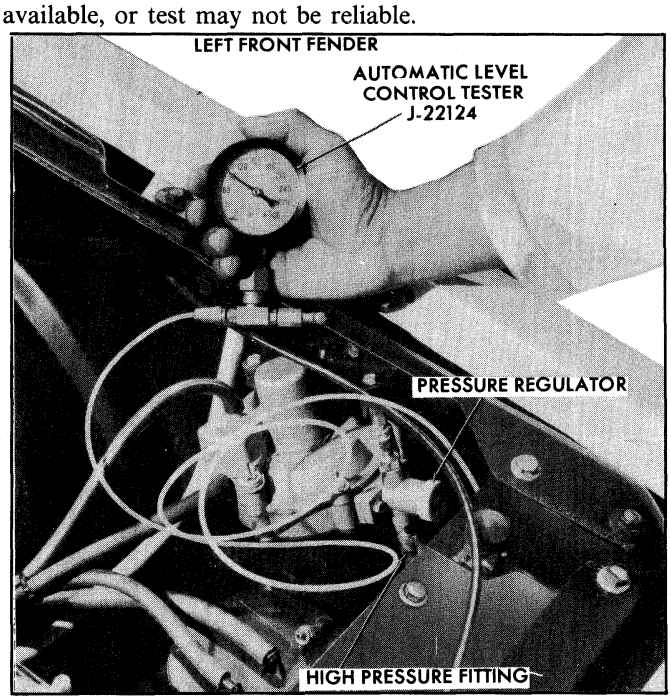


Fig. 3D-24 Testing Compressor Output

6. If compressor fails to cycle, make sure the vacuum and air intake lines are not reversed and are open and unobstructed before removing compressor for repair. Check for pinched or kinked vacuum hoses.
7. If build-up is too slow, and a recheck of vacuum and intake hoses show no restrictions, repair compressor as outlined on pages 3D-22 through 3D-26.
8. Satisfactory pressure build-up indicates compressor is functioning properly. Continue to build up pressure and perform regulator check as described.
9. If no leaks are detected and compressor and regulator functions properly, remove test gage. Install high pressure line and proceed to Control Valve Test, as described below.

Control Valve Test

If tests are performed when car is cold, (-9°C/15°F or less) time delay may be as much as 30 seconds.

a. Intake - Reservoir Pressure 862 kPa (125 psi) Minimum

1. Disconnect overtravel lever from link.
2. Hold lever up in intake position until shock absorbers inflate or for a minimum of 18 seconds.
3. If shock absorbers inflate and hold, proceed to Time Delay Check.
4. If shock absorbers inflate and then leak down, perform leak test on lines and fittings and then on shock absorbers, page 3D-20.
5. If shock absorbers inflate with the lever in the neutral position, perform leak check on valve.
6. If shock absorbers do not inflate, check air source. Also check and, if necessary, replace intake and shock absorber screens and O-rings. If shock absorbers still do not inflate, perform leak test on valve, page 3D-19 (b).

Repair as indicated and proceed to time-delay check.

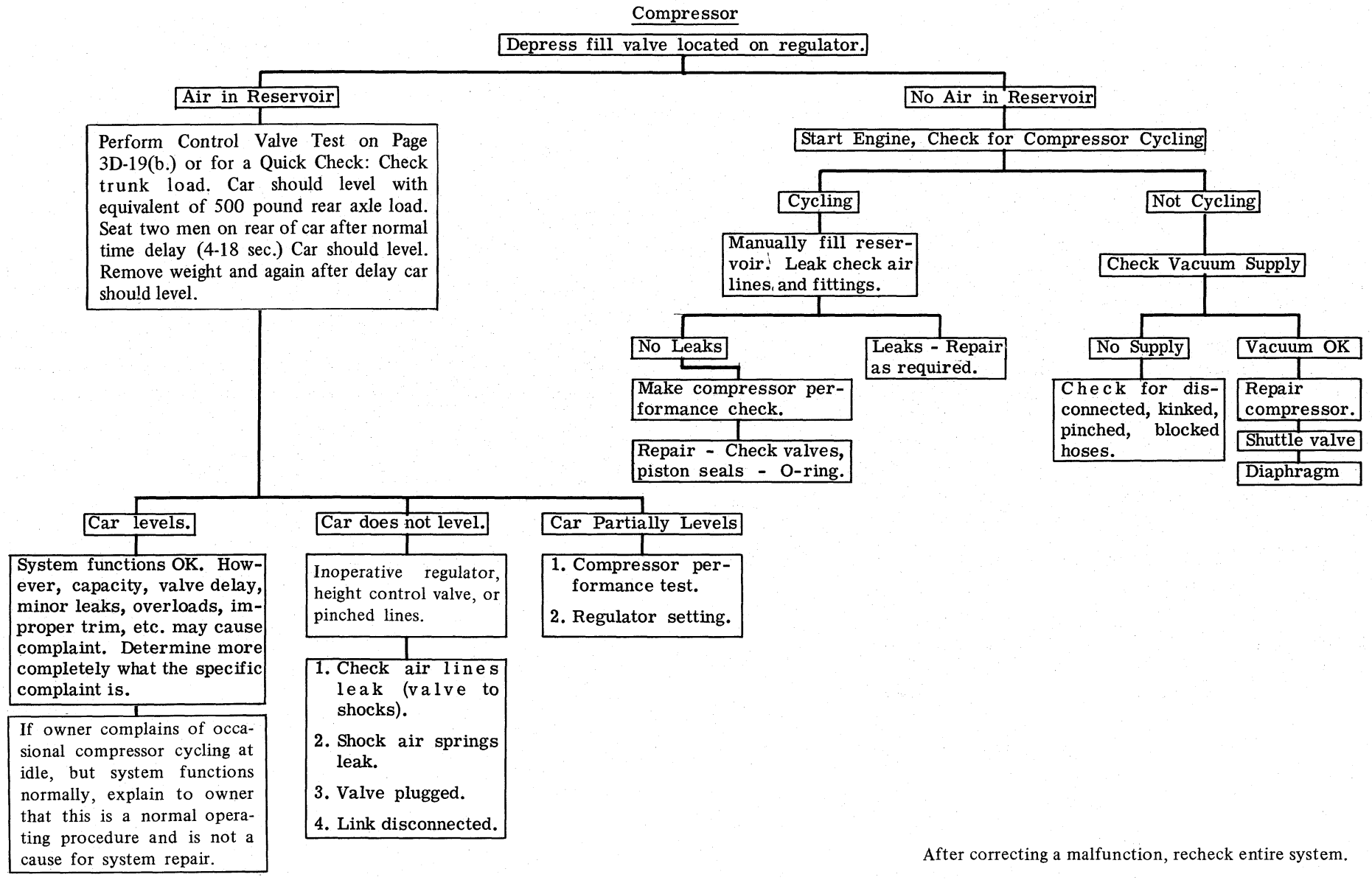
b. Exhaust - Shock Absorbers Inflated

1. Disconnect overtravel lever from link.
2. Hold lever down in exhaust position until shock absorbers deflate, or for a minimum of 18 seconds.
3. If shock absorbers deflate, perform Intake Check.
4. If shock absorbers do not deflate, remove exhaust adapter from control valve and hold lever down as in Step 2. Replace adapter, O-ring, and filter if this deflates shock absorbers.
5. If shock absorbers deflate with lever in neutral position, perform leak checks on lines and fittings. If continuous leakage appears at exhaust valve port, check control valve for leaks, page 3D-19 (b.).
6. Replace control valve if none of the above steps correct the condition.

c. Time Delay Check

1. Disconnect overtravel lever from link.
2. Disconnect lines at shock absorbers and intake ports.
3. Connect Test Gage J-22124, to intake valve port and open air pressure (655 kPa/95 psi). Move overtravel lever

DIAGNOSIS CHART
AUTOMATIC LEVEL CONTROL



After correcting a malfunction, recheck entire system.

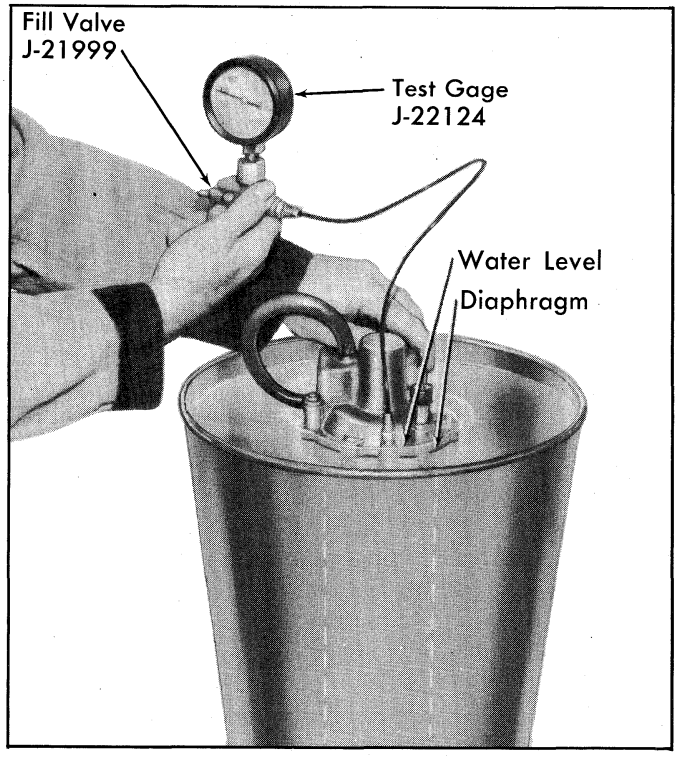


Fig. 3D-25 Checking Compressor for Leaks

approximately one inch down from neutral position as measured from end of lever, and hold for 15-20 seconds.

4. Quickly move overtravel lever upward two inches and note number of seconds before air starts to escape from shock absorber port. This delay should be from 4-18 seconds. Repeat check. This will check the air intake time delay. Proceed with check to determine air exhaust time delay.

5. Remove Test Gage and plug intake port with Fill Valve J-21999, (female end).

6. Connect Test Gage to shock absorber port and open air pressure (655 kPa/95 psi). Move overtravel lever approximately one inch up from neutral position as measured from end of lever, and hold for 15-20 seconds.

7. Quickly move overtravel lever downward two inches; at the same time begin timing number of seconds until air begins to escape from exhaust port. This delay should be 4-18 seconds. Repeat check.

If either delay is not within specification, replace the leveling control valve and proceed to Trim Adjustment On Car, page 3D-20.

Regulator Test

Performance test the regulator with a known good compressor on the car.

1. Deflate system through service valve, remove line at regulator and connect Test Gage, J-22124, at regulator adapter.

2. Inflate reservoir through service valve to maximum pressure available. If less than 965 kPa (140 psi), start engine to build up reservoir to this pressure.

3. Regulated pressure on the Test Gage should build up to 689 kPa - 896 kPa (100-130 psi) and hold steady within this pressure.

4. Recheck regulated pressure by momentarily depressing valve core on Test Gage and observe gage reading.

5. If regulated pressure exceeds 896 kPa (130 psi), replace regulator as a unit.

Leak Tests

a. Compressor, Reservoir, and Regulator

1. Remove assembly as described on page 3D-20 (page 3D-21 if Seville).

2. Connect Test Gage to regulator. Inflate reservoir through service valve to 552 - 758 kPa (90-110 psi).

3. Route an eight inch rubber hose between vacuum and vent ports, Fig. 3D-25.

4. While holding assembly in a vertical position with reservoir end down, immerse in water until the diaphragm is just submerged, Fig. 3D-25. Do not submerge completely, as water can enter around the cover gasket. Observe for air leaks at:

. Reservoir weld seam.

. Reservoir to compressor O-ring. A stream of bubbles are caused by atmospheric air being purged from air pockets in the second stage housing. If the bubbles stop in 20 seconds or less there is no leak.

. Regulator to compressor O-ring.

. Regulator boot - defective internal O-ring.

. Diaphragm between first and second stage housings - tightening through bolts may correct the leak.

. Service valve.

. Test gage connections.

5. Remove hose from vacuum port and submerge disconnected end in water. Cover vacuum port with finger. Do not permit water to enter through vacuum port. If bubbles are evident, the probable cause is a defective second stage housing check valve.

6. Correct any leaks by either tightening screws or replacing parts.

7. If the cover gasket area is inadvertently submerged, remove cover and tilt unit so that water may drain through openings by distributor valve mechanism. Move distributor valve from side to side until all water is purged. Dry both the distributor valve mechanism and the interior of the cover with compressed air. Replace cover.

If the compressor passes this test, yet fails the output test, overhaul the compressor, reservoir, and regulator assembly.

b. Control Valve

1. Remove control valve from car as described on page 3D-20.

2. Clean exterior of control valve thoroughly.

3. Connect Test Gage, J-22124, and air pressure source to intake adapter and open air pressure (552-758 kPa/80-110 psi).

4. Submerge unit in water. No air should escape if overtravel lever is in "neutral" position. If bubbles escape from shock absorber port, proceed to step 8.

5. Shut off air pressure and detach test gage from air intake port. Plug intake port with Fill Valve, J-21999, (female end).

6. Connect Test Gage to shock absorber port and open air pressure.

7. With overtravel lever in "neutral" position no air should escape. If bubbles escape from exhaust port, proceed to step 8.

8. If the intake valve or exhaust valve is leaking with the lever in the neutral position, remove the cover plate and clean out the valve body. Blow air through the intake and exhaust valves while actuating the valves with the lever arm, do not remove the valve cores as they are selected and calibrated in each valve.

9. Install gasket and cover plate and check for leaks. If the valve cores still leak, replace the control valve.

c. Lines and Fittings

1. Disconnect overtravel lever from link.

2. Hold lever up in intake position for maximum shock absorber inflation and release.

3. Leak check all connections, with a soap and water solution. Leak test solution may also be used.

d. Shock Absorbers

1. Disconnect lines and remove shock absorber from car as described on page 3D-3.

2. Inflate individually to 345-414 kPa (50-60 psi), utilizing Fill Valves, J-21999. Submerge in water and observe for leaks.

3. Install shock absorbers as described on page 3D-3.

ON-CAR SERVICE

Trim Adjustment - On Car

Trim adjustment should be performed with a full tank of fuel (or the equivalent in load at the rate of 6 lbs/gal).

a. Adjustment

1. Raise car with rear axle supported.

2. Remove shock absorber line at control valve letting all air out of shock absorbers.

3. Loosen overtravel lever adjusting nut, allowing short plastic lever to center itself. Move car up and down to neutralize suspension, centering lever.

4. Retighten locking nut and reconnect line to control valve.

5. Lower car and inflate system through service valve.

Tubing (Fig. 3D-26)

NOTE: Tubing may be removed by simply unscrewing nut. Be sure system is deflated when separating air lines. When installing tubing at any Automatic Level Control fitting, be careful not to kink line.

1. Preassemble metal sleeve and rubber seal, Fig. 3D-26.

2. Place nut on tubing.

3. Insert tube into metal sleeve and rubber seal until tube bottoms.

NOTE: Be careful not to extend tubing completely through rubber seal.

4. Holding tubing in bottomed position, tighten tube nut securely (30-40 inch-pounds).

NOTE: Tubing may be reinstalled at its connections. If tubing is cracked at end, it will be necessary to cut flush and use a new metal sleeve and rubber seal to assemble connector. Be careful not to remove too much, or tubing may be kinked or broken at full suspension travel. Care should be taken that proper routing is followed in areas close to the exhaust system to prevent burning the tubing. Note particularly the areas at rear suspension crossmember.

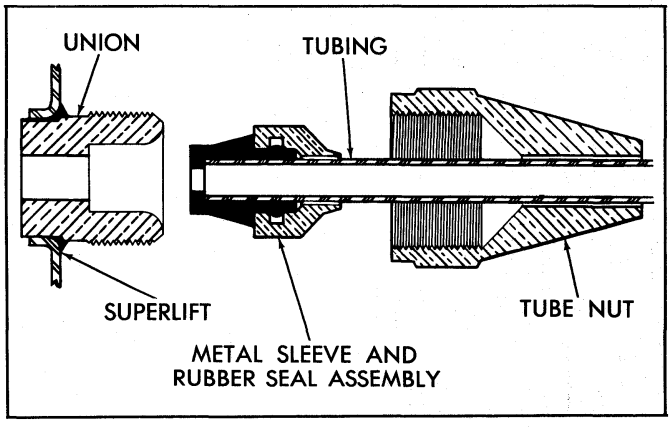


Fig. 3D-26 Typical Tubing Fitting

Height Control Valve

a. Removal

1. Deflate system, using service valve.

2. Disconnect air lines at leveling valve intake and shock absorber ports.

3. Disconnect link from overtravel lever by removing nut.

4. Remove two screws securing leveling valve to frame and remove leveling valve.

b. Installation

1. Install leveling valve with two screws, with time delay mechanism down.

2. Secure link to overtravel lever with retaining nut.

NOTE: If working on limousine, use lower hole in overtravel lever.

3. Connect air lines at control valve intake and at shock absorber port, assembling tubing as described in column 1 ("Trim Adjustment") on this page.

NOTE: Line from upper port of control valve to double port shock absorber is white. This white line can be connected to either upper or lower port of shock absorber.

4. Inflate reservoir to 965 kPa (140 psi) or maximum pressure available through service valve.

Compressor, Regulator, and Reservoir Assembly (Except Seville) (Fig. 3D-27)

a. Removal

1. Raise hood and deflate system.

NOTE: For C-Car: Compressor is mounted in canister tray. For Eldorado: Compressor is on rear of right wheelhousing.

2. Remove air intake and vacuum hoses from compressor fittings.

3. Remove high pressure line from regulator fitting.

4a. C-Car only:Remove two screws securing compressor mounting bracket to fender. Remove compressor by lifting from lower pilot hole in tray.

b. Remove bracket from compressor.

5a. Eldorado only: Remove three screws securing compressor to rear of right wheelhousing, screws are accessible **inside** wheelhousing.

b. Remove compressor and brackets from wheelhousing.

c. Remove nuts and lockwashers securing mounting brackets to flexible mounts on compressor assembly and remove mounting brackets.

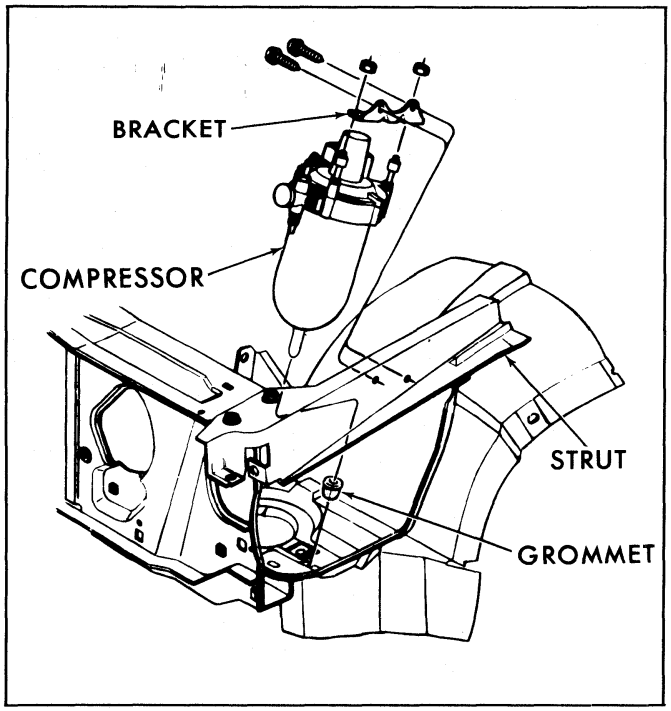


Fig. 3D-27 ALC Compressor Mounting

b. Installation

1a. On C-car, position compressor so that lower pilot fits into rubber bushed hole in tray.

CAUTION: *Make sure rubber grommet is installed in pilot hole before installing compressor.*

b. Install two screws securing compressor mounting bracket to fender.

2a. Eldorado only: Position mounting brackets to flexible mounts and secure with lockwashers and nuts.

b. Position mounting brackets to right wheelhousing with compressor end of assembly facing up.

c. Install three screws securing compressor to wheelhousing.

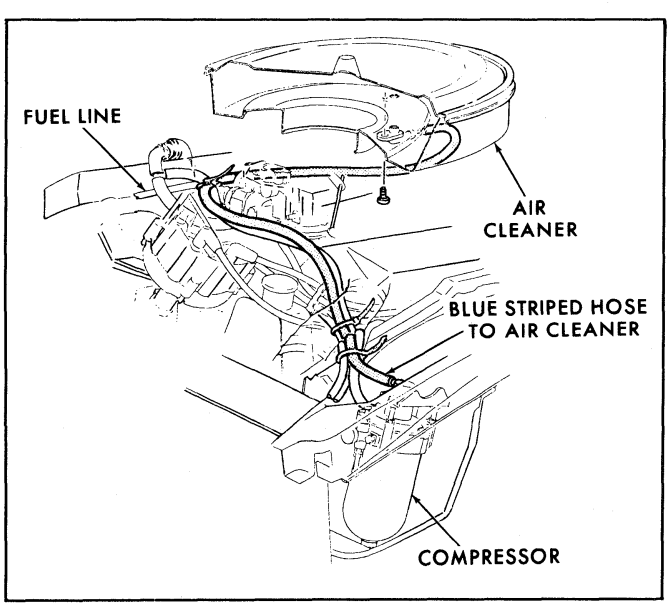


Fig. 3D-28 ALC Compressor Hose Connections (C-Car)

3. Install high pressure line on regulator fitting as described on page 3D-20.

4. Install blue striped air inlet hose (yellow striped for Eldorado) to vent fitting, Fig. 3D-28 and 3D-29.

5. Install vacuum hose (black) to vacuum fitting.

6. Inflate reservoir to 965 kPa (140 psi) or maximum pressure available through service valve.

7. Lower hood.

Compressor, Regulator and Reservoir Assembly - Seville

a. Removal

1. Raise hood and deflate system.

2. Remove screw holding diagonal fender tie strut to compressor bracket and move strut out of way.

3. Remove radiator coolant reservoir mounting screw from compressor upper mounting bracket.

4. Remove compressor upper mounting bracket screws to front fender.

5. Remove lower compressor mounting nut to lower mount.

6. Remove air intake and vacuum hoses from compressor fittings.

7. Remove high pressure line from regulator fitting and remove compressor.

b. Installation

1. Position compressor to lower mounting bracket and secure with nut.

2. Install high pressure line to regulator fitting using procedure on page 3D-20.

3. Install air inlet hose (yellow striped) to vent fitting, Fig. 3D-30.

4. Install vacuum hose (black) to vacuum fitting.

5. Position upper mounting bracket to fender and secure with two screws.

6. Position coolant reservoir to upper compressor mounting bracket and secure with screw.

7. Position fender tie strut to compressor mounting bracket and secure with screw. Check torque of tie strut screw to cowl bracket.

8. Inflate reservoir to 965 kPa (140 psi) or maximum pressure available through service valve.

9. Lower hood.

Disassembling Compressor, Reservoir, and Regulator into Major Components (Fig. 3D-31)

The compressor is a precision-built mechanism. All parts should be carefully handled and assembled. Take care to prevent entrance of dirt or foreign matter. **DO NOT LUBRICATE** as unit is designed to run dry.

1. Remove compressor as described on page 3D-20 (above procedure if working on Seville).

2. Remove two flexible mounts and two adapters.

3. Remove reservoir retaining through bolt, cover retaining screw, and cover gasket that secure cover and gasket to first stage housing. Remove cover and discard gasket, if necessary.

4. Remove two regulator retaining screws, regulator assembly, and O-ring from second stage housing. Discard O-ring, if necessary.

5. Remove three nuts at reservoir flange and two through bolts that enter from flanged side of reservoir. Separate reservoir and O-ring. Discard O-ring, if necessary.

6. Remove three compressor retaining through bolts that

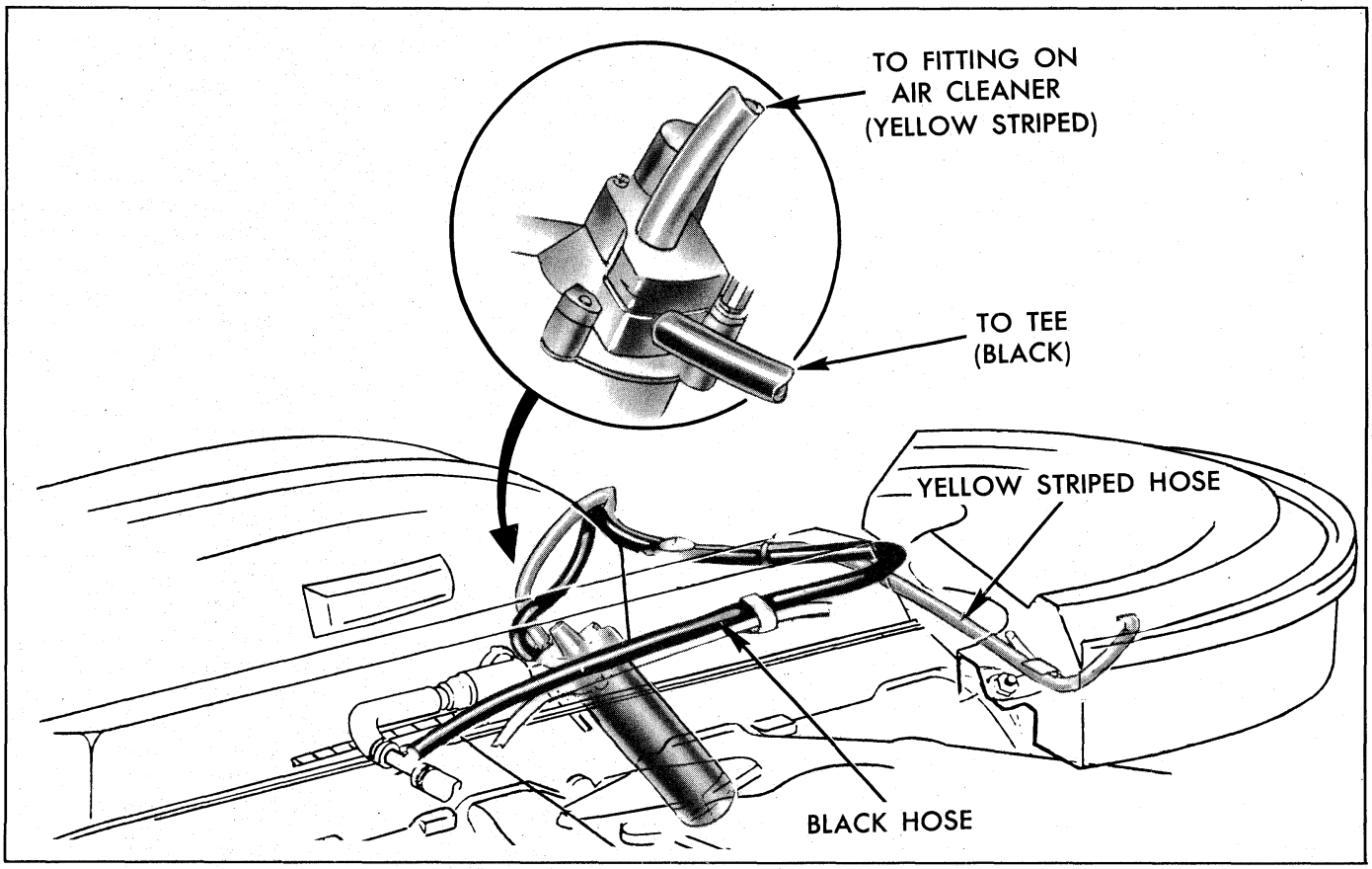


Fig. 3D-29 ALC Compressor Hose Connections (Eldorado)

secure second stage housing to first stage housing.

7. Slide second stage (small diameter) housing straight off piston.

8. Disconnect arm tension spring from swivel arm.

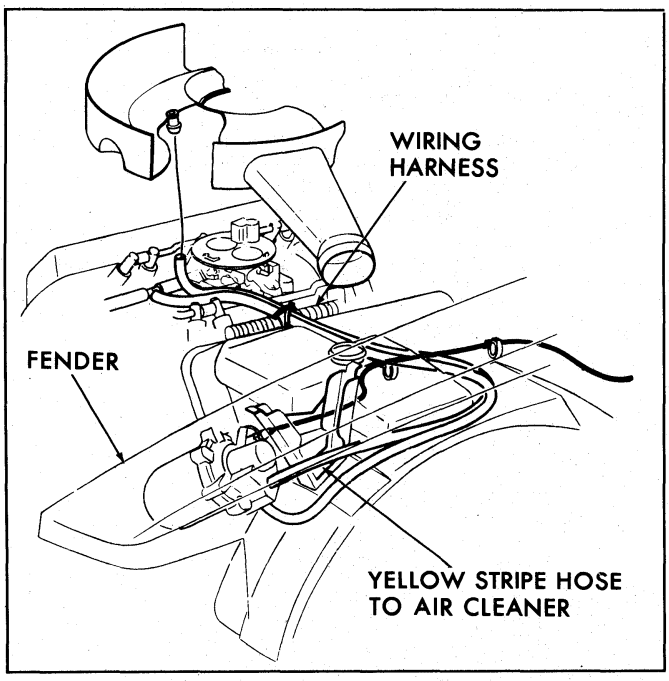


Fig. 3D-30 ALC Compressor Hose Connections (Seville)

9. Remove air pivot screw and actuating arm.

10. Slide piston assembly straight out of first stage housing.

Compressor, Reservoir, and Regulator; Disassembly, Inspection, and Assembly of Major Components

a. Diaphragm

Inspection

1. Inspect diaphragm for holes, looseness, or other defects and replace as necessary.

Disassembly

1. Remove diaphragm retainer with snap ring pliers.

2. Remove diaphragm plate, diaphragm, second diaphragm plate, and washer from piston.

Assembly

1. Install new washer, old plate, new diaphragm with outer lip toward second stage side, Fig. 3D-31, and second plate. Plates should be installed so that lips on plates face outboard from diaphragm.

2. Install diaphragm retainer snap ring on groove in piston, Fig. 3D-32.

b. Piston Seals

Inspection

1. Inspect seals for evidence of excessive wear or scoring. If necessary, replace seals and O-rings.

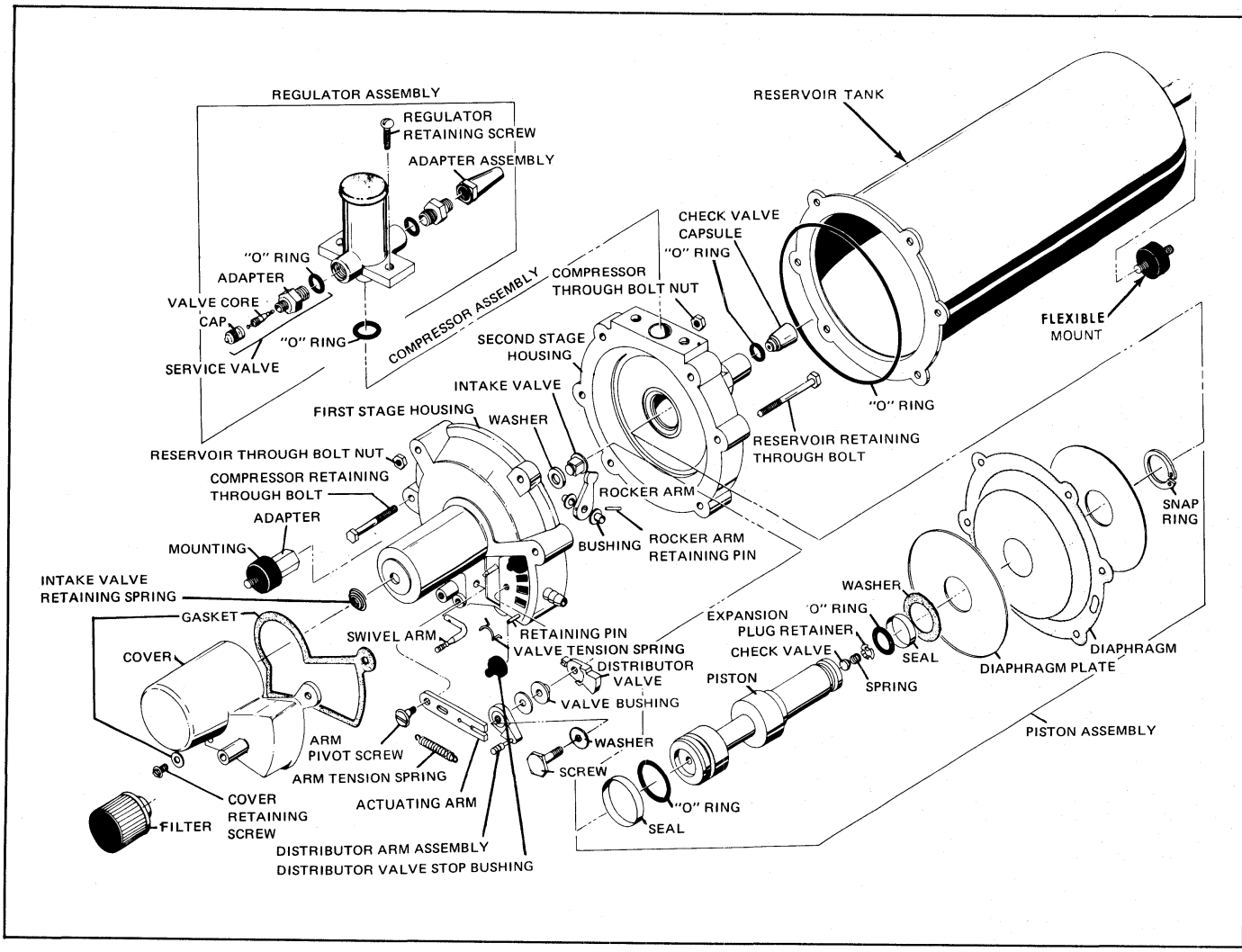


Fig. 3D-31 Compressor Assembly Disassembled

Removal

1. Remove seals and O-rings from piston.

Installation

1. Install new O-rings by rolling into groove. Relieve any resulting twist.

2. Install new seals using a piece of .020" shim stock, Fig. 3D-33. Make sure shim stock has no sharp edges that may cut seal. Do not stretch seal more than necessary to install. Seals should be installed so they are not twisted.

c. Distributor Valve Mechanism and Intake Valve - First Stage Housing

NOTE: Actuate distributor valve with finger. Valve tension spring should press against distributor valve, holding it against either stop. If valve action is not free and positive, it will be necessary to rebuild, using new parts in distributor valve and arm package. If action is free and positive, and inspection upon disassembly shows no damaged parts, parts may be re-used.

Disassembly

1. Remove screw, washer, distributor arm assembly, washer, and distributor valve bushing.

2. Remove two distributor valve and arm assembly bumper stops.

3. Remove distributor valve, being careful not to distort valve tension spring.

4. Remove distributor valve tension spring from first stage housing boss, again being careful not to distort valve tension spring.

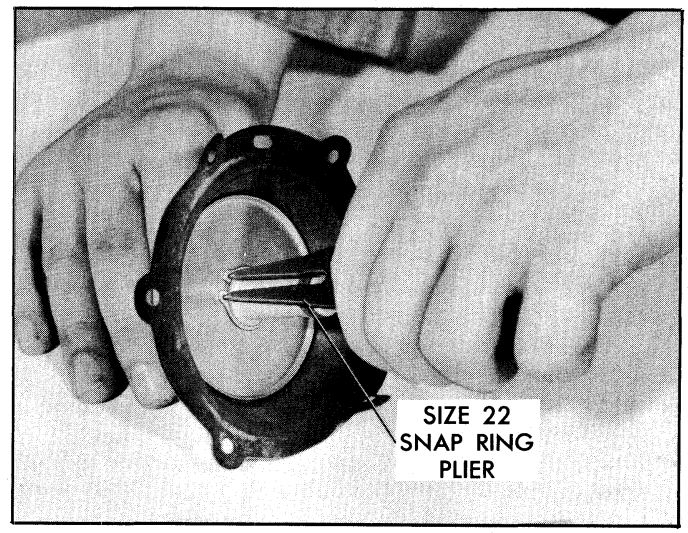


Fig. 3D-32 Removing and Installing Snap Ring

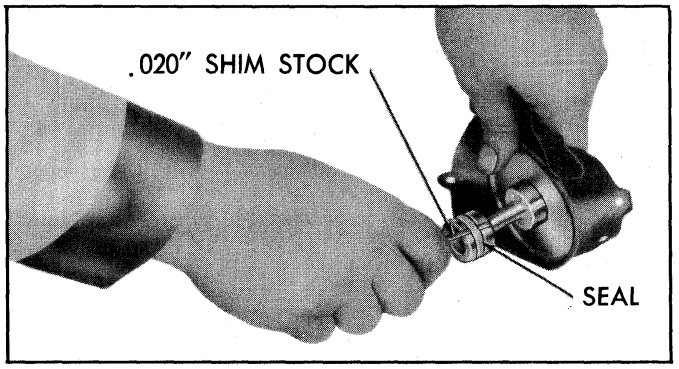


Fig. 3D-33 Installing Seal

5. Remove intake valve retaining spring, intake valve, and washer, using pocket knife.

6. If necessary, remove rocker and swivel arms. Grip pin with water pump pliers and remove pin. Remove swivel arm, rocker arm, and bushings.

Cleaning and Inspection

1. Clean all parts in clean solvent except distributor arm assembly and blow dry with compressed air.

2. Inspect distributor valve for cracks. Discard if damaged.

3. Inspect all other parts for wear or damage.

Assembly

1. If removed, position bushings in first stage housing and install rocker arm and swivel arm. Align hole in rocker arm with swivel arm and install rocker arm retaining pin, small end first. Check for clearance of pin to housing.

NOTE: If distributor mechanism failed to function properly or one or more parts were found defective, use new parts in distributor valve and arm package during remaining build-up.

2. Install washer on intake valve and install in first stage housing with intake valve retaining spring. Check for proper seating of valve by blowing air from piston side. No air should pass through valve.

3. Install longer leg of valve tension spring into boss on first stage housing, being careful not to distort valve tension spring.

4. Position distributor valve, being careful not to distort valve tension spring.

5. Install two distributor valve and arm assembly bumper stops.

6. Install distributor valve bushing, washer, distributor arm assembly, and washer and secure with screw. Tighten to 12 inch-pounds.

NOTE: Do not install remaining parts at this time as rocker arm must be free to permit entrance of piston into first stage housing.

Check Valve Replacement (Second Stage Piston)

1. Pry out expansion plug retainer on second stage piston, with pointed tool and remove spring and check valve.

2. Pour a small amount of clean solvent through bore in piston and blow dry with compressed air. Check valve seat should be smooth and clean.

3. Install new check valve and spring.

4. Insert new expansion plug retainer and tap in until it bottoms.

NOTE: Check for proper seating of valve by blowing through small end of piston. No air should pass through.

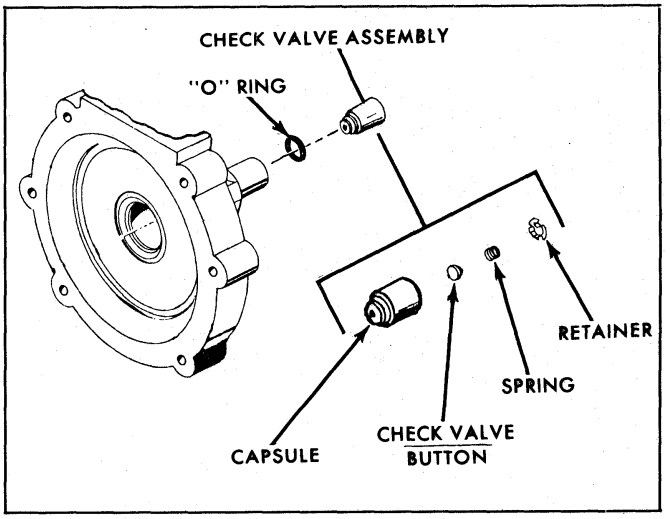


Fig. 3D-34 Check Valve Disassembled

e. Check Valve Replacement (Second Stage Housing)

NOTE: When a past model compressor 2nd stage housing shows a high level of corrosion in the area of the check valve, install a new design housing and check valve assembly, Fig. 3D-34, using the following procedure:

1. Support second stage housing in a vise and, using a short piece of 5/16" drill rod, carefully drive the check valve assembly out of the casting cavity. See Fig. 3D-35.

2. Clean second stage housing with clean solvent and blow dry with compressed air.

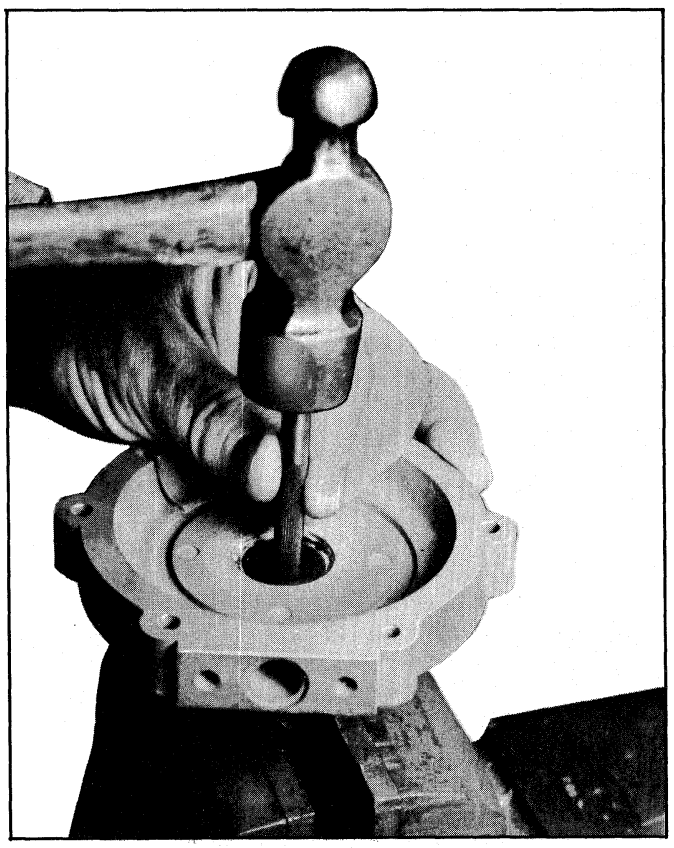


Fig. 3D-35 Removing Check Valve

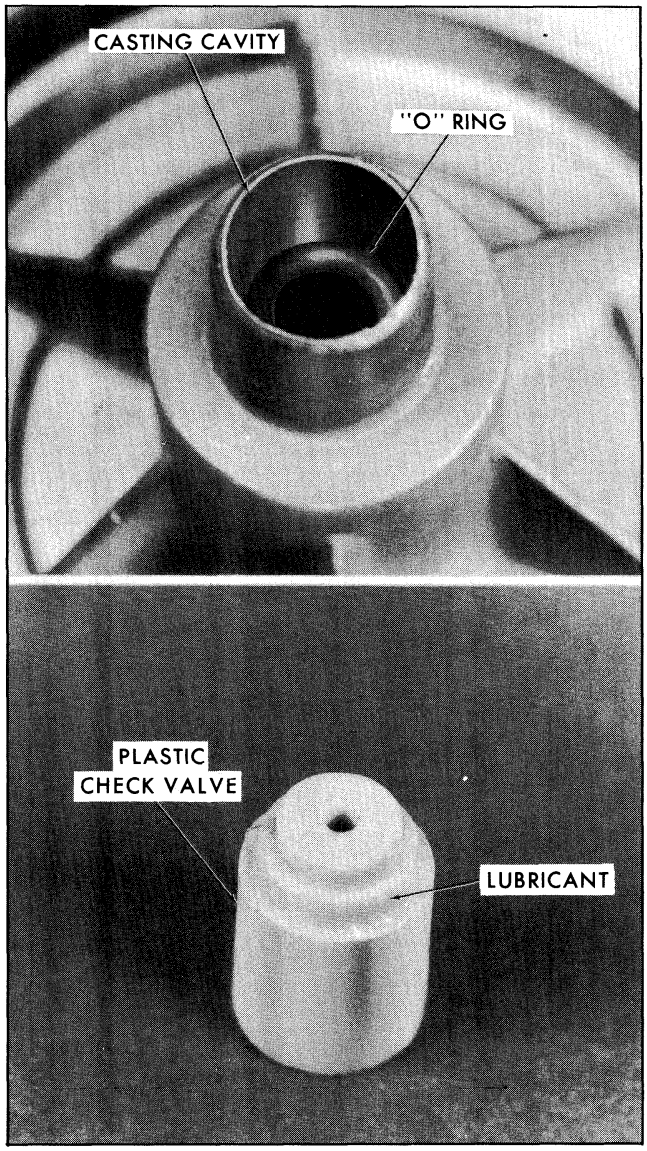


Fig. 3D-36 Installing "O" Ring

3. Discard and install a new "O" ring in the casting, Fig. 3D-36.

4. Apply a light coating of Parker "O" ring lubricant or its equivalent on the 2nd step of the new plastic check valve housing.

5. Install new check valve and spring.

6. Insert new expansion plug retainer and tap in until it bottoms in check valve housing.

7. Carefully insert check valve assembly and start it into the cavity of the casting.

8. To properly install the check valve assembly, the check valve must maintain a slight amount of pressure against the casting cavity while the assembly is staked in position. Using an arbor or drill press, push the check valve the remainder of the way into the casting against the "O" ring until the top surface of the check valve is slightly below the top edge of the casting cavity, Fig. 3D-37.

9. When staking the valve assembly in position, Fig. 3D-38, make sure stake marks are 90° apart (totaling four).

NOTE: Check for proper seating of valve by blowing through small end. No air should pass through.

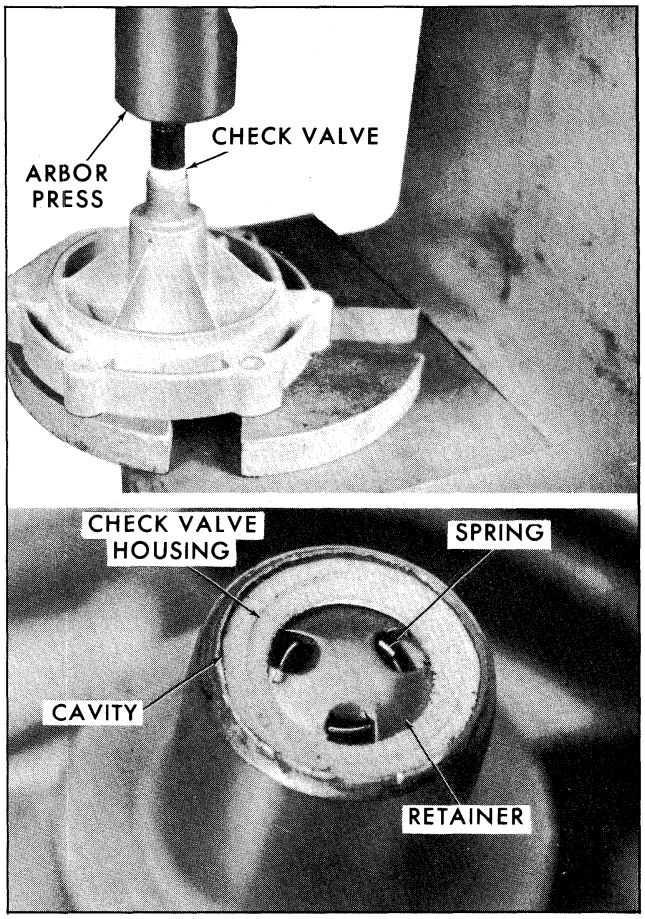


Fig. 3D-37 Installing Check Valve Assembly

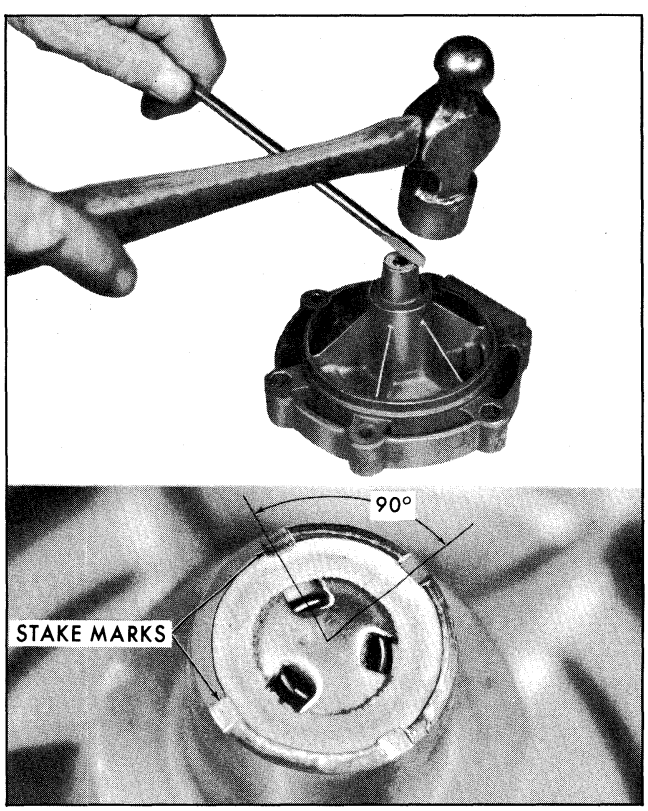


Fig. 3D-38 Staking Valve Assembly

Assembling Compressor, Reservoir, and Regulator from Major Components

1. Slide piston assembly straight into first stage (large diameter) housing.

2. Install aetuating arm and attach to first stage housing with arm pivot screw.

3. Connect arm tension spring to swivel arm.

4. Rotate piston in first stage housing to align elongated hole in diaphragm with vent port in first stage housing.

5. Install three compressor retaining through bolts that secure second stage housing to first stage housing. Housings will align one way only. Nuts are positioned in counterbores in second stage housing. Tighten to 28 inch-pounds. Check for free operation of valve parts.

6. Install new O-ring on second stage housing. Wash inside of reservoir in clean solvent and blow dry with compressed air. Install reservoir on second stage housing with three nuts, tightening to 28 inch-pounds. Install two reservoir retaining through bolts, tightening to 28 inch-pounds. Through bolt heads should be positioned against reservoir. Do not install through bolt that secures cover at this time.

7. Install new O-ring on regulator and secure regulator with two regulator retaining screws. Tighten to 35 inch-pounds. Service valve should be on same side as first stage housing.

8. Install new gasket and cover, and secure with cover retaining screw and new cover gasket. Tighten cover retaining screw to 35 inch-pounds. Install through bolt with head positioned against reservoir. Tighten through bolt to 28 inch-pounds.

9. Install two adapter and flexible mounts.

10. Proceed to compressor output test on car, page 3D-17.

11. If compressor passes output test, install as outlined on page 3D-20 (page 3D-21 if Seville).

TORQUE SPECIFICATIONS

Material No.	Application	Size	Newton-Metres	Foot-Pounds
	C-CAR			
300M	Rear Lower Control Arm (At Axle Bracket)	1/2 x 13	—	122*
510M	Rear Lower Control Arm (At Frame Bracket)	14.0 x 2.0	110*	80*
286M	Rear Shock Absorber Attaching Nut (Lower)	1/2 x 20	—	60
280M	Rear Shock Absorber Bolts (Upper)	5/16 x 18	—	20
280M	Rear Stabilizer Bar to Lower Control Arm	7/16 x 14	—	55*
6010M	Rear Stabilizer Bracket to Lower Control Arm	3/8 x 16	—	22*
300M	Rear Upper Control Arm Bolts (At Axle Bracket While Holding Nuts)	3/16 x 13	—	85*
500M	Rear Upper Control Arm Bolts (At Frame Crossmember Whole Holding Nuts)	14.0 x 2.0	120*	90*
301M	Rear Upper Control Arm Nuts (At Axle Bracket While Holding Bolts)	1/2 x 13		75*
510M	Rear Upper Control Arm Nuts (At Frame Crossmember While Holding Bolts)	14.0 x 2.0	115*	85*
	ELDORADO			
500M	Rear Lower Control Arm	14.0 x 2.0	190*	142*
286M	Rear Shock Absorber Attaching Nuts (Lower)	1/2 - 20	—	50
275M	Rear Shock Absorber Bolts (Upper)	5/16 - 18	—	12
300M	Rear Upper Control Arm Bolts (At Axle Bracket While Holding Nuts)	1/2 - 13	—	110*
500M	Rear Upper Control Arm Bolts (At Frame Crossmember While Holding Nuts)	14.0 x 2.0	190*	142*
300M	Rear Upper Control Arm Nuts (At Axle Bracket While Holding Bolts)	1/2 - 13	—	80*
510M	Rear Upper Control Arm Nuts (At Frame Crossmember While Holding Bolts)	14.0 x 2.0	135*	100*
	SEVILLE			
301M	Rear Leaf Spring Front Eye — Bolt Nut	1/2 - 20	—	105*
286M	Rear Leaf Spring Shackle Nuts	7/16 - 20	—	50*
301M	Rear Leaf Spring U-Bolt Nuts	7/16 - 20	—	45*
275M	Rear Shock Absorber Bolts (Upper)	5/16 - 18	—	18*
286M	Rear Shock Attaching Nut (Lower)	7/16 - 14	—	45*
300M	Spring Front Mounting Bracket to Underbody Bolt	3/8 - 16	—	30*
286M	Stabilizer Mounting Bracket to Spring Plate Nut	3/8 - 16	—	30*
				Inch-Pounds
Special	Air Line Fitting to Shock Absorber Nut	—	—	35

***CAUTION:** *These control arm fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. Each must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure the proper retention of these parts.*

Eldorado Only: Pivot bolts in control arms must be torqued when axle is under normal load. If not, the ride rate may be adversely affected.

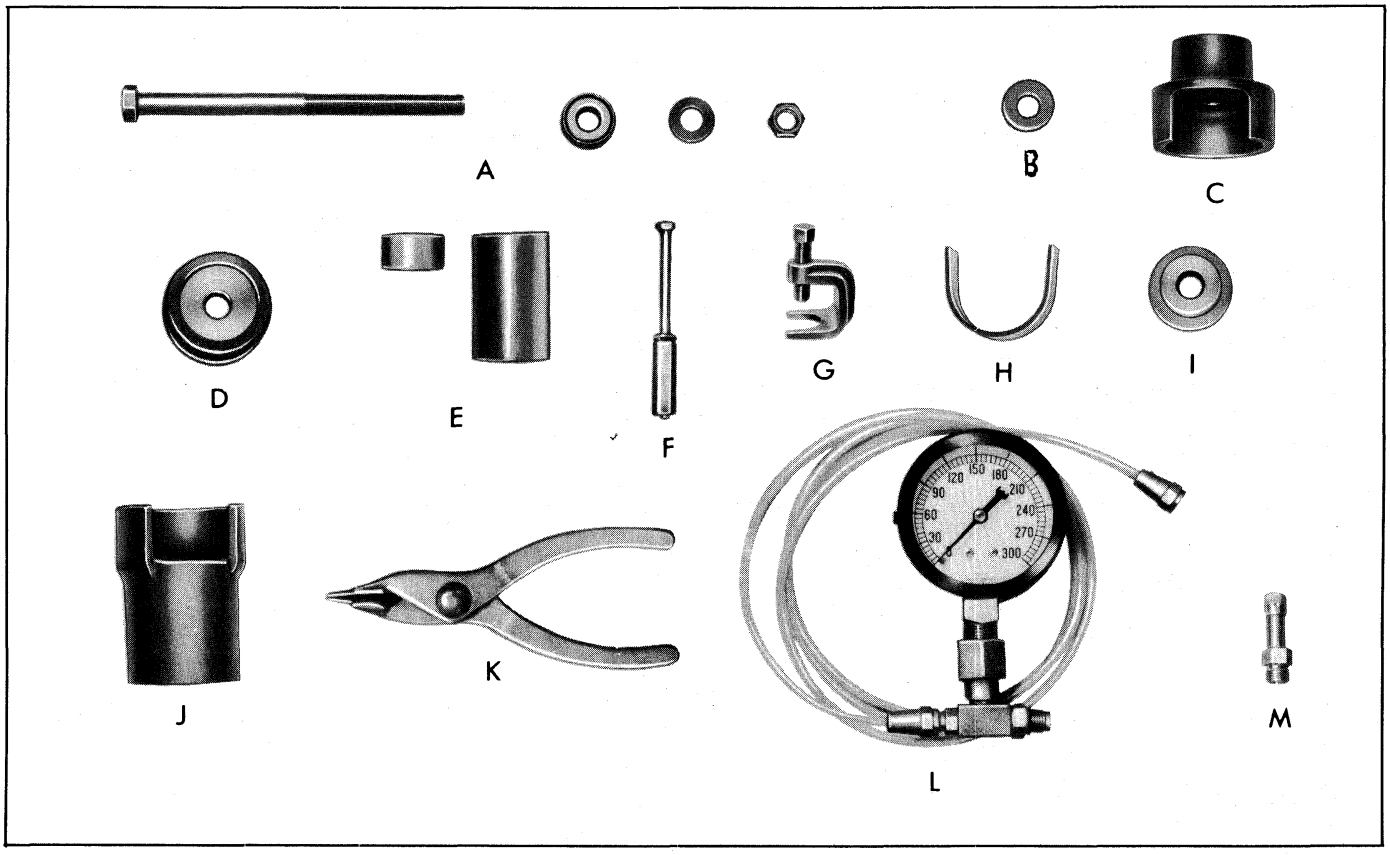


Fig. 3D-39 Special Tools

Key	Tool No.	Name
A	J-21474-3	Driver Bolt Set
B	J-21978-1	Rear Spring Front Bushing Installer
C	J-22222-1	Bushing Installer
D	J-22222-2	Pilot
E	J-22553-1	Rear Spring Front Bushing Remover — Installer — Receiver, J-22553-2 Installer
F	J-21058	Rear Spring Front Bushing Puller Screw and Nut
G	J-5504	Stud Remover
H	J-23705	Spacer
I	J-22222-3	Pilot
J	J-21474-5	Bushing Remover
K	J-4880	#22 Snap Ring Pliers
L	J-22124	Test Gage
M	J-21999	Fill Valve

WHEELS AND TIRES
GENERAL DESCRIPTION

Wheels

Wheels are of steel construction with the center, or spider and rim sections joined by spot welds or rivets. Wheels are attached with five 1/2-20 right hand thread cone face nuts, on a 5" bolt circle. Replacement wheels must be equivalent to original equipment wheels in load capacity, diameter, rim width, and offset.

Tires

The tires are designed to operate satisfactorily with loads up to the full rated load capacity, when inflated to the recommended pressures. Correct tire pressures and driving habits have an important influence on tire life. Heavy cornering, excessively rapid acceleration, and unnecessary sharp braking increase tire wear. When replacement is necessary, the original equipment type tire should be used. Refer to the Tire Inflation Chart in Fig. 3E-1.

Tire Size and Load Rating

Tire sizes and load ratings are indicated by a combination of numbers and letters such as GR78-15, load range B. The first letter, G, designates the load the tire will carry at a given inflation pressure. The "higher" the letter, the bigger the tire and so the greater the load capacity. The second letter, R, designates a radial construction.

The first set of numbers (78) denotes the ratio of tire height to width. Height divided by width equals section ratio. For example, a 78 tire is 78 percent as high as it is wide. The lower the number, the wider the tire. The second set of numbers (15) shows the bead diameter of the tire.

Load range replaces the ply-rating system. Load range B and load range D tires will carry the same load at the same pressure. Load range D tires may be inflated to higher pressures. At the higher pressures, they will carry a greater load.

A TPC SPEC. NO. (Tire Performance Criteria Specification Number) is molded into the sidewall of each radial tire next to the tire size designation. The TPC number indicates that the tire meets GM size and performance specifications for each specific model.

Replacement Tires

When replacing tires, only the size, load range, and construction type (bias, bias-belted, or radial) originally installed on the vehicle are recommended. Use of any other tire size or type tire may seriously affect ride, handling, speedometer/odometer calibration, vehicle ground clearance and tire clearance to the body and chassis. The following also should be considered when replacing tires:

WARNING: DO NOT MIX DIFFERENT TYPES OF TIRES ON THE SAME VEHICLE SUCH AS RADIAL, BIAS, AND BIAS-BELTED TIRES EXCEPT IN EMERGENCIES, BECAUSE VEHICLE HANDLING MAY BE SERIOUSLY AFFECTED AND MAY RESULT IN LOSS OF CONTROL.

It is recommended that new tires be installed in pairs on the same axle.

When replacing only one tire, it should be paired with the tire having the most tread, to equalize braking traction.

A TPC Spec. No. (Tire Performance Criteria Specification Number) is molded into the sidewall of most original equipment radial tires next to the tire size designation. Replacement tires with the same T.P.C. number will meet GM size and performance specifications for each specific model.

TIRE PRESSURE CHART

Vehicle Capacity — Plus 91kg (200 lbs) Trunk Load

Brougham, DeVille Sedan and Coupe, Eldorado — 6 Occupants
Fleetwood Limousine — 8 Occupants
Fleetwood Formal Limousine — 7 Occupants
Seville — 5 Occupants

	Up to Vehicle Capacity		Up to Five Occupants (Four-Seville)	
Car Series	Front kPa — psi	Rear kPa — psi	Front kPa — psi	Rear kPa — psi
Brougham	166 — 24	207 — 30	166 — 24	166 — 24
DeVille	193 — 28	221 — 32	179 — 26	179 — 26
Eldorado	193 — 28	166 — 24	186 — 27	138 — 20
Limousine	207 — 30	248 — 36	186 — 27	186 — 27
Seville	166 — 24	193 — 28	166 — 24	166 — 24
Commercial	345 — 50	517 — 75	—	—

Fig. 3E-1 Tire Pressure Chart

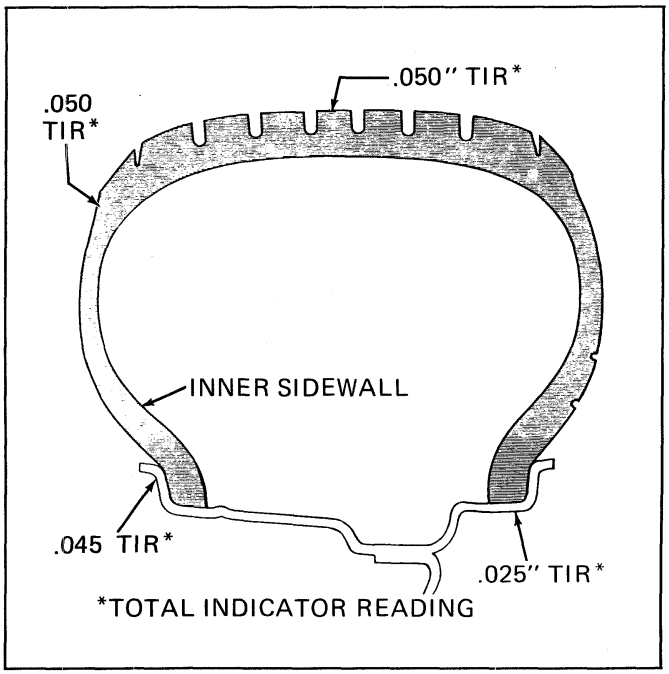


Fig. 3E-2 Wheel Run Out

Replacement Wheels

Wheels must be replaced if they are bent, dented, have excessive lateral or radial runout, leak air through welds, have elongated bolt holes, if lug nuts won't stay tight, or if they are heavily rusted. Wheels with greater runout than shown in Figure 3E-2 may caust objectional vibrations.

Replacement wheels must be equivalent to the original equipment wheels in load capacity, diameter, rim width, offset, and mounting configuration. A wheel of improper size or type may affect wheel and bearing life, brake cooling, speedometer/odometer calibration, car ground clearance, and tire clearance to the body and chassis.

Use of Tire Chains

Tire chains may be used on the drive wheels of all models if equipped with recommended size tires. It is recommended that vehicles equipped with chains be limited to 72 km/h (45 mph) or the chain manufacturer's speed limit, if lower.

MAINTENANCE AND MINOR ADJUSTMENTS

Wheel Maintenance

Wheel repairs that use welding, heating, or peening are not approved. An inner tube is not an acceptable repair for leaky wheels or tires.

Wheel nuts must be tightened in sequence and to the specified torque range for proper attaching and to avoid bending wheel, brake drum or rotor, Fig. 3E-3. For uniform torque results, the mounting sequence shown should be followed twice. First to firmly seat all nuts and a second time to achieve the recommended torque. If a broken stud is found, see page 3C-7 for caution and replacement procedures. If working on Eldorado, see page 3C-30.

Inflation of Tires

Correct inflation pressure is an important item of tire care. The recommended pressure is carefully calculated to give a satisfactory ride, stability, steering, tread wear, cord life and resistance to bruises.

Tire pressure, with tires cold (after vehicle has set for 3 hours or more, or driven less than 1 mile), should be checked monthly or before any extended trips and set to specifications on the placard label, located on the glove box door. See Fig. 3E-1.

Valve caps or extensions should be on the valve to keep dust and water out.

For continuous high speed operation (over 121 km/h or 75 mph) increase pressures 28 kPa (4 psi) up to maximum of 221 kPa cold (32 psi cold), for load range B tires, 276 kPa (40 psi) for load range D tires. For continuous high speed operation (over 105 km/h or 65 mph), increase pressures 70 kPa (10 psi) up to a limit of 552 kPa (80 psi) for load range E tires.

Sustained speeds above 121 km/h (75 mph) are not recommended when the 28 kPa (4 psi) adjustment would require pressures greater than maximum.

Tire pressures may increase as much as 41 kPa (6 psi) when hot.

HIGHER THAN RECOMMENDED PRESSURE CAN CAUSE:

1. Hard ride.
2. Tire bruising or carcass damage.
3. Poor traction at rear wheels.
4. Rapid tread wear at center of tire.

LOWER THAN RECOMMENDED PRESSURE CAN CAUSE:

1. Tire squeal on turns.
2. High effort steering.
3. Rapid and uneven wear on the edges of the tread.
4. Tire bruises and rupture from rim.
5. Tire cord breakage.
6. Tramp and shimmy.
7. High tire temperatures.
8. Decreased handling capability.
9. Decreased fuel economy.
10. Wheel rim impact damage.

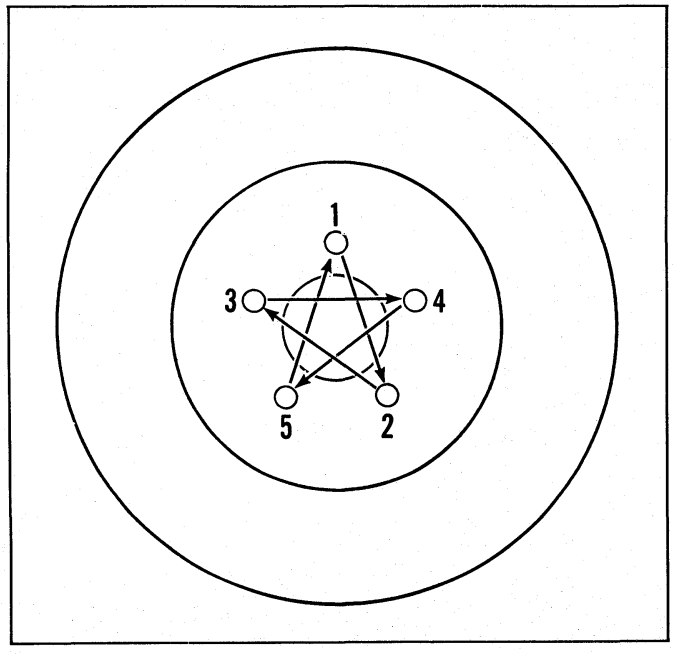


Fig. 3E-3 Wheel Nut Tightening Sequence

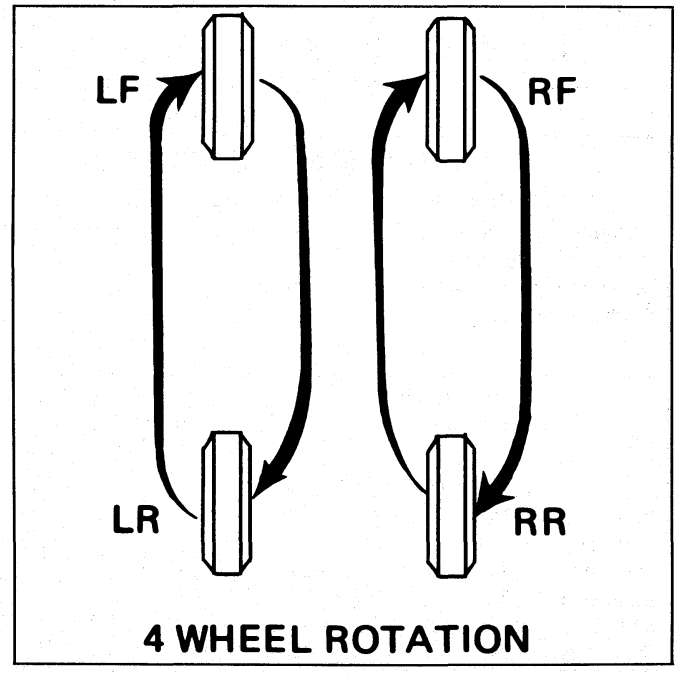


Fig. 3E-4 Tire Rotation Diagram

UNEQUAL PRESSURE ON SAME AXLE CAN CAUSE:

1. Uneven braking.
2. Steering lead.
3. Decreased handling capability.
4. Swerve on acceleration (torque steer).
5. Overheating of differential (drive axle).

Tire Rotation

To equalize wear, rotate radial tires according to Fig. 3E-4.

Do not use the X method as roughness and irregular wear can result. Radial tires should be rotated at the first 7,500 miles and then at least every 15,000 miles.

Due to their design, radial tires tend to wear at a faster rate in the shoulder area, particularly in front positions. This makes regular rotation necessary.

The importance of regular rotation and an occasional alignment check cannot be over-emphasized.

ON-CAR SERVICE

The following caution applies to certain steps in the assembly procedure of components in this section. The critical fasteners to which this caution applies are identified by the terminology CAUTION:

CAUTION: *See "CAUTION" on page 3E-3 of this section.*

CAUTION: *This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.*

Wheel Removal

Wheels can be hard to remove from the car due to rusting or a tight fit between the wheel center hole and the axle or rotor. These wheels can be removed without damage as follows:

1. Retighten all lug nuts on the affected wheel, then loosen each nut two turns.
2. Lower vehicle onto floor.
3. Start engine and rock car from "drive" to "reverse" allowing car to move several feet in each direction. Apply quick, hard jabs on the brake pedal to loosen the wheel.
4. Stop engine and raise car. Remove the lug nuts and the wheel.

Penetrating oil has not been found to be effective in removing tight wheels. However, if it is used, it should be applied only to the hub surface.

WARNING: DO NOT ALLOW THE PENETRATING OIL TO GET ON THE VERTICAL SURFACES BETWEEN THE WHEEL AND THE DRUM (OR ROTOR) BECAUSE PENETRATING OIL IN THIS AREA COULD CAUSE THE WHEEL TO WORK LOOSE AS THE CAR IS DRIVEN CAUSING LOSS OF CONTROL.

Never use heat to loosen a tight wheel because the application of heat to the wheel can shorten the life of the wheel.

Wheel nuts must be tightened in sequence and to proper torque to avoid bending wheel or brake drum or rotor (Fig. 3E-3).

Demounting and Mounting of Tubeless Tire

Use a tire changing machine to mount or demount tubeless tires. Follow the equipment manufacturer's instructions.

Rim bead seats should be cleaned with a wire brush or coarse steel wool to remove lubricants, old rubber, and light rust if evident. Before mounting or demounting a tire, the bead area should be well lubricated with an approved tire lubricant.

NOTE: Do not use hand tools or tire irons to change tires as they may damage the tire beads or wheel rim.

WARNING: DO NOT STAND OVER TIRE WHEN INFLATING. BEAD MAY BREAK WHEN BEAD SNAPS OVER SAFETY HUMP AND CAUSE SERIOUS PERSONAL INJURY.

After mounting, inflate to 276 kPa (40 psi), so that beads are completely seated.

WARNING: DO NOT EXCEED 276 kPa (40 psi) PRESSURE WHEN INFLATING. IF 276 kPa (40 psi) PRESSURE WILL NOT SEAT BEADS, DEFLATE, RELUBRICATE AND REINFLATE. OVERINFLATION MAY CAUSE THE BEAD TO BREAK AND CAUSE SERIOUS PERSONAL INJURY.

Install valve core and inflate to proper pressure shown in Fig. 3E-1. Check the locating rings of the tire to be sure they show around the rim flanges on both sides.

Tire Repair

There are many different materials and techniques on the market to repair tires. As not all of these work on all types of tires, tire manufacturers have published detailed instructions on how and when to repair tires. These

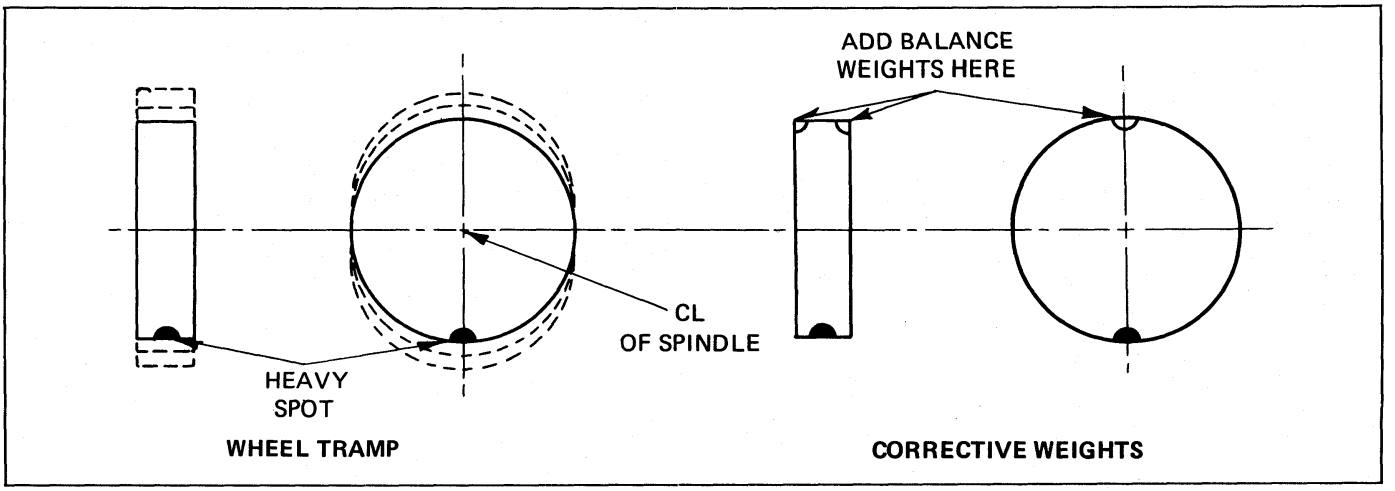


Fig. 3E-5 Static Unbalance Correction

instructions can be obtained from the tire manufacturer.

Stowaway Spare

The stowaway spare is designed to be used only as a spare. It allows the car to be driven to a convenient service station for ground wheel tire repair.

It is recommended that repair or replacement of the stowaway spare tire be made by the authorized tire dealer.

Factory Tire to Wheel Matching

All "C" and "K" tire and wheel assemblies are processed to minimize force variation. Wheels are marked with a yellow paint mark or a stamped impression ( ) as the low point of average first harmonic radial runout (this is not the same spot as the low point measured by a dial indicator). Tires are marked with a red paint spot at the high point of first harmonic radial force variation.

Service wheels and replacement tires are also marked to allow service matching. The paint spots should be placed together for maximum rolling smoothness. The cam effect (cancelling factor) produces an assembly with better uniformity than either component.

Balancing Wheels

There are two types of wheel balance: static and dynamic. Static balance is the equal distribution of weight around the wheel. Wheels that are statically unbalanced cause a bouncing action called wheel shake. This condition will eventually cause wear and damage to the tire. Fig. 3E-5.

Dynamic balance is the equal distribution of weight on each side of the centerline of the tire so that when the tire spins, there is no tendency for the assembly to move from side to side. Wheels that are dynamically unbalanced may cause a vibration at any speed. Fig. 3E-6.

General Balance Precautions

Deposits of mud, etc. must be cleaned from the inside of the rim. Stones should be pried from the tread in order to avoid operator injury during spin balancing and to obtain a good balance. The tire should be inspected for any damage, then balanced according to the equipment manufacturer's recommendation.

RECOMMENDED BALANCE METHOD

Off the car static and dynamic balance is recommended to achieve balance accuracy. Also, rotation of tires can be performed without balance being affected. However, due to component balance stack up (brake drums, front hub and rotor, rear axles, etc.), **ON CAR** "STATIC" balance will produce an additional ride improvement.

Factory Balance Method and Specification

Cadillac "C" and "D" tire/wheel assemblies are statically balanced to a tolerance of 0.5 ounce at the rim.

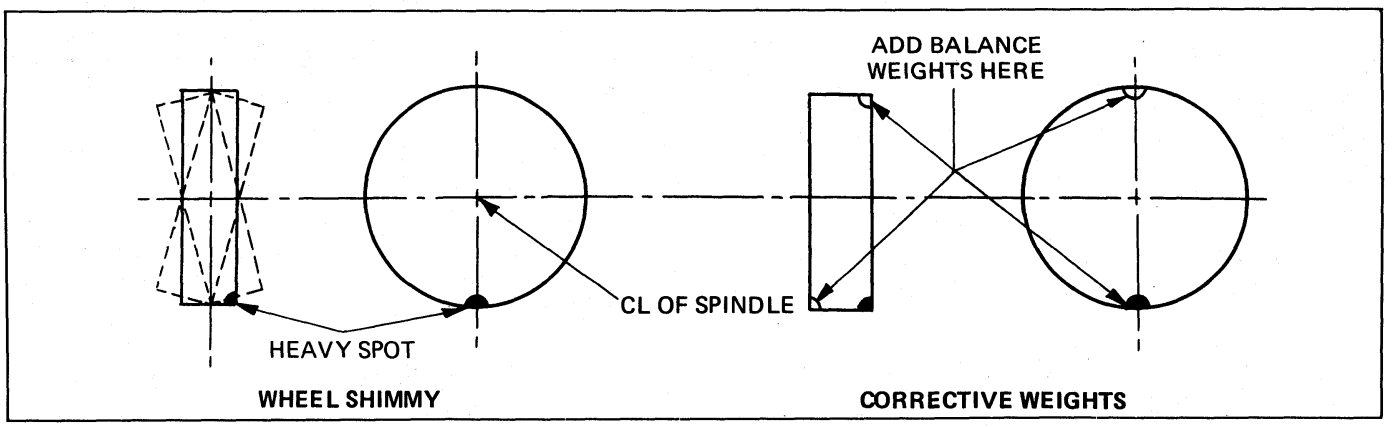


Fig. 3E-6 Dynamic Unbalance Correction

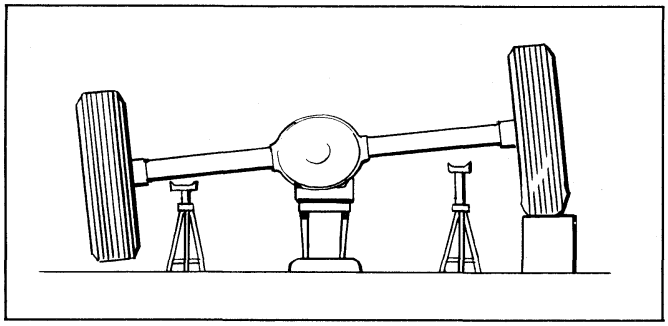


Fig. 3E-7 Standard Axle

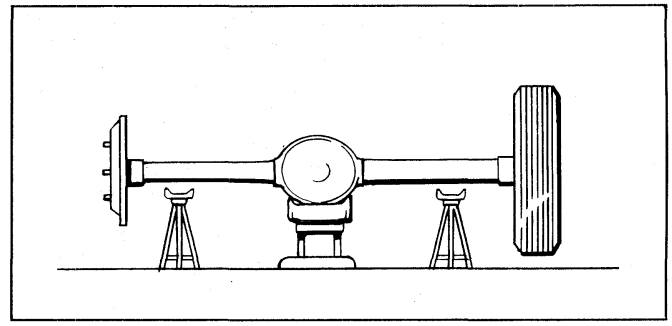


Fig. 3E-8 Controlled Axle

Correction weight is added to the inside rim up to 3.0 ounces and the remainder up to a total of 5.0 ounces to the outer rim.

Cadillac "E" tire/wheel assemblies are dynamically balanced to a tolerance of 0.5 ounce per rim. The factory balancing method does not place the dynamic weights equal and opposite as illustrated in the service manual diagram. Therefore, if a balance problem, is suspected, it is necessary to check the factory balance. The balance should be accurate to a tolerance of 0.5 ounce at the rim. Static weights should be split between the inner and outer rim flange to maintain the dynamic balance.

NOTE: The factory uses precision equipment and considerable manpower to achieve balance specifications. Before removing factory weight, check balance accuracy, if necessary.

Off-Car Balancing

When an off-car spin balance is performed, it is necessary that the equipment being used pilots on the center hole, not the lug holes.

On-Car Balancing

WARNING: ON CARS THAT DO NOT HAVE A CONTROLLED DIFFERENTIAL, DRIVE WHEEL SPIN SHOULD BE LIMITED TO 56 km/h (35 mph) AS INDICATED ON THE SPEEDOMETER. THIS LIMIT IS NECESSARY BECAUSE THE SPEEDOMETER ONLY INDICATES ONE-HALF OF THE ACTUAL WHEEL SPEED WHEN ONE DRIVE WHEEL IS SPINNING AND THE OTHER DRIVE WHEEL IS STOPPED. UNLESS CARE IS TAKEN IN LIMITING DRIVE WHEEL SPIN, THE SPINNING WHEEL CAN REACH EXCESSIVE SPEEDS. THIS CAN RESULT IN POSSIBLE TIRE DISINTEGRATION OR DIFFERENTIAL FAILURE, WHICH COULD CAUSE SERIOUS PERSONAL INJURY OR EXTENSIVE VEHICLE DAMAGE.

a. Rear Wheels

To distinguish between standard and controlled axles on passenger cars, raise rear of vehicle so both wheels are clear of ground. With transmission in park, attempt to turn one wheel by hand. If you can turn a wheel, it is a standard axle. If you cannot turn a wheel, it is a controlled differential.

Standard Axle

On vehicles equipped with standard axle, raise rear of vehicle with floor jack under differential. This must be done to allow car to vibrate while balancing. Place a block under the opposing wheel and let vehicle down so opposing wheel sits on block and the wheel to be balanced is at least two inches off the ground, Fig. 3E-7.

This is to allow only one wheel to spin. Proceed with balance, using engine power to spin the wheel. Use a spinner to drive rear wheels on front wheel drive cars.

Controlled Axle

On vehicles equipped with a controlled differential, the following procedure should be used:

Raise rear of vehicle with floor jack under differential. Put jack stands under axle as safety measure, but do not put car weight on stands.

WARNING: DO NOT ATTEMPT TO BALANCE A TIRE ON A DRIVE WHEEL WITH THE OTHER DRIVE WHEEL ON THE GROUND. THE CAR MAY DRIVE THROUGH THIS WHEEL AND CAUSE THE VEHICLE TO MOVE UNEXPECTEDLY, RESULTING IN PERSONAL INJURY AND PROPERTY DAMAGE.

Remove one wheel, Fig. 3E-8. Reinstall lug nuts, flat side to drum, and tighten securely to retain the brake drum. Balance the remaining wheel using engine power to spin the wheel.

WARNING: ON CARS THAT HAVE A CONTROLLED DIFFERENTIAL DRIVE WHEEL SPIN SHOULD BE LIMITED TO 113 km/h (70 mph.) THIS IS TO PREVENT TIRE DISINTEGRATION RESULTING IN SERIOUS PERSONAL INJURY AND EXTENSIVE PROPERTY DAMAGE.

When proper balance has been achieved on first wheel, reinstall the second wheel and balance.

b. Front Wheels

Front of vehicle should be lifted with floor jack under front crossmember in center of frame to allow vehicle to vibrate while balancing.

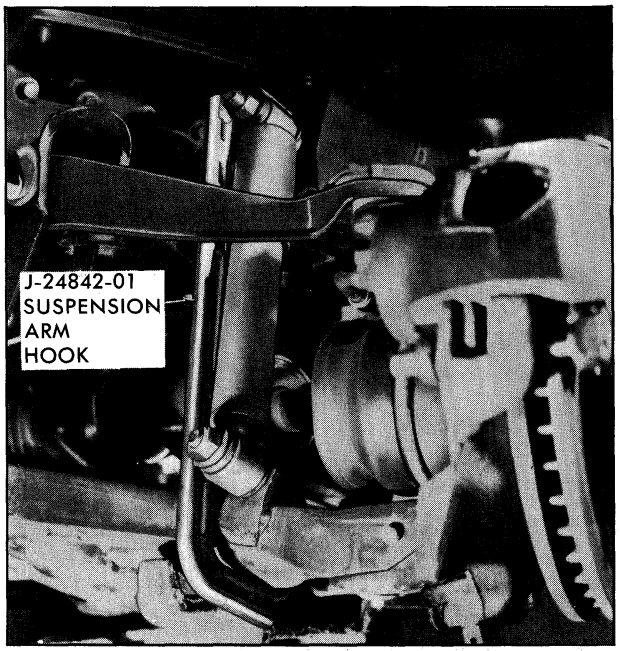


Fig. 3E-9 Suspension Arm Hook

Eldorado Front Wheel Balance

"On car" balancing of Eldorado front wheel and tire assemblies require heavy duty equipment.

Suspension arm hook J-24842-01 must be installed on the Eldorado front suspension before balancing. This is to keep suspension at normal standing height to avoid extra vibration or damage to seals and joints in drive axles.

Fig. 3E-9 shows the hook in the installed, on-car position. The installation and removal procedures are as follows:

a. Installation

1. Open hood.
2. Reaching over fender, position hook through upper suspension arm inboard of front shock absorber, engaging lower end of hook into channel in lower suspension arm (as shown) below shock absorber lower mount.
3. Using your body weight on fender, engage top of hook in hole in top of upper shock absorber mount.

b. Removal

1. Using your body on fender, disengage top of hook from upper shock absorber mounting bracket hole.
2. Working hook downward, disengage hook at lower suspension arm and remove hook.
3. Close hood.

DIAGNOSIS

Irregular and/or Premature Tire Wear

Irregular and premature tire wear has many causes. Some of them are: Incorrect inflation pressures, lack of tire rotation, driving habits, improper wheel alignment.

a. Rotate tires if the following conditions exist:

- Front tire wear is different from rear.
- Uneven wear exists across the tread of any tire.
- Left front and right front tire wear is unequal.
- Left rear and right rear tire wear is unequal.
- There is cupping, flat spotting, etc.

b. A wheel alignment check is in order if the following conditions are noted:

- Rapid wear on both outside or inside tread edges.
- Left front and right front tire wear is unequal.
- Rapid wear on one edge of any front tire.

Tire Wear Indicators

Tires have built-in tread wear indicators to show when they need replacing. These indicators will appear as 1/2 inch wide bands when the tire tread depth becomes 2/32 of an inch. When the indicators appear in two or more adjacent grooves at three locations around the tire or when cord or fabric is exposed, tire replacement due to tread wear is recommended, Fig. 3E-10.

Vibration

Wheel unbalance causes about 75% of the highway speed vibration problems, so balance should be checked first. However, if a vibration remains after careful on-car balancing, it can be caused by three things, Fig. 3E-11:

1. Tire runout.
2. Wheel runout.
3. Tire stiffness variation.

Measuring tire and/or wheel runout will uncover only part of the problem. It's best to check all three causes at the same time. This can be done by using a Tire Problem Detector (TPD) as in the following diagnosis charts:

Radial Force Variation

For a tire-wheel assembly to cause car vibration, it must first cause movement in the spindle or axle of the car. The spindle or axle of a car must be moved before the car can "feel" a vibration.

Think of a "perfectly" round tire as a number of identical "springs", Fig. 3E-11. As the tire and wheel rotate, each one of these springs contacts the road and flexes.

If the amount of flexing of each spring is uniform as the tire rolls over the smooth road surface, it does not cause the spindle to move. As long as all the springs have the same stiffness, they will flex the same and the spindle will not be moved and thus the car will not "feel" any vibration.

If one of these springs is stiffer than the others, and the tire comes into contact with the road at this stiffer point, Fig. 3E-11, the spindle will move upward because the stiffer spring does not "give" as much as the other springs in the tire.

As the tire revolves faster, this spindle movement speeds up. At highway speed, it matches the resonant frequency of most cars' suspension systems and causes a shake-type ride or car vibration.

The difference in the stiffness of the tire is called tire "radial force variation" and is a cause of vehicle vibration. The greater the spindle movement (loaded radial runout), the more the car will vibrate.

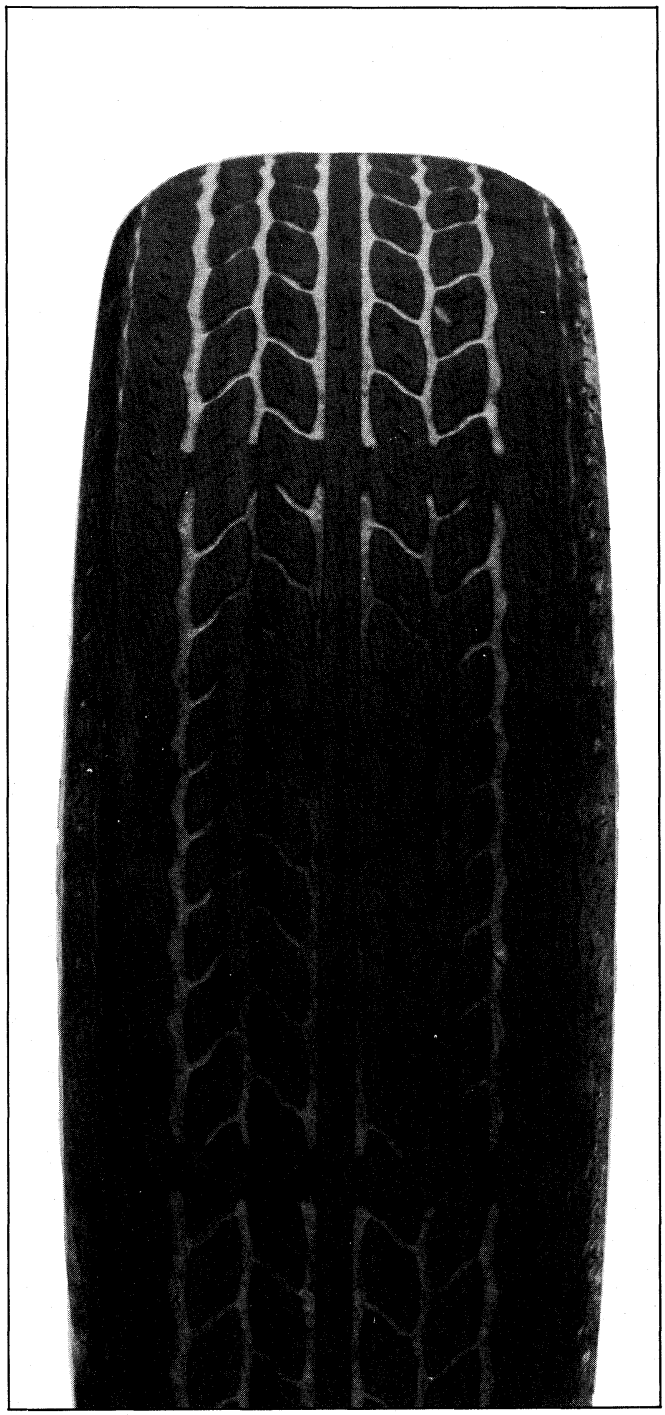


Fig. 3E-10 Tread Wear Indicators

Substitution Method

If a TPD is not available, the more time consuming method of substituting known good tire and wheel assemblies on the problem vehicle can be used as follows:

1. Ride vehicle and attempt to determine if the vibration is coming from the front or rear.

2. Install tires and wheels that are known to be good (on similar vehicles) in place of those on the offending end of the problem vehicle. If vibration cannot be isolated to front or rear, substitute all car tire and wheel assemblies.

3. If there is no improvement, then either the "good" set is not good, or the vibration is caused by something other than tires and wheels.

4. Replace original tires one at a time until offender is found.

Correcting Non-Uniform Tires (When wheel and/or tire is not marked for match mounting)

If a replacement tire cannot be obtained, there are several methods commonly used to correct tires which cause a vibration even though they are properly balanced. The best method uses an automatic machine which buffs small amounts of rubber from selected spots on the outer two tread rows. Correction by this method is usually permanent, and, if done properly, does not significantly affect the appearance or tire tread life. Tire truing with a blade-type machine is not recommended as this reduces the tread life substantially and often does not permanently correct the problem.

Another method which quite often works is to dismount the tire and rotate it 180 degrees on the rim. **It is important that this only be done on tire assemblies which are known to be causing a vibration** as it is just as likely to make good assemblies worse.

Lateral Force Variation (Radial Tire Waddle) Complaint Description

Waddle is side to side movement at the front and/or rear of the car, Fig. 3E-13. It is caused by lateral force variation in one or more of the radial tires. It is most noticeable at low speed, 8 to 48 km/h (5 to 30 MPH). It may also appear as a ride roughness at 81 to 113 km/h (50 to 70 MPH).

It is possible to road test a car and tell on which end of the car the objectionable tire is located. If the waddle tire is on the rear, the rear end of the car will shake from side to side or "waddle". From the driver's seat, it feels as though someone is pushing on the side of the car.

If the objectionable tire is on the front, the waddle is more visual. The front sheet metal appears to be moving from side to side and the driver feels as though he is at the pivot point in the car.

It should be noted that if the waddle condition is constant within a certain speed range, it is probably caused by one tire. If, however, the waddle condition comes and goes within this speed range, it is probably caused by two tires, on the same end of the car, going into and out of phase with each other.

Vehicle Directional Lead

"Lead", is the deviation of the vehicle from a straight path on a level road with no corrective force on the steering wheel.

Lead is usually caused by these conditions: (1) improper alignment, (2) tire construction, and (3) uneven tire pressure. This section relates how to tell between tire lead and the need for alignment correction.

The way in which a tire is built can produce lead in a vehicle. An example of this is placement of the belt. Off center belts on radial tires can cause the tire to develop a side force (conicity) while rolling straight down the road. If one side of the tire is a little larger diameter than the other, the tire will tend to roll to one side. This develops a side force that can produce vehicle lead.

The procedure in Fig. 3E-14 should be used to insure that front alignment is not mistaken for tire lead.

Part of the lead diagnosis procedure is different from the proper tire rotation pattern currently in the owner's manual.

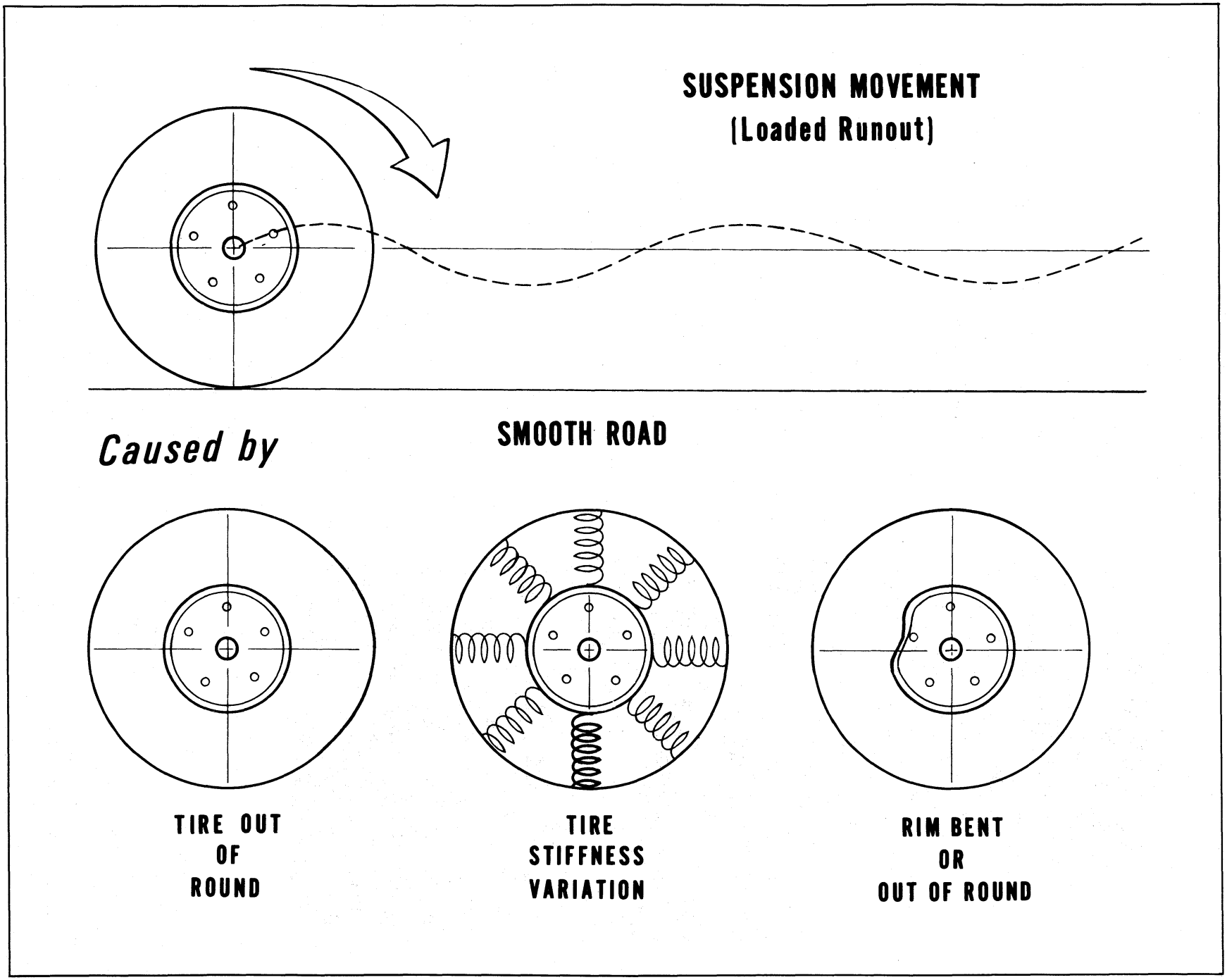
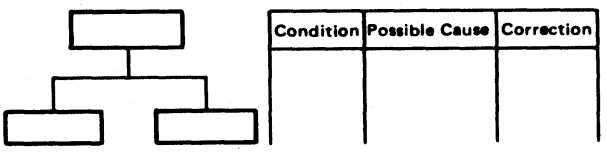


Fig. 3E-11 Causes of Vibration

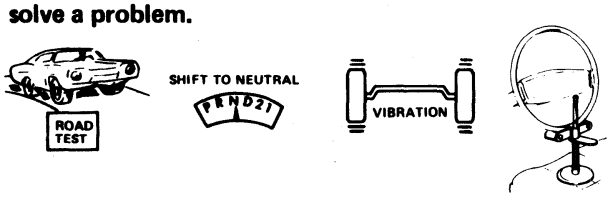
DIAGNOSIS CHARTS

Introduction

This section presents a systematic method of diagnosing and troubleshooting RADIAL–LATERAL VIBRATION. The charts you will be using are different from the ones you have used before. They aren't "go–no go" decision trees or tables.



Instead the new diagnosis and troubleshooting charts use pictures plus a few words to help you solve a problem.

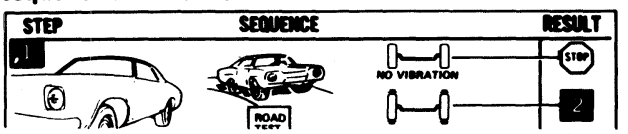


and symbols have replaced words.

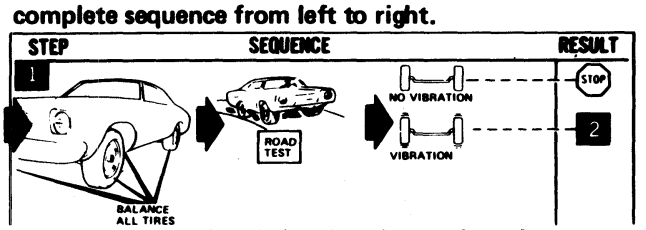


Using the Charts

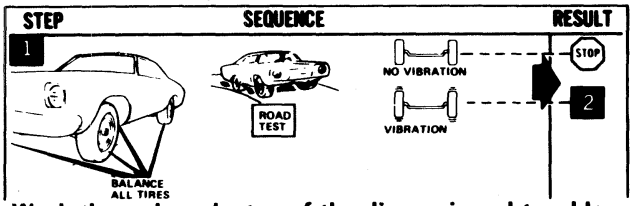
The charts are divided into three sections: step, sequence and result.



Always start at the first step and go through the complete sequence from left to right.

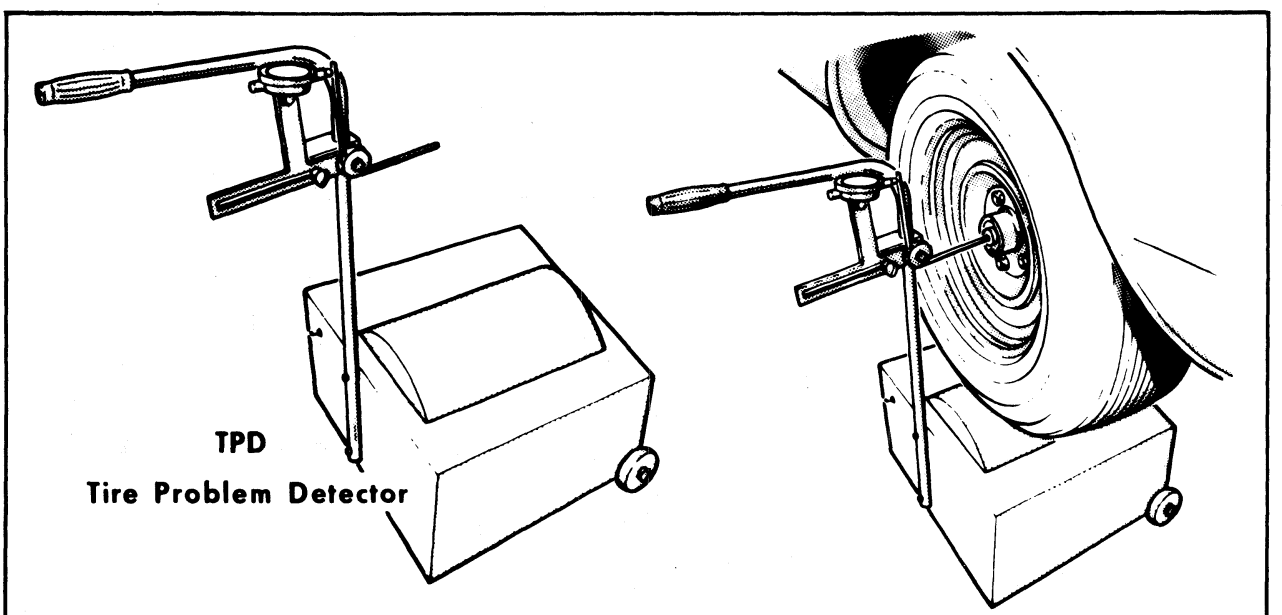


A sequence could be balancing tires and road testing for vibration. Each sequence ends with a result and tells you the next step to go to.



Work through each step of the diagnosis and trouble-shooting charts till the system is repaired. STOP

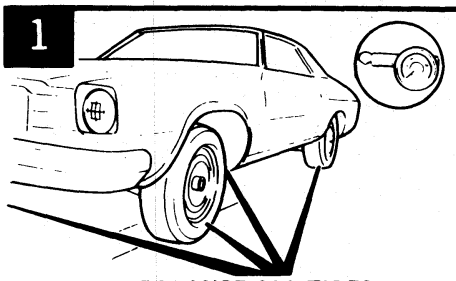
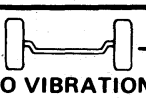
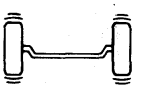
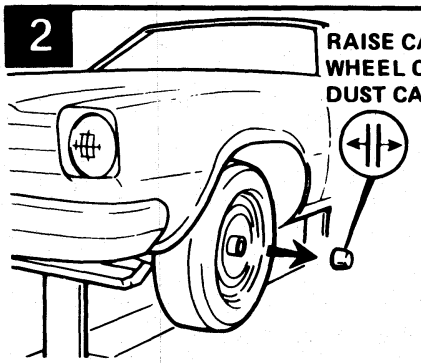
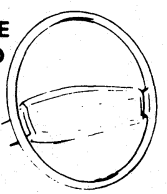
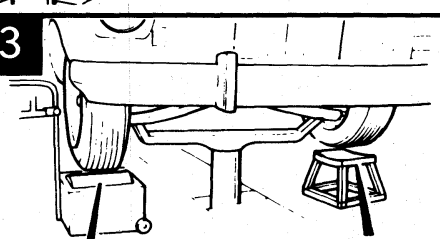
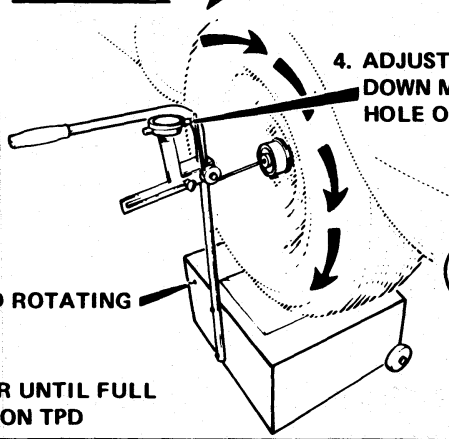
Using the TPD for RADIAL-LATERAL VIBRATION

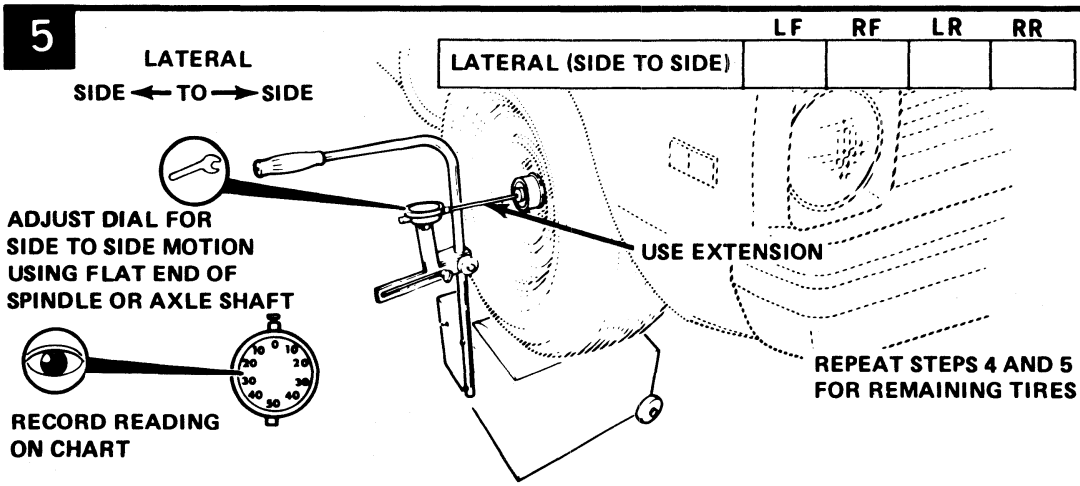
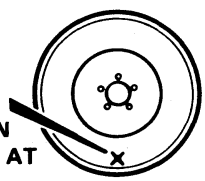
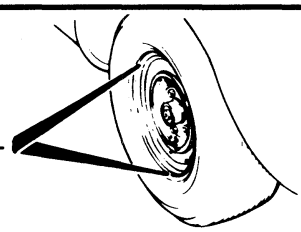
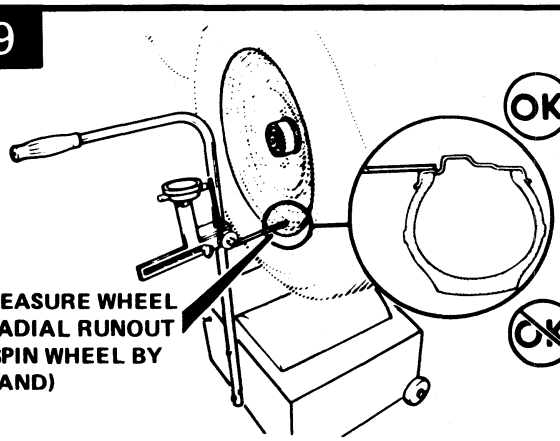
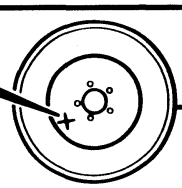
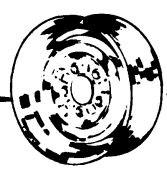


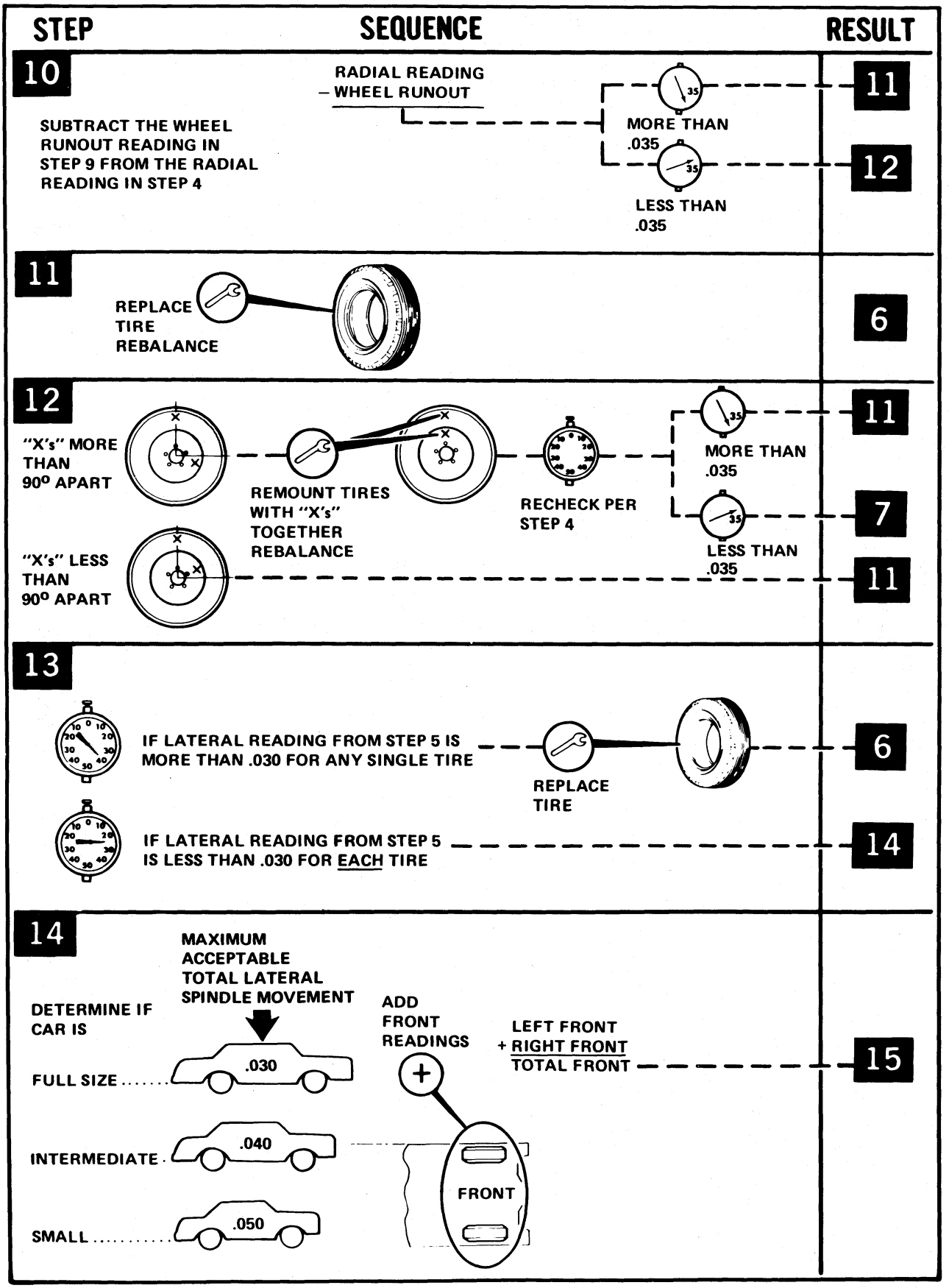
If TPD is not available use SUBSTITUTION METHOD shown at back of charts

Vibration only . . . . . Start with 1

Waddle, or Vibration and Waddle . . . Start with 2

STEP	SEQUENCE	RESULT
1	 BALANCE ALL TIRES ADJUST TIRES TO RECOMMENDED PRESSURE  ROAD TEST (BALANCE WILL NOT AFFECT WADDLE)  NO VIBRATION  VIBRATION	STOP 2
2	 RAISE CAR - REMOVE WHEEL COVERS AND DUST CAPS  FOR FRONT WHEELS: USE IGNITION LOCK. WHEELS IN STRAIGHT-AHEAD POSITION. FOR FRONT WHEEL DRIVE SHIFT TO NEUTRAL AND BRACE STEERING WHEEL FOR CHECKING DRIVE WHEELS, SHIFT TO NEUTRAL 	3
3	 CENTER TPD UNDER TIRE PLACE STAND UNDER OPPOSITE TIRE SAME HEIGHT AS TPD ON CARS WITH LIMITED SLIP DIFFERENTIAL, MOVE DRIVE TIRES TO FRONT OF THE CAR FOR TESTING NOTE – TIRES MUST ROTATE: RIGHT SIDE - CLOCKWISE LEFT SIDE - COUNTER CLOCKWISE	4
4	RADIAL UP AND DOWN 1. MAKE CHART → RADIAL (UP AND DOWN) LF RF LR RR  2. START TPD ROTATING 3. LOWER CAR UNTIL FULL WEIGHT IS ON TPD 4. ADJUST DIAL FOR UP AND DOWN MOTION USING PILOT HOLE ON END OF SPINDLE RECORD READING ON CHART REPEAT FOR OTHER THREE TIRES NOTE: FOR DRIVE AXLE, CLEAN PILOT HOLE WITH EMERY CLOTH AND LUBRICATE TO PREVENT PICKUP CHATTER	5

STEP	SEQUENCE	RESULT
5	LATERAL SIDE ← TO → SIDE  LF RF LR RR LATERAL (SIDE TO SIDE) | | | | REPEAT STEPS 4 AND 5 FOR REMAINING TIRES	7
6	 RECHECK NEW ASSEMBLY PER STEPS 4 AND 5 REVISE TABLE LF RF LR RR RADIAL (UP AND DOWN) | | | | LATERAL (SIDE TO SIDE) | | | |	7
7	 IF ALL RADIAL READINGS ARE LESS THAN .035 IF ANY RADIAL READING IS MORE THAN .035	13 8
8	 MARK "X" ON TIRE AT 6 O'CLOCK WHEN DIAL INDICATOR IS AT MAX. SPINDLE LIFT  RAISE CAR OFF ROLLER CLEAN WHEEL SURFACE	9
9	 MEASURE WHEEL RADIAL RUNOUT (SPIN WHEEL BY HAND) .025 FOR STANDARD STEEL WHEELS .035 FOR OTHER OK MARK "X" ON WHEEL WHERE IT RUNS OUT LEAST  OK REPLACE WHEEL REBALANCE 	10 6

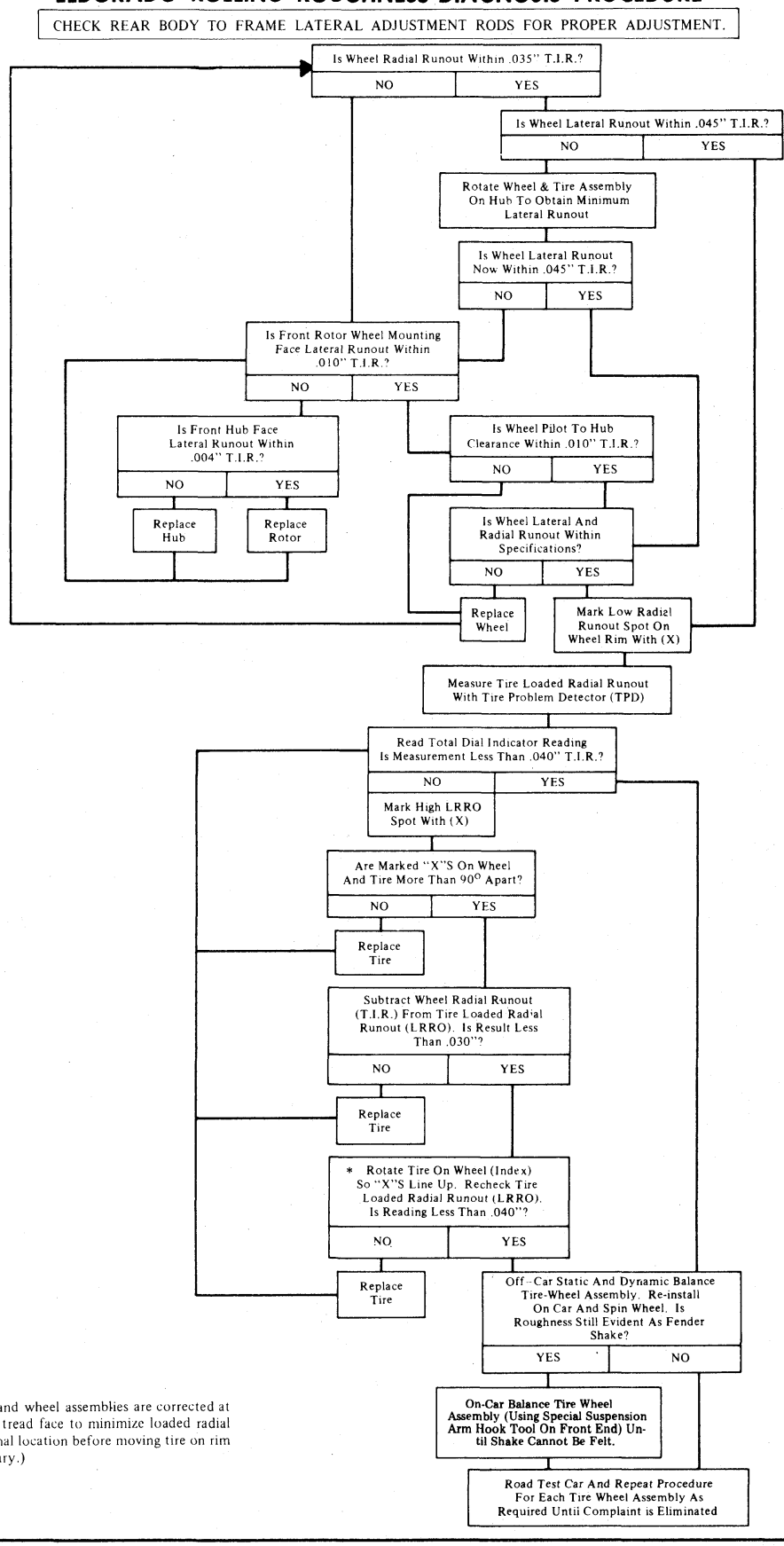

STEP
SEQUENCE
RESULT
10
SUBTRACT THE WHEEL RUNOUT READING IN STEP 9 FROM THE RADIAL READING IN STEP 4
RADIAL READING
– WHEEL RUNOUT
MORE THAN .035
LESS THAN .035
11
12
11
REPLACE TIRE
REBALANCE
6
12
"X's" MORE THAN 90° APART
REMOUNT TIRES WITH "X's" TOGETHER
REBALANCE
RECHECK PER STEP 4
MORE THAN .035
LESS THAN .035
11
7
"X's" LESS THAN 90° APART
11
13
IF LATERAL READING FROM STEP 5 IS MORE THAN .030 FOR ANY SINGLE TIRE
REPLACE TIRE
6
IF LATERAL READING FROM STEP 5 IS LESS THAN .030 FOR EACH TIRE
14
14
MAXIMUM ACCEPTABLE TOTAL LATERAL SPINDLE MOVEMENT
DETERMINE IF CAR IS
FULL SIZE
.030
INTERMEDIATE
.040
SMALL
.050
ADD FRONT READINGS
FRONT
LEFT FRONT
+ RIGHT FRONT
TOTAL FRONT
15

STEP	SEQUENCE	RESULT
15	ADD REAR READINGS (+) → LEFT REAR + RIGHT REAR = TOTAL REAR (REAR) → TOTAL REAR OK → IF TOTAL FRONT READING OK → 17; IF TOTAL FRONT READING OK → 16; TOTAL REAR OK → 16	
16	SWAP OR REPLACE TIRES AS NECESSARY TO GET A GOOD TOTAL REAR READING AND A GOOD TOTAL FRONT READING. SEE CHART. (REAR / FRONT) NOTE: PARTLY WORN TIRES SWITCHED TO THE OPPOSITE SIDE MAY CAUSE ROUGHNESS	FULL SIZE .030; INTERMEDIATE .040; SMALL .050 (OR LESS) → 17
17	BALANCE ALL TIRES NOT BALANCED IN PREVIOUS STEPS. ROAD TEST	NO VIBRATION → STOP; VIBRATION → PROBLEM IS NOT WHEELS AND TIRES. CHECK OTHER DRIVETRAIN COMPONENTS

SUBSTITUTION METHOD

STEP	SEQUENCE	RESULT
1	ROAD TEST — TRY TO DETERMINE WHERE VIBRATION IS COMING FROM, FRONT OR REAR. REPLACE THOSE THOUGHT TO BE BAD (IF NOT SURE, REPLACE ALL FOUR) WITH KNOWN GOOD TIRE AND WHEEL ASSEMBLIES FROM A SIMILAR CAR THAT DOES NOT VIBRATE.	→ 2
2	ROAD TEST	NO VIBRATION → 3; VIBRATION → PROBLEM IS NOT WHEELS AND TIRES. CHECK OTHER DRIVETRAIN COMPONENTS
3	REINSTALL ORIGINAL TIRES ONE AT A TIME UNTIL BAD TIRE (OR TIRES) IS FOUND	IF WHEEL IS OK REPLACE TIRE AND REBALANCE → STOP

ELDORADO ROLLING ROUGHNESS DIAGNOSIS PROCEDURE



* (NOTE: Tire and wheel assemblies are corrected at the factory on the tread face to minimize loaded radial runout. Mark original location before moving tire on rim to restore if necessary.)

Fig. 3E-12 Diagnosis Procedure

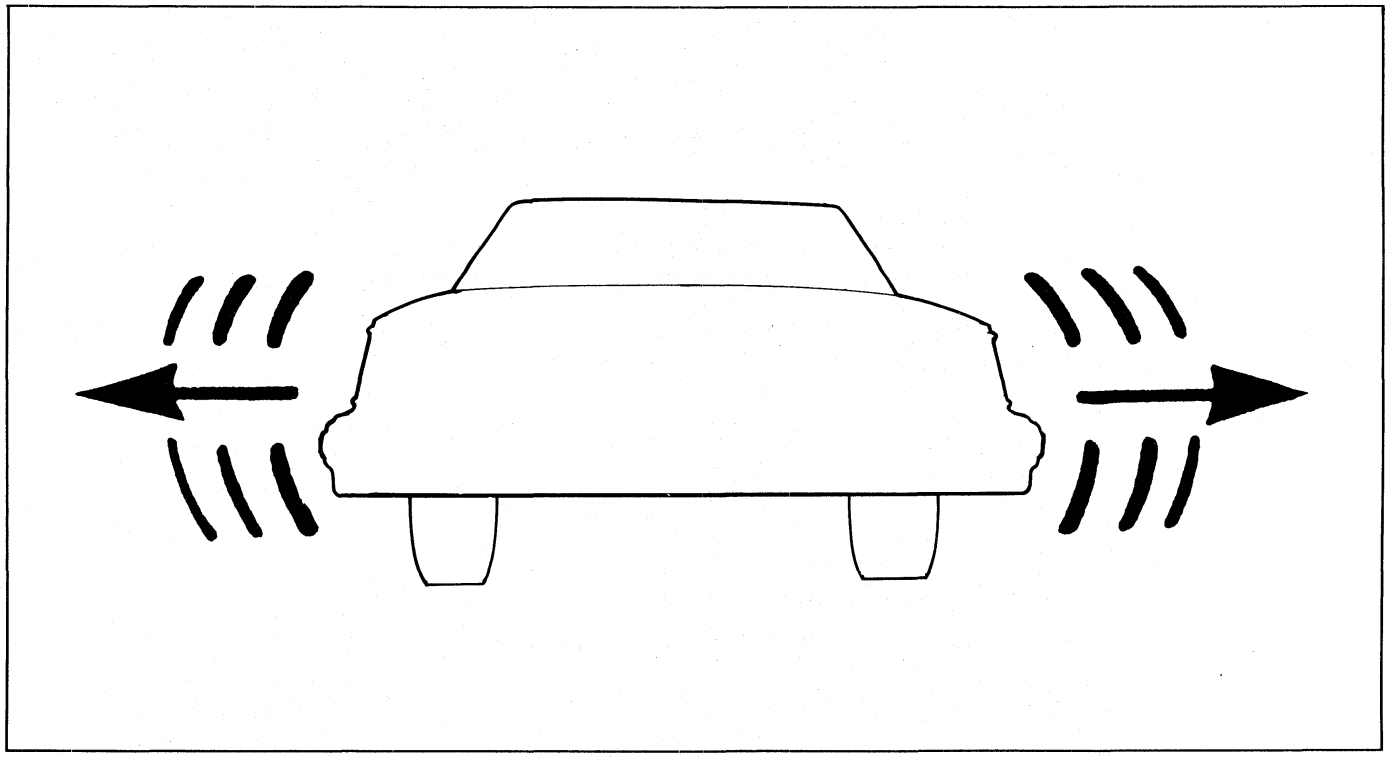


Fig. 3E-13 Radial Tire Waddle

The owner's manual recommends front to rear rotation only. If a medium to high mileage tire is moved to the other side of the car, be sure to check that rolling smoothness has been maintained.

Rear tires will **not** cause lead. However, high conicity forces at the rear wheel positions can cause "dog-tracking".

CAUTION: *See "CAUTION" on page 3E-3 of this section.*

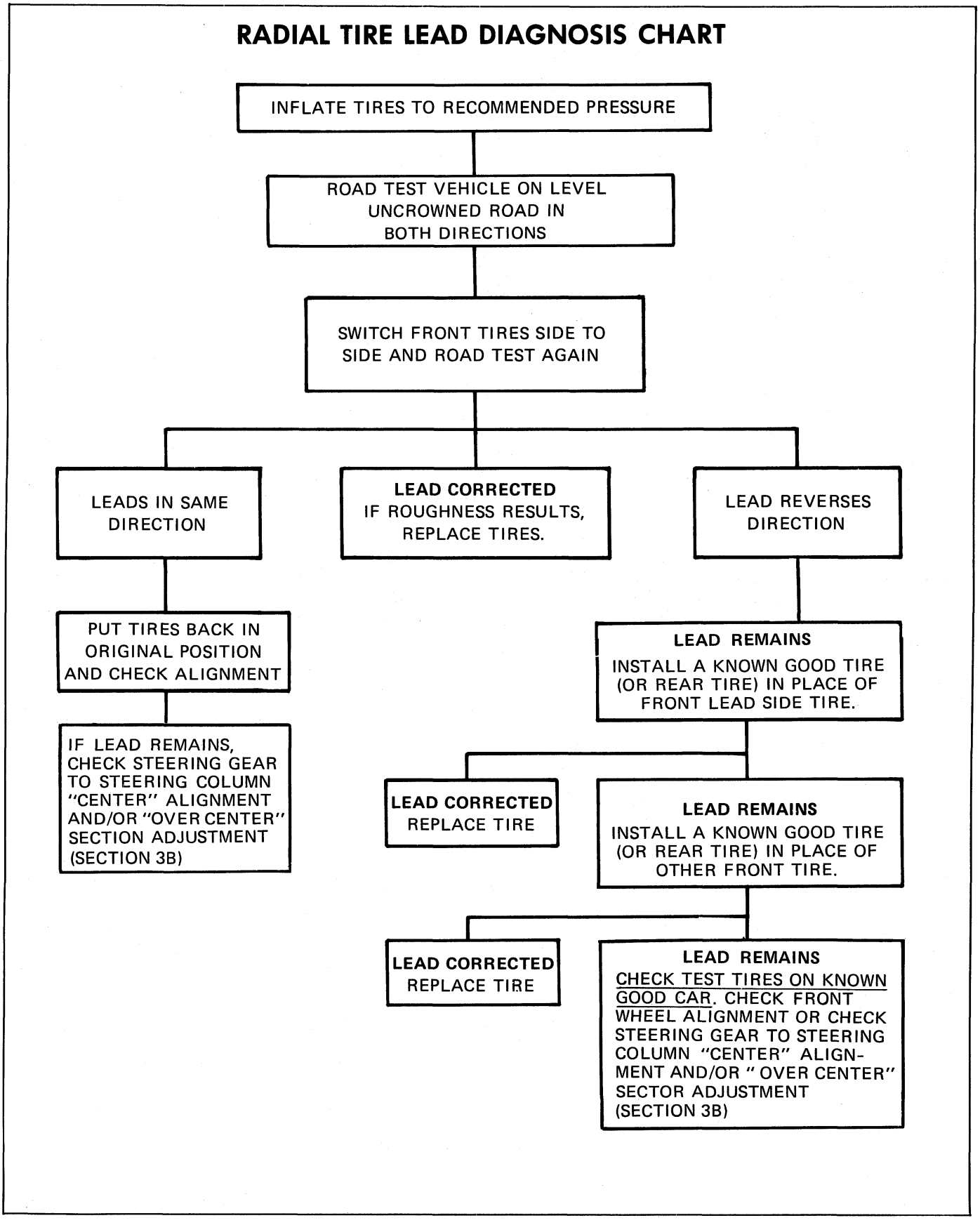


Fig. 3E-14 Lead Diagnosis Chart

WHEEL, VALVE AND FASTENING TABLE

Wheel, Valve and Fastening Table	DeVille & Seville	Brougham	Limousine	Commercial	Eldorado
Tire Size	GR 78-15/B	HR 78-15/B	HR 78-15/D	HR 78-15LT/E	LR 78-15/B
T.P.C. Spec. No.	1003	1001	1021	—	1005
Wheel Size & Flange Type	15x6JJ	15x6JJ	15x6JK	15x6JK	15x6JK
Spider to Rim Attachment	Spot Welded	Spot Welded	Riveted	Riveted	Riveted
Offset (Rim Center Line to Mounting Surface)	.50 In.	.50 In.	.50 In.	.50 In.	3.31 In.
Wheel Identification	SL	SL	SM	SM	SD
Valve Stem	T.R. 413 or T.R. 418	T.R. 413 or T.R. 418	T.R. 413 or T.R. 418	T.R. 416S	T.R. 417
(Number of Fasteners) Bolt Circle	(5), 5.0 In.	(5), 5.0 In.	(5), 5.0 In.	(5), 5.0 In.	(5), 5.0 In.
Fastener Torque	100 Ft. Lbs.	100 Ft. Lbs.	100 Ft. Lbs.	100 Ft. Lbs.	130 Ft. Lbs.

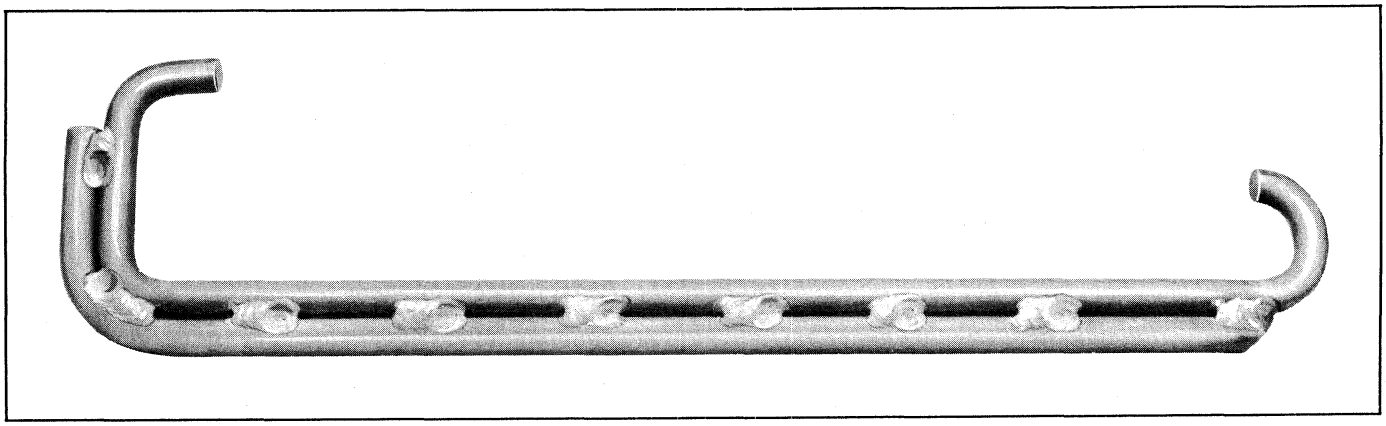


Fig. 3E-15 Special Tools

Key	Tool No.	Name
A	J-24842-01	Suspension Arm Hook (Eldorado)

PROPELLER SHAFT
TABLE OF CONTENTS

General Description 4A-1
Diagnosis 4A-3
On-Car Service 4A-2
Propeller Shaft Rebalancing - On-Car 4A-2
Propeller Shaft - Removal and Installation - Except Limousine and Commercial Chassis 4A-5
Propeller Shaft - Removal and Installation - Limousine and Commercial Chassis 4A-6
Unit Repair
Universal Joint - Constant Velocity 4A-7
Link Yoke 4A-8
Centering Ball 4A-8
Ball Seat 4A-9
Propeller Shaft - Limousine and Commercial Chassis 4A-10
Front Section 4A-10
Centering Ball 4A-11
Universal Joint - Front - Limousine, Commercial Chassis, and Seville 4A-12
Specifications 4A-13
Special Tools 4A-14

GENERAL DESCRIPTION

Propeller Shaft-Except Limousine, Commercial and Seville

A one-piece propeller shaft assembly, Fig. 4A-1, is used on all styles except Fleetwood Limousines, Commercial Chassis.

Double Cardan constant velocity universal joints, Fig. 4A-3, are used on both the front and rear of the shaft. A Double Cardan joint consists of two single joints connected by a special link yoke. A ball and socket centering device is located between the crosses to maintain their relative positions, causing each cross to operate through one half of the total angle across the joint.

Any time a constant velocity joint is disassembled, inspect the centering ball for corrosion, distortion or wear before continuing procedure. A new replaceable centering ball is used, avoiding the need to replace the entire shaft if such wear exists. A replacement ball seat kit must be installed in the corresponding yoke whenever a centering ball is replaced.

Propeller Shaft-Seville

A one piece propeller shaft assembly, Fig. 4A-1, is used to transmit power from the transmission output shaft to the differential.

A single cardan universal joint is used at the front of the shaft and a double cardan constant velocity joint, made up of two single joints connected by a special link yoke is used at the rear. A ball and socket centering device is located between the crosses of the rear joint to maintain their relative positions, causing each cross to operate through one half of the total angle across the joint.

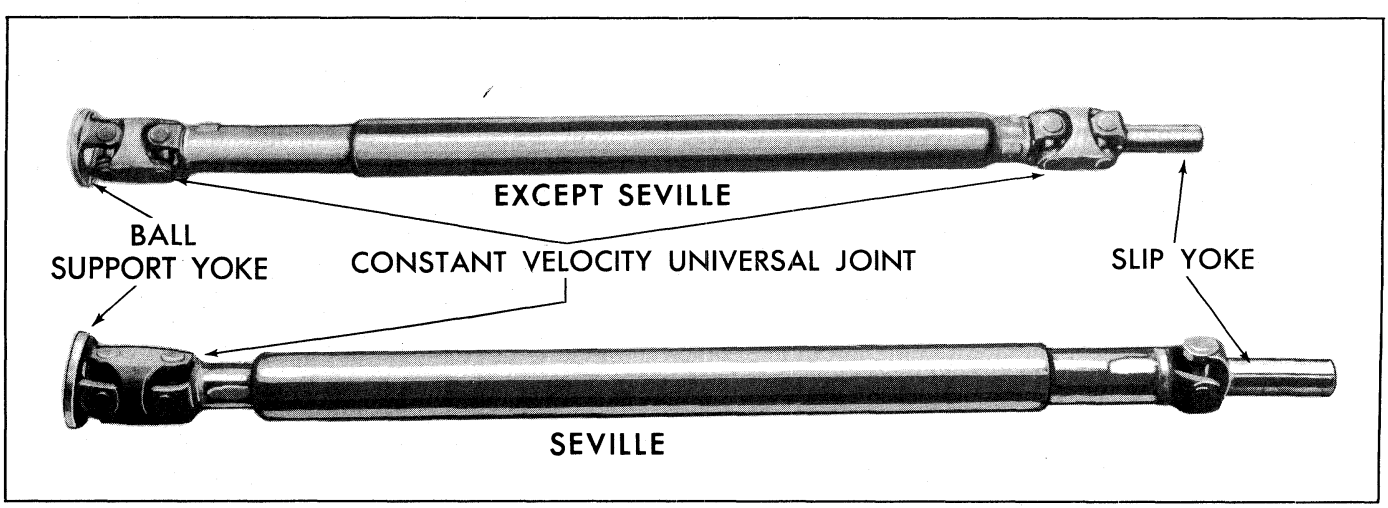


Fig. 4A-1 Propeller Shaft-Except Limousine, Commercial Chassis

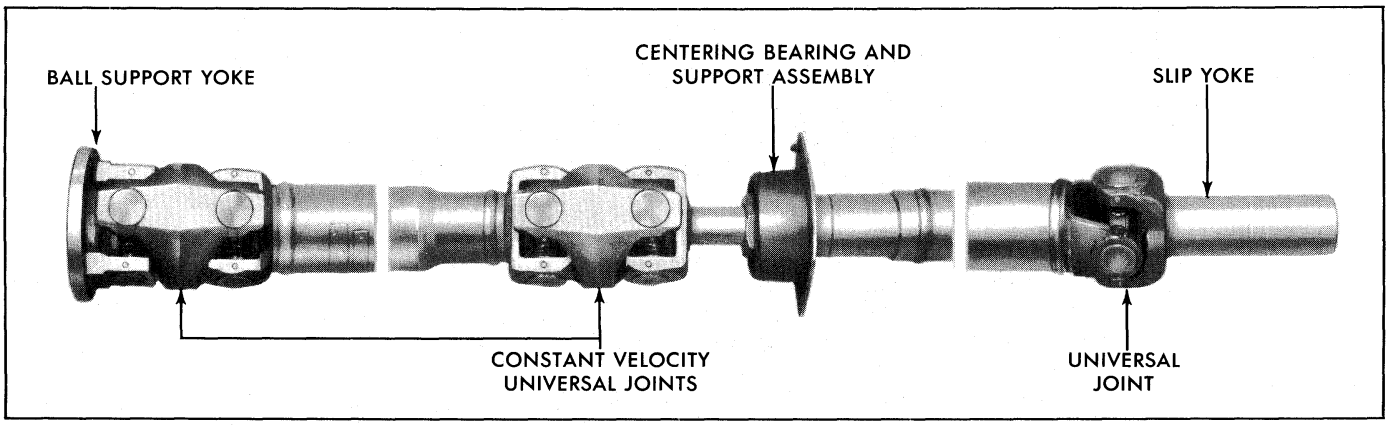


Fig. 4A - 2 Propeller Shaft-Limousine, Commercial Chassis

Propeller Shaft–Limousine and Commercial

A two-piece propeller shaft assembly, Fig. 4A-2, is used on the Limousine and Commercial Chassis. Attachments at the transmission output shaft and differential carrier are identical to those of the single piece shaft. Double Cardan joints are located at the center and axle end of the propeller shaft assembly. A single Cardan joint is used at the transmission end.

The assembly is supported at the center by a center bearing and support and bracket assembly attached to a frame crossmember.

As on the one-piece shaft, components that can be serviced separately from the tube include the centering ball, ball seat assembly, bearing cups, crosses, link yokes, slip yoke and ball support yoke.

In addition, the center bearing and the center bearing support assembly are serviceable.

ON CAR SERVICE

CAUTION: *If any mispositioning, incorrect assembly, or failure of components in the area of the brake system pipes, hoses, or cylinders is observed, be sure to check for any brake damage that may have resulted from such a condition and correct as required. Components that could damage the brake system due to mispositioning, incorrect assembly, or failure include the exhaust system, shock absorbers, springs and stabilizer bar.*

When raising rear of car, support car weight at underbody or axle or both.

The following caution applies to certain steps in the assembly procedure of components in this section. The critical fasteners to which this caution applies are identified by the terminology. *See "CAUTION" on page 4-2.*

CAUTION: *This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.*

Propeller Shaft Rebalancing–On Car

1. Road test car (with owner if possible) to determine nature and speed ranges of complaint.

2. Raise car so that rear axle housing is supported and remove rear wheel and tire assemblies.

3. If car was not road tested, start engine, engage transmission and run speedometer slowly from 0-80 MPH. Note speeds at which roughness is closest to owner's complaint.

NOTE: Disturbance due to propeller shaft unbalance is most likely to occur at 30-35 MPH or at freeway speeds (approximately 60 MPH).

4. At the suspected unbalanced end of shaft, number the joint bearing cups from 1 through 4. See Fig. 4A-3

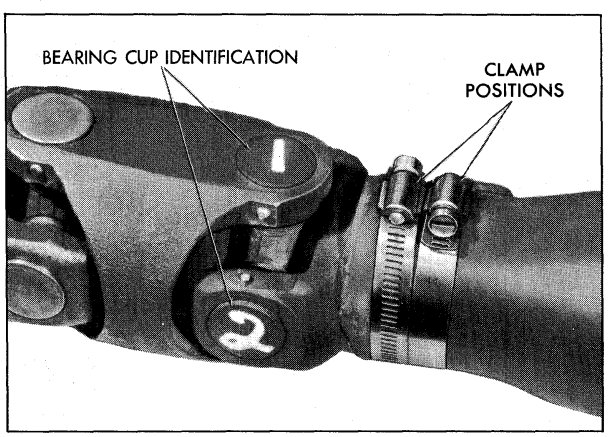
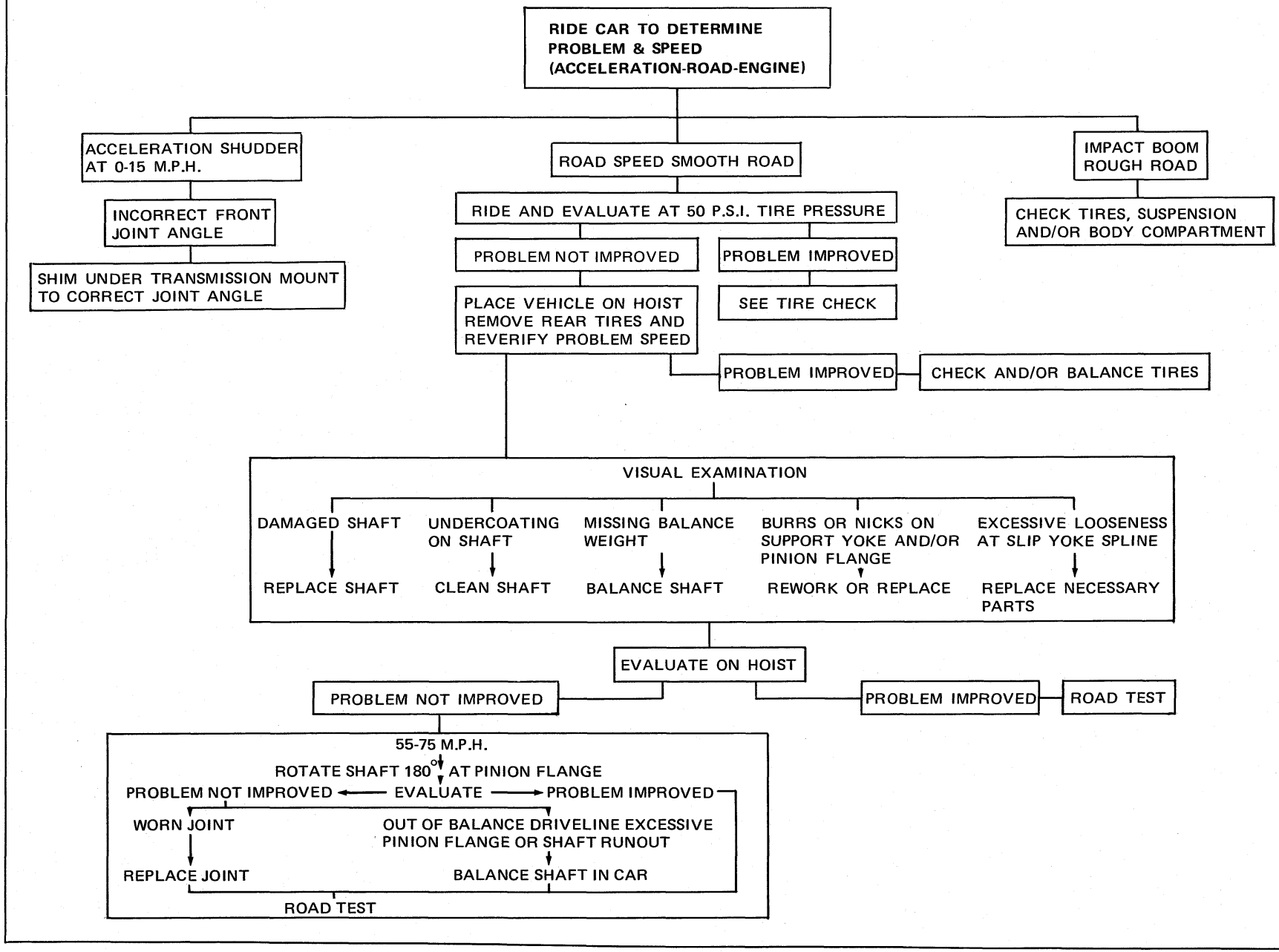


Fig. 4A-3 Clamps in Position 1 (Rear)

DIAGNOSIS

PROPELLER SHAFT TROUBLE DIAGNOSIS		
Condition	**Possible Cause**	**Correction**
Leak at front slip yoke. (An occasional drop of lubricant leaking from splined yoke is normal and requires no attention.)	1. Rough outside surface on slip yoke.	1. Replace seal if cut by burrs on yoke. Minor burrs can be smoothed by careful use of crocus cloth or honing with a fine stone. Replace yoke if outside surface is rough or burred badly.
	2. Defective transmission rear oil seal.	2. Replace transmission rear oil seal.
		3. Bring transmission oil up to proper level after correction.
Knock in drive line clunking noise when car is operated under float condition at 10 mph in "Neutral".	1. Worn or damaged universal joints.	1. Replace.
	2. Side gear hub counterbore in differential worn oversize.	2. Replace differential case and/or side gears as required.
Ping, snap, or click in drive line.	1. Loose upper or lower control arm bushing bolts.	1. Tighten bolts to specified torque.
	2. Worn or damaged Universal joints.	2. Replace
Roughness on heavy acceleration (short duration).	1. Double cardan joint ball seats worn. Ball seat spring may be broken.	1. Replace with ball seat repair kit. If centering ball is badly worn, replace.

PROPELLER SHAFT DIAGNOSIS
VIBRATION, ROUGHNESS, RUMBLE AND/OR BOOM



5. Install two aircraft type hose clamps (size 40 or 44) on swedged down portion of shaft so both clamp screws are aligned with position #1 on the first joint to be checked, Fig. 4A-3.

EVALUATION CHART

CLAMP POSITIONS		#1	#2	#3	#4
FRONT JOINT	Two Clamps				
	Three Clamps				
REAR JOINT	Two Clamps				
	Three Clamps				

W - Worse
N - No Change
I - Improved Slightly
S - Substantial Improvement
A - Acceptable

6. Run rear wheels to speed of disturbance and evaluate. Indicate test results on evaluation chart as shown above.

7. Rotate clamps to position 2 and repeat Step 6. Continue test until all four positions have been checked.

If improvement is found at any location, add another clamp and check for further improvement. Do not add more than five clamps in this manner.

If more weight is required to balance joint, propeller shaft should be removed from car and sent to an approved machine shop for rebalance.

If no improvement is found at any of the four positions, proceed to next joint and repeat Steps 4 through 6 of this procedure.

8. When best possible improvement is achieved, road test car. Often roughness noticeable on hoist will disappear when car is driven on road.

9. Make sure clamps are tight and have sufficient clearance to underbody and catalytic converter under all operating conditions. Clamps are to be left on car as permanent fixture.

10. Lower car to floor.

Propeller Shaft Assembly

a. Removal

1. Raise car on hoist with transmission in Park. Mark shaft relationship to axle pinion flange.

2. Remove four ball support yoke attaching screws.

CAUTION: *Do not permit propeller shaft to be supported by the front universal joint only, as damage may result. Rear of propeller shaft must be supported to underbody. A fan belt or piece of wire may be used, Fig. 4A-5.*

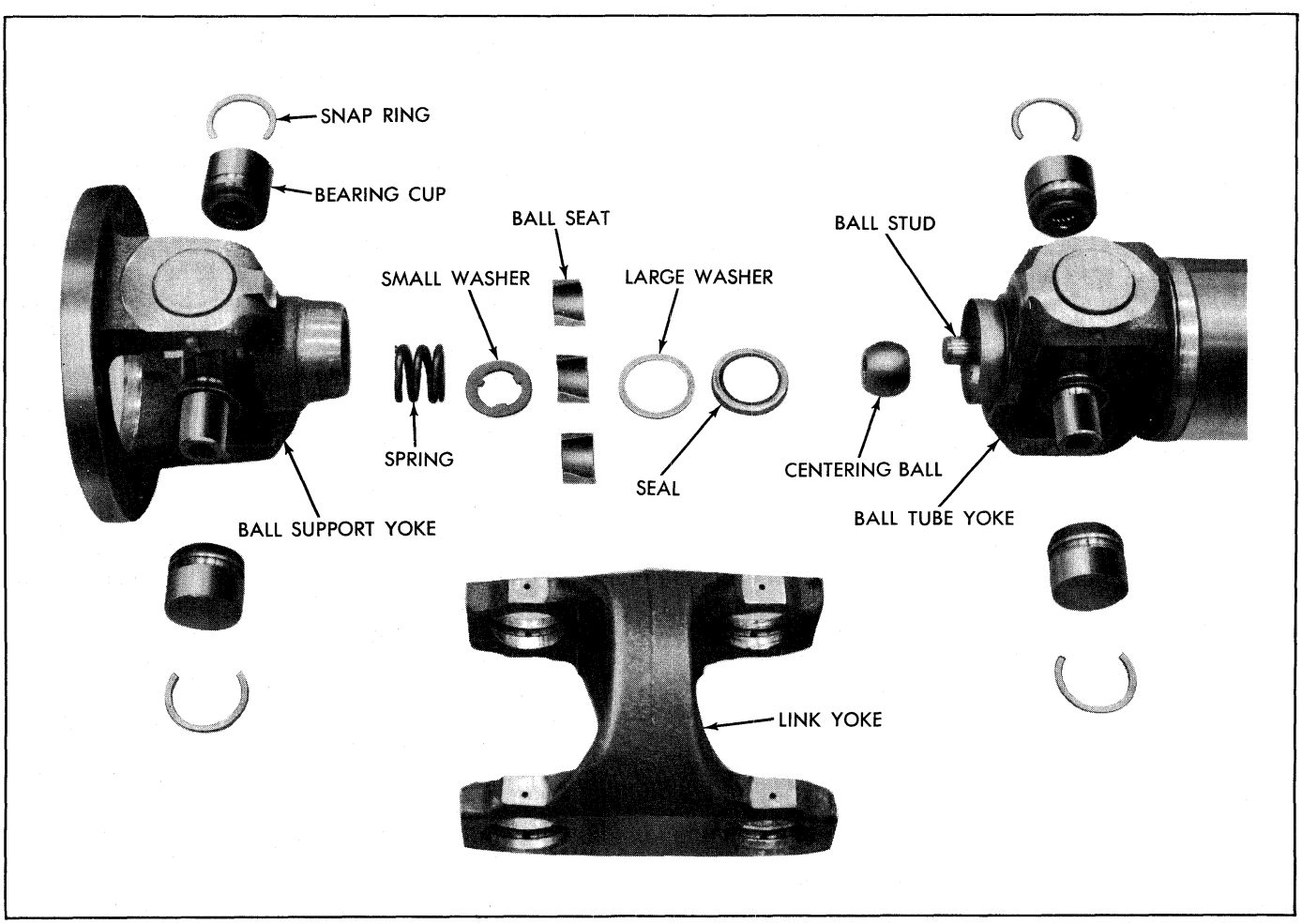


Fig. 4A-4 Rear Double Cardan Joint

NOTE: Have container ready to catch fluid which may leak from transmission when slip yoke is removed. If using twin-post hoist, lower front of car a foot or two, to reduce loss of transmission fluid.

3. Remove propeller shaft by pushing shaft forward to clear pinion flange, then pull shaft rearward to disengage slip yoke.

4. Install a clean cardboard shipping cover or similar device on slip yoke, to protect it from damage.

5. Install spare, clean slip yoke into transmission extension housing to prevent loss of fluid and entrance of dirt.

b. Installation

1. Remove any nicks, burrs, dirt or rust from differential pinion flange face and from face of mating flange of ball support yoke.

2. Inspect transmission extension housing oil seal and replace if necessary. Pack slip yoke lubricant, Part No. 105 0169, or equivalent, between lips of extension housing seal.

3. Remove cardboard cover and clean slip yoke. Inspect outer surface for rust, scratches, or gouges.

Check internal splines for damage. If damage to yoke is **not** evident, yoke does not require replacement. Minor burrs can be smoothed by careful use of crocus cloth or honing with a fine stone. Replace yoke if outside surface is rough or badly burred.

4. Thoroughly clean slip yoke with mineral spirits or kerosene and dry with compressed air.

Lubricate I.D. of slip yoke with approximately two tablespoons of propeller shaft slip yoke lubricant, Part No. 105 0169, or equivalent and lubricate O.D. with transmission fluid.

5. Remove spare yoke previously installed in transmission extension housing, and pack slip yoke lubricant, Part No. 105 0169, or equivalent, between lips of transmission extension housing seal. Install slip yoke on transmission output shaft.

6. Position ball support yoke flange to pinion flange as marked upon removal and install four screws. Torque screws to 70 foot-pounds.

CAUTION: *See "CAUTION" on page 4-2.*

7. Lower car and check transmission fluid level as described in Section 7.

Propeller Shaft Assembly–Limousine and Commercial

a. Removal

1. Raise car on hoist with transmission in neutral. Mark shaft relationship to axle pinion flange.

2. Remove two accessible ball support yoke attaching screws.

CAUTION: *Do not permit propeller shaft to be supported by the front or center universal joint only, as damage may result. Rear of propeller shaft must be supported to underbody. A fan belt or piece of wire may be used, Fig. 4A-5.*

3. Rotate propeller shaft and remove two remaining screws.

4. Pull rear half of shaft forward to clear pinion flange and support rear end of shaft.

5. Remove the two center bearing support to frame bolts and nuts.

NOTE: Have container ready to catch fluid which may leak from transmission when slip yoke is removed.

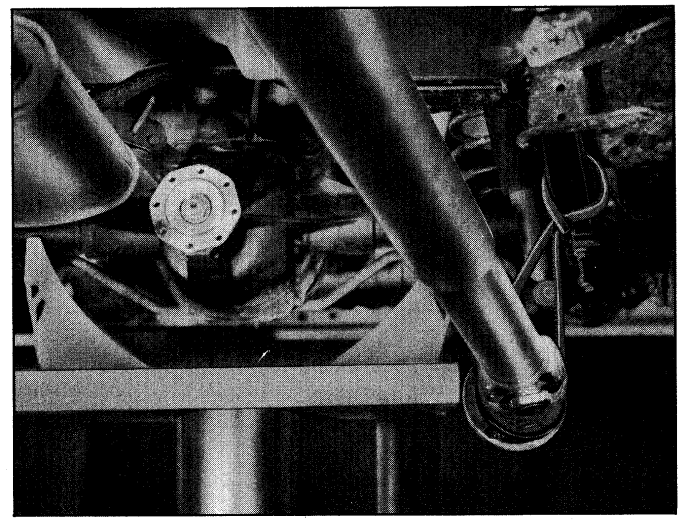


Fig. 4A-5 Supporting Propeller Shaft

6. Slide propeller shaft rearward until slip yoke comes off of transmission output shaft and install cardboard shipping cover, or similar protective device on slip yoke. The cardboard cover will prevent nicking of the yoke during removal as well as keeping the yoke as clean as possible.

7. Lower propeller shaft from chassis.

8. Install a spare yoke into transmission extension housing to prevent loss of fluid and entrance of dirt.

b. Installation

1. Remove any nicks, burrs, dirt, or rust from differential pinion flange face and from face of mating flange of ball support yoke.

2. Remove cardboard cover and clean slip yoke, if necessary, avoiding the use of anything that may scratch or damage yoke. Lubricate I.D. of slip yoke with approximately two tablespoons of propeller shaft slip yoke lubricant, Part No. 105 0169 or equivalent.

3. Lubricate O.D. of slip yoke with transmission fluid. Insert rear portion of propeller shaft in support and support front section of shaft by hand.

4. Remove spare yoke previously installed in transmission extension housing and pack slip yoke lubricant between lips of transmission extension housing seal. Install slip yoke on transmission output shaft.

5. Install two bolts and lock nuts securing center bearing support to frame crossmember, tightening to 18 foot-pounds.

6. Remove from support and position ball support yoke flange to pinion flange as marked upon removal and install two screws. Torque screws to 70 foot-pounds.

CAUTION: *See "CAUTION" on page 4-2.*

CAUTION: *Engage emergency brake or service brake to hold propeller shaft when tightening flange attaching screws. Do not use a pry bar or heavy tool as universal joint bearing seals could be damaged.*

7. Rotate propeller shaft to gain access to two remaining screw holes.

8. Install remaining two attaching screws. Torque screws to 70 foot-pounds. Remove support wire or belt used to support rear of shaft.

CAUTION: *See "CAUTION" on page 4-2.*

9. Lower car and check transmission fluid level as described in Section 7.

UNIT REPAIR

Universal Joint-(Constant Velocity)

a. Removal

1. Remove propeller shaft from car as described on page 4A-5.

2. Scribe or punch alignment marks on all yokes for proper orientation on reassembly, Fig. 4A-6

3. Support propeller shaft in horizontal position in line with base plate of press.

4. Place ordinary mechanics 1-1/4" socket on press, with open end facing upward.

NOTE: A piece of pipe of equal dimensions can be used in place of the 1-1/4" socket.

5. Position #1 bearing cups of link yoke over hole in socket.

NOTE: Link yoke bearing cups are pressed out first because replacement ball support yokes are supplied with a new cross already installed.

6. If working on joint that has been serviced previously, remove snap rings from grooves in bearing cups.

7. Install Cross Remover, J-9522-3, over link yoke, engaging sides of bearing cups, similar to Fig. 4A-10. Use press to shear nylon injection of link yoke bearing cups and press bearing cup out of yoke as far as possible.

NOTE: When press is operated, joint will angulate, causing opposite end of shaft to rise. This movement is necessary to remove bearing cups. Use other hand to support and guide shaft in its upward movement, and to lower shaft gently when press lever is released.

8. Release press and remove Cross Remover, J-9522-3. Lift up on cross and position Spacer, J-9522-5, around lower journal, similar to Fig. 4A-11.

9. Position Cross Remover, J-9522-3, and continue pressing bearing cup from link yoke.

10. Repeat Steps 8 and 9 for other #1 link yoke bearing cup.

11. Separate cross and ball support yoke from link yoke to gain access to centering ball.

12. Clean ball and examine thoroughly for rust, corrosion, distortion or excessive wear. If any of these conditions exist, replace ball and corresponding ball seat components.

NOTE: If ball does not need replacing, universal joint can be reassembled using a service kit which contains two bearing cup assemblies, retainers and seals, and two snap rings. Follow Steps 7 thru 11 of the installation procedure.

13. Position yoke and cross assembly on press and use Cross Remover, J-9522-3, to remove remaining bearing cups.

NOTE: Spacer, J-9522-5, is not necessary at this stage of procedure.

14. If ball support yoke cross is to be replaced, position yoke and cross assembly on press with #2 bearing cups over socket. Use cross remover J-9522-3, to remove remaining bearing cups, Fig. 4A-6.

NOTE: Spacer J-9522-5, is not necessary at this stage or procedure.

b. Installation

Whenever a universal joint or bearing cup is removed, a service kit must be installed, as production universal joints have no snap ring grooves. Install only complete universal joint repair kits. Kits include a new cross, four bearing cup assemblies, retainers and seals, and four snap rings, Fig. 4A-13.

1. Insert cross into ball support yoke.

2. Insert one bearing cup assembly by hand.

CAUTION: *Make certain all needles are properly seated in bearing cup. If any needles are missing or mispositioned, early failure will result.*

3. Adjust position of cross so that one leg of cross is all the way into bearing. make sure bearing is not cocked in yoke.

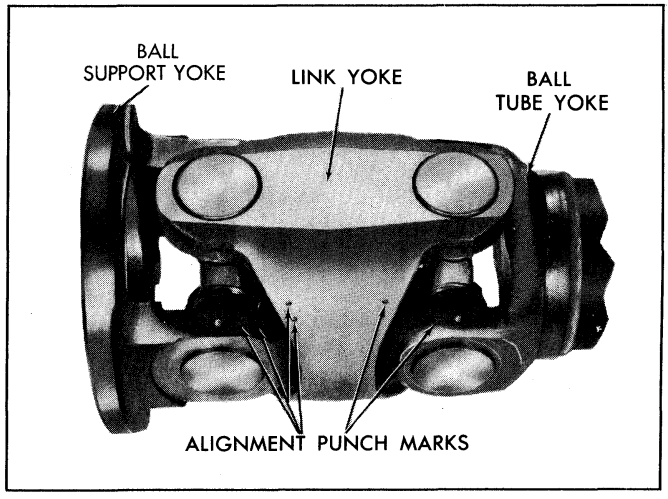


Fig. 4A-6 Alignment Marks on Yokes

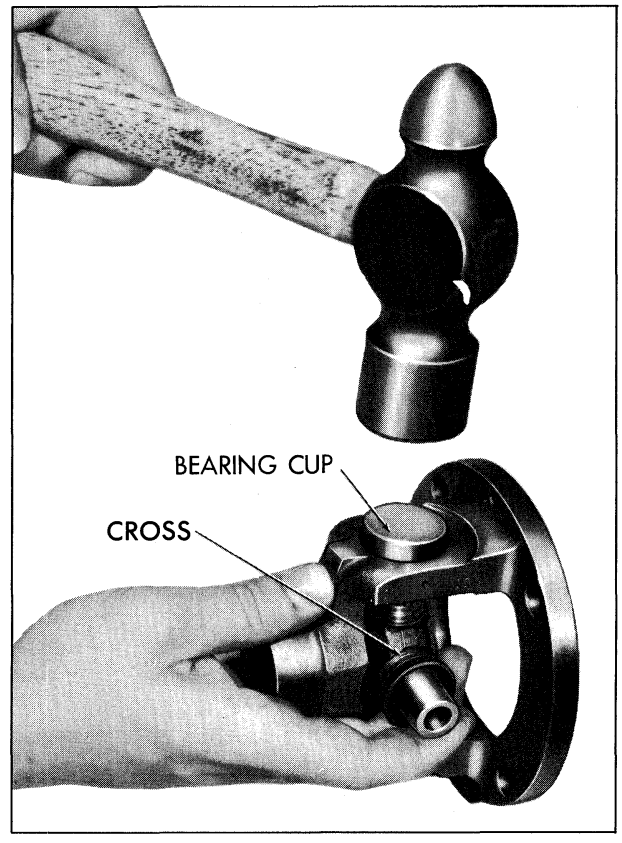


Fig. 4A-7 Installing Bearing Cups

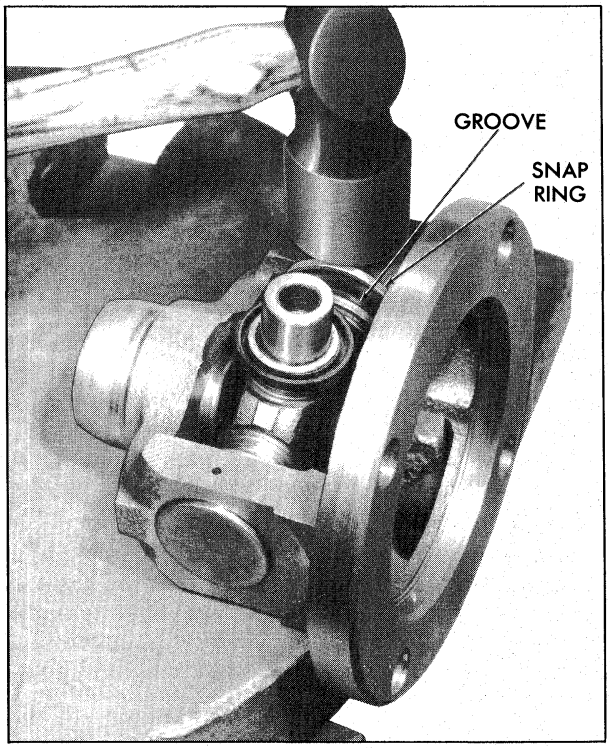


Fig. 4A-8 Installing Snap Ring (Rear)

4. Maintain position of cross in bearing to keep needles seated, and firmly tap bearing cup into yoke, Fig. 4A-7, until snap ring groove is exposed.

5. Install snap ring in groove in bearing cup, Fig. 4A-8.

6. Repeat Steps 2 through 5 for opposite bearing assembly.

7. Position link yoke over ball support yoke and cross assembly, observing alignment marks made on disassembly.

8. Repeat Steps 2 through 6 to install link yoke bearing cups.

9. Check cross for travel. Some resistance is normal and requires no further adjustment. If heavy resistance is encountered, strike yoke behind installed bearing cups, Fig. 4A-9

10. Install propeller shaft on car as outlined on page 4A-6.

11. Road test car. If a propeller shaft unbalance condition is found, rebalance serviced end of propeller shaft as outlined on page 4A-2.

Link Yoke

a. Removal (Fig. 4A-6)

NOTE: The link yoke can be replaced (serviced) without disassembly of the "U" joint from the tube yoke or ball support yoke.

1. Perform procedure on page 4A-7, Steps 1 through 11, to remove ball support yoke cross from link yoke and to inspect ball for damage.

2. Remove link yoke from inner cross by repeating Steps 5 through 11, page 4A-7, on #3 bearing cups.

b. Installation

1. Obtain a new link yoke and either a kit with two bearing cup assemblies and two snap rings or a complete universal joint assembly as required.

2. Position link yoke on inner cross and install two bearing cup assemblies by following page 4A-7, Steps 2 through 6.

3. Position support yoke cross in link yoke, orienting with tube yoke according to marks made on disassembly.

4. Repeat steps 2 through 6, page 4A-7, to install remaining bearing cups.

5. Install propeller shaft on car as outlined on page 4A-6.

6. Road test car. If a propeller shaft unbalance condition is found, rebalance serviced end of shaft as outlined on page 4A-2.

Propeller Shaft Centering Ball

a. Removal

1. To gain acess to centering ball, perform Steps 1 through 11, page 4A-7.

2. Clamp shaft in bench vise as shown in Fig. 4A-10 and install Ball Puller, J-23996-2, over ball. Tighten nut finger tight.

NOTE: A light coat of multi-purpose grease applied to outer surface of jaws of ball puller tool, will reduce friction between jaws and inside surface of tool sleeve.

3. Tighten nut until ball is removed from stud.

NOTE: Ball seat components must always be replaced when a new centering ball is installed. A ball and seat kit is available separately. Kit has two seat springs. Discard the pink "long" spring.

b. Installation

1. Position new ball on stud.

2. Position Ball Installer Tool, J-23996-1, against ball and drive with hammer, Fig. 4A-11, until ball bottoms on stud.

3. Re-assemble shaft using Steps 1 through 11, page 4A-7.

4. Install propeller shaft as described on page 4A-7.

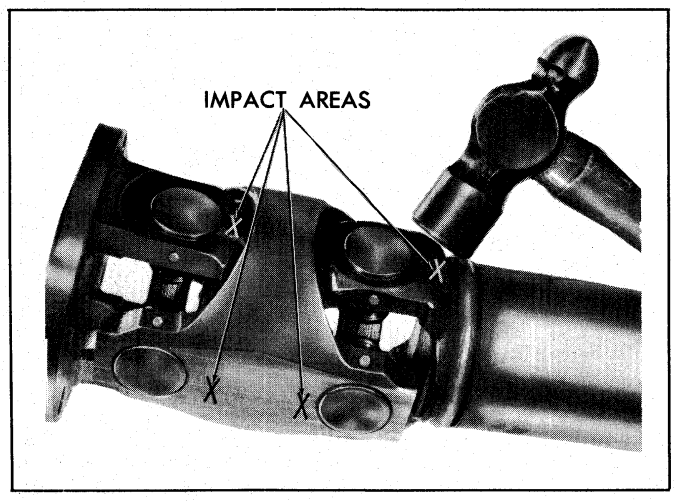


Fig. 4A-9 Seating Bearing Cups and Snap Rings (Rear)

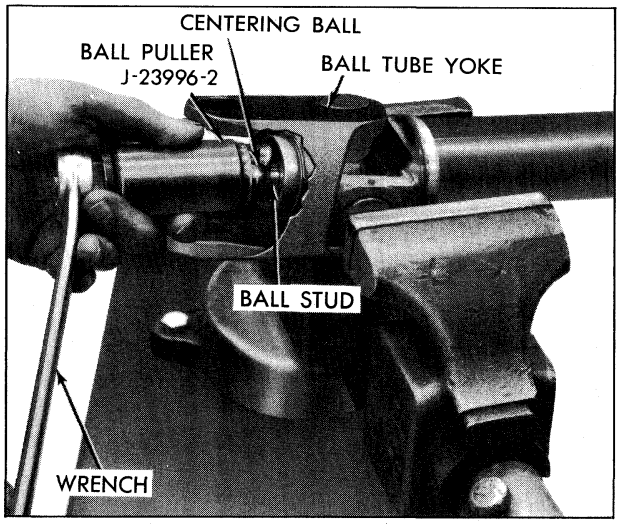


Fig. 4A-10 Removing Centering Ball

Ball Seat Assembly (Fig. 4A-4)

a. Disassembly

1. Remove propeller shaft from car, page 4A-5.

2. Remove ball support yoke from shaft to gain access to centering ball, following page 4A-7, Steps 1 through 11.

3. Clean ball and examine thoroughly for rust, corrosion, distortion or excessive wear. If any of these conditions exist, replace ball and corresponding ball seat components.

NOTE: If ball does not need replacing, universal joint can be reassembled using a service kit which contains two bearing cup assemblies, retainers and seals, and two snap rings. Follow page 4A-7, Steps 7 through 11.)

4. Pry grease seal from ball seat housing.

CAUTION: *Take care not to damage seal bore when prying seal.*

5. Remove large washer, three seats, small washer, and spring from seat housing.

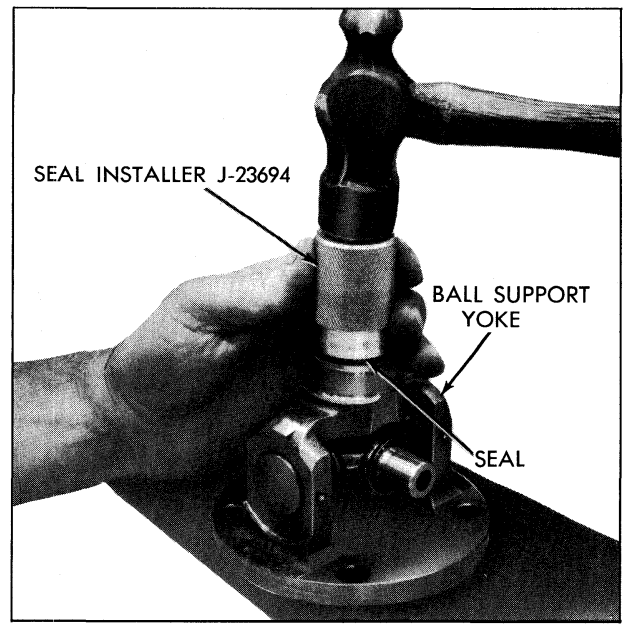


Fig. 4A-12 Installing Ball Support Yoke Seal

6. Wash bore of housing thoroughly with mineral spirits to remove all traces of old lubricant and dry thoroughly with compressed air.

b. Assembly

NOTE: A ball and seat kit is available separately. It has two springs. Discard the pink "long" spring.

1. Obtain ball and seat kit, Fig. 4A-4.

2. Liberally grease the I.D. of the seat housing.

3. Insert spring, small washer, three seats, and large washer into housing, thoroughly greasing each part as it is inserted.

4. Place grease seal on housing with seal lip facing down into bore.

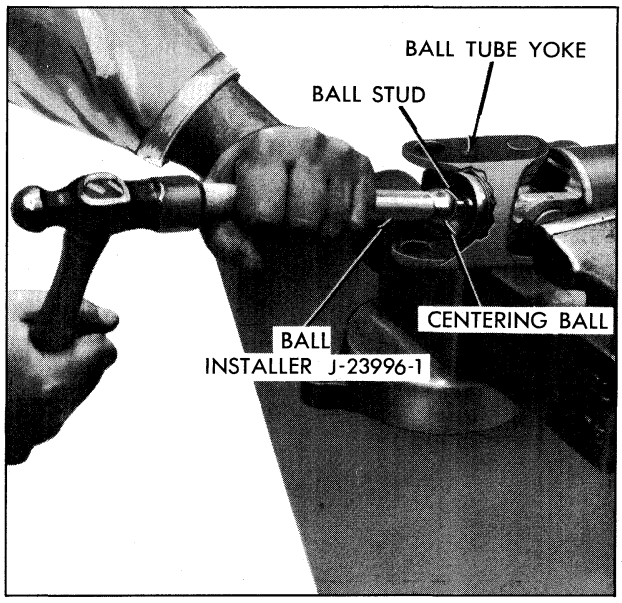


Fig. 4A-11 Installing Centering Ball

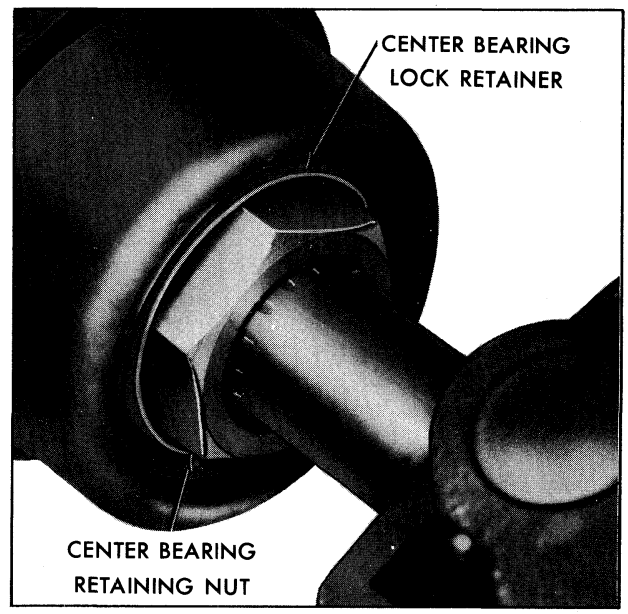


Fig. 4A-13 Propeller Shaft Retainer

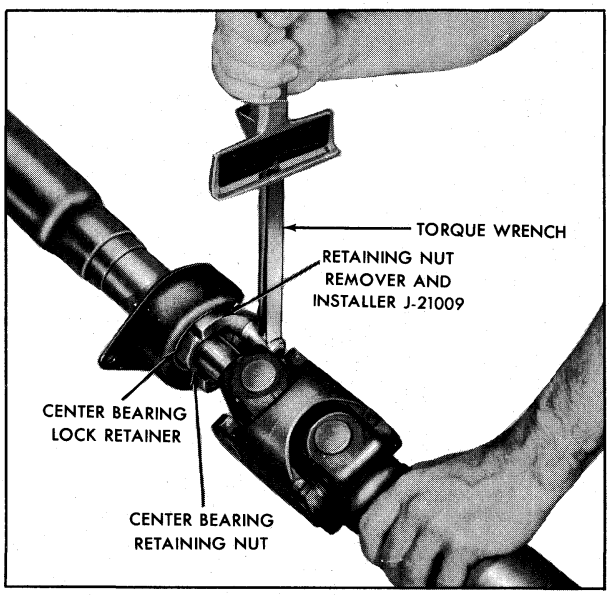


Fig. 4A-14 Tightening Center Bearing Retaining Nut

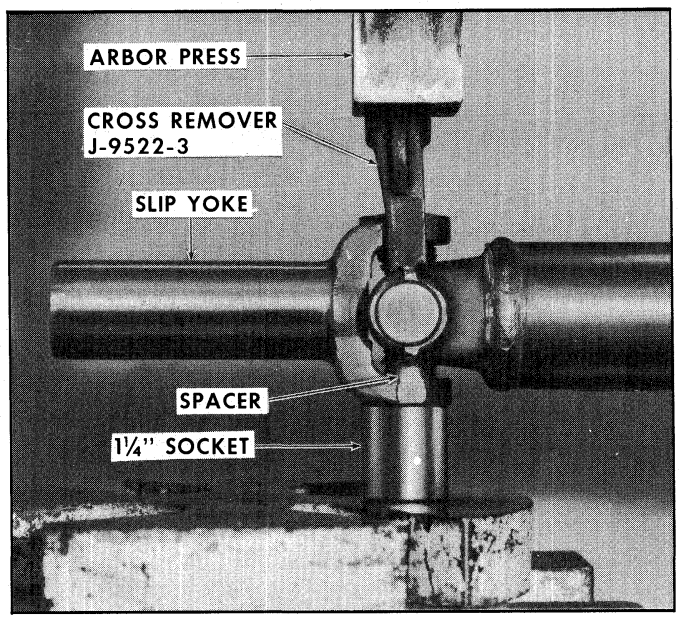


Fig. 4A-16 Position of Spacer on Cross

5. Place Seal Installer, J-23694, over seal and tap seal into place, Fig. 4A-12. Seal is installed when flush with housing.

6. Pack remaining grease in seat assembly and on seal. Make sure inner surfaces of seats are liberally lubricated.

7. Position yoke and cross assembly in link yoke and install bearing cups, observing procedure in page 4A-7, Steps 2 through 6.

8. Install propeller shaft, page 4A-6.

9. Rebalance serviced end of shaft as outlined on page 4A-2.

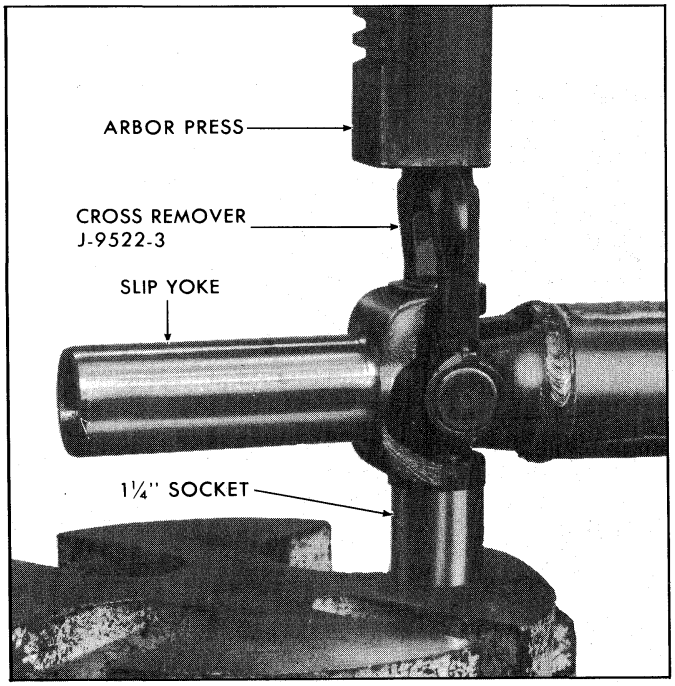


Fig. 4A-15 Removing Bearing Cups

Front Section–Limousine and Commercial

a. Disassembly

1. Remove propeller shaft assembly as described on page 4A-5.

2. Pry up center bearing lock retainer, Fig. 4A-13.

3. Back off center bearing retaining nut, using Center Bearing Retaining Nut Remover and Installer, J-21009, and separate front and rear propeller shafts by sliding front shaft off center slip yoke.

4. Remove and discard center bearing lock retainer if damaged.

5. Remove center slip yoke seal, split washer, and center

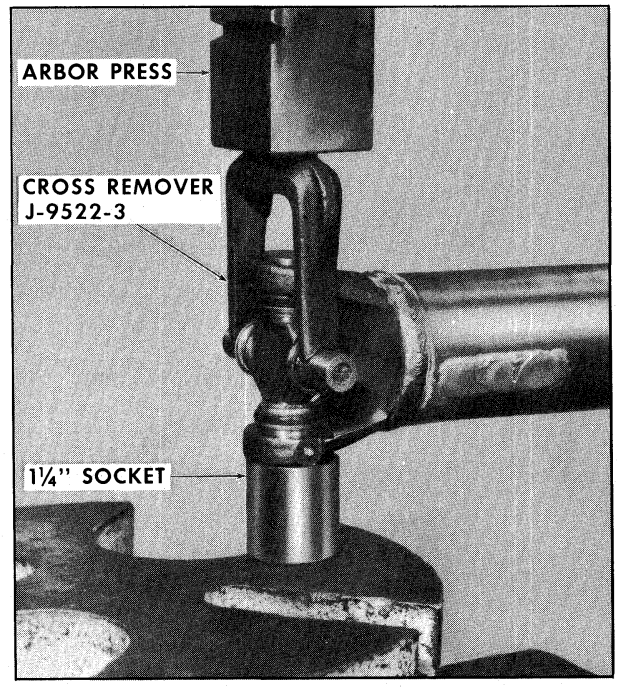


Fig. 4A-17 Removing Cross

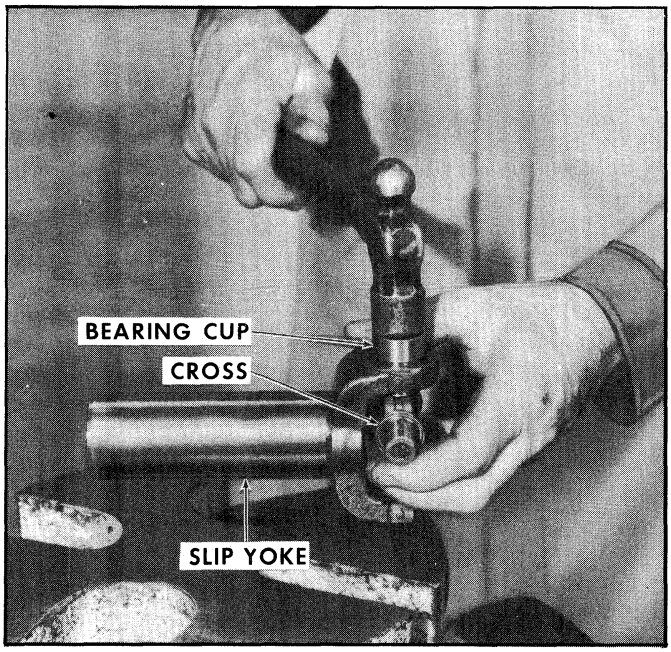


Fig. 4A-19 Installing Bearing Cups in Slip Yoke

bearing retainer nut from slip yoke. Inspect for damage or excessive wear.

b. Assembly

1. Clean spline of center slip yoke.
2. Install center bearing retaining nut on slip yoke with threaded end toward front propeller shaft.
3. Install split washer, being sure to slide washer securely against inner shoulder or retaining nut.
4. Slide slip yoke seal over center slip yoke and into retaining nut.
5. Install new center bearing lock retainer on center slip yoke.
6. Coat inner spline of front propeller shaft and spline of center slip yoke with center bearing slip yoke lubricant, Part No. 1050191, or equivalent.
7. Align wire clip on end of center slip yoke with missing land on inner spline of front shaft and slide center slip yoke into front propeller shaft spline.
8. Tighten center bearing retaining nut to 55 foot-pounds using Center Bearing Retaining Nut Remover and Installer, J-21009, and a torque wrench. Fig. 4A-14.

CAUTION: *Particular care should be taken in application of torque wrench and installer tool, to prevent over-torquing the nut. Hold torque wrench perpendicular to installer tool to cancel off-set error on torque reading.*

Bend edge of center bearing lock retainer in two places of lock center bearing retaining nut.

10. Install propeller shaft assembly as described on page 4A-6.

Center Bearing–Limousine and Commercial

a. Removal

1. Remove propeller shaft assembly as described on page 4A-6.
2. Disassemble front and rear propeller shafts as described on page 4A-10.
3. Remove center bearing support and bracket assembly from front propeller shaft by tapping on front side of assembly with a soft head hammer or through a block of wood.
4. Remove slinger from end of propeller shaft.

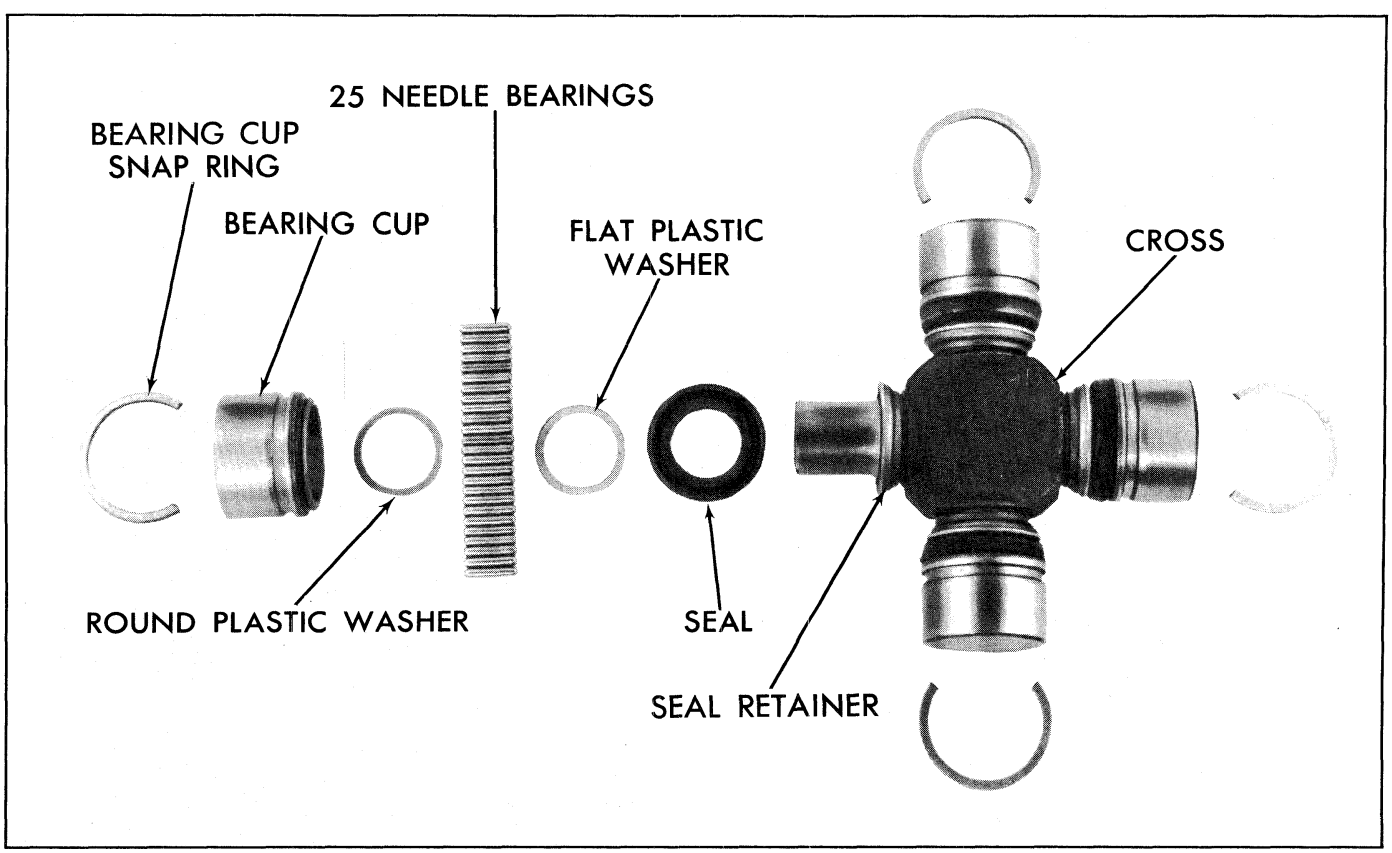


Fig. 4A-18 Universal Joint Service Kit

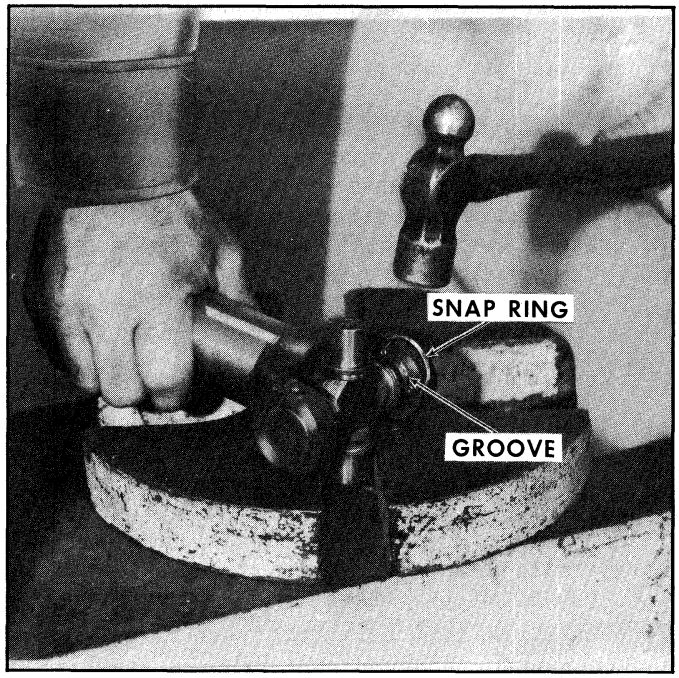


Fig. 4A-20 Installing Snap Rings

5. Pry out snap ring from open side of bearing retainer and remove bearing from support bracket by tapping lightly from rear with a soft head hammer, or through a block of wood.

b. Installation

1. Install bearing into bearing retainer, pressing on outer race of bearing only. use care not to damage bearing or support. Secure bearing in retainer with snap ring.

2. Pack front and rear face of center bearing with artic #5 grease or other heavy duty lubricant, such as water pump grease.

3. Install slinger on front propeller shaft.

4. Position center bearing support assembly on rear of front propeller shaft with snap ring facing rear end of shaft. (It may be necessary to tap alternately on inner race of bearing with a brass drift to permit clearance for installing retaining nut.)

5. Assemble front and rear propeller shafts as described on page 4A-11.

6. Install propeller shaft assembly as described on page 4A-6.

Universal Joint-Front - Limousine, Commercial Chassis and Seville

a. Removal

1. Remove propeller shaft from car as described on page 4A-6.

2. Scribe or punch alignment marks on all yokes for proper orientation on reassembly, Fig. 4A-6.

3. Support propeller shaft in horizontal position in line with base plate of press.

4. Place ordinary mechanics 1-1/4" socket on press, with open end facing upward.

NOTE: A piece of pipe of equal dimensions can be used in place of 1-1/4" socket.

5. Position one ear of the slip yoke over hole in socket.

6. If working on joint that has been serviced previously, remove snap rings from grooves in bearing cups.

7. Install Cross Remover, J-9522-3, over slip yoke, engaging sides of bearing cups, Fig. 4A-15. Use press to shear nylon injection of yoke bearing cups and press bearing cup out of yoke as far as possible.

8. Release press and remove Cross Remover, J-9522-3. Lift up on cross and position Spacer, J-9522-5, around lower journal, Fig. 4A-16.

9. Position Cross Remover, J-9522-3, and complete pressing of bearing cup from yoke.

10. Repeat Steps 8 and 9 for other slip yoke bearing cup.

NOTE: if disassembly was made only to replace slip yoke, propeller shaft can be reassembled at this time using a new slip yoke and two new bearing cups and snap rings. Observe alignment marks made on disassembly.

11. Position tube yoke and cross assembly over socket on press and use Steps 6 through 10 to remove remaining bearing cups, Fig. 4A-17.

NOTE: Spacer, J-9522-5 is not necessary at this stage of procedure.

b. Installation

Whenever a universal joint or bearing cup is removed, a service kit must be installed, as production universal joints have no snap ring grooves. Install only complete universal joint repair kits. Kits include a new cross, four bearing cup assemblies, retainers and seals, and four snap rings. Fig. 4A-18

1. Position cross into slip yoke.

2. Insert one bearing cup assembly by hand.

CAUTION: *Make certain all needles are properly seated in bearing cup. If any needles are missing or mispositioned, early failure will result.*

3. Adjust position of cross so that one leg of cross is all the way into bearing. Make sure bearing is not cocked in yoke.

4. Maintain position of cross in bearing to keep needles seated, and firmly tap bearing cup into yoke, Fig. 4A-19, until snap ring groove is exposed.

5. Install snap ring in groove in bearing cup, Fig. 4A-20.

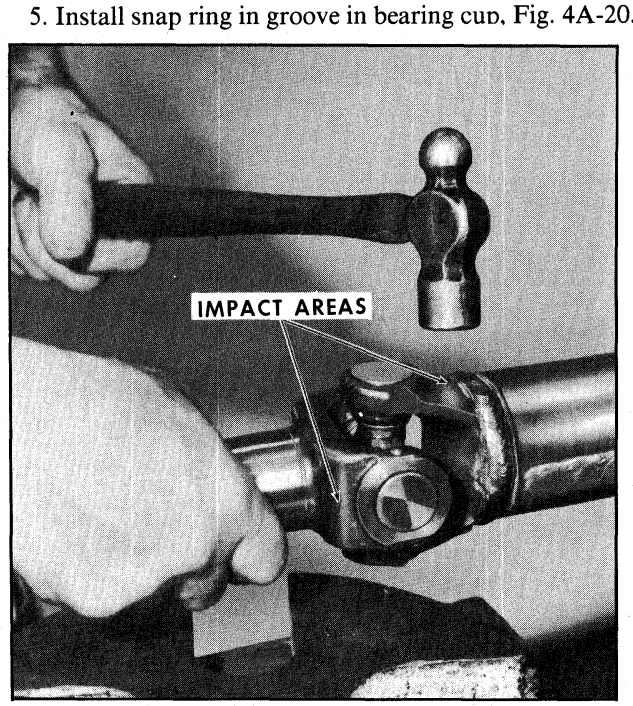


Fig. 4A-21 Seating Bearing Cups and Snap Rings

6. Repeat Steps 2 through 5 for opposite bearing assembly.

7. Position tube yoke over slip yoke and cross assembly, observing alignment marks made on disassembly.

8. Repeat Steps 2 through 6 to install tube yoke bearing cups.

9. Check cross for travel. Some resistance is normal and requires no further adjustment. If heavy resistance is encountered, strike yokes behind installed bearing cups, Fig. 4A-21.

10. Install propeller shaft on car as outlined on page 4A-6.

11. Road test car. If a propeller shaft unbalance condition is found, rebalance serviced end of shaft as outlined on page 4A-2.

TORQUE SPECIFICATIONS

Material No.	Application	Size	Foot-Pounds
300M	Pinion Flange to Universal Joint Flange Attaching Screws	7/16-14	70*
Special	Propeller Shaft Center Bearing Retaining Nut (Limousine and Commercial)	1-9/16-18	55
300-M	Center Bearing Support Bolts (Limousine and Commercial)	5/16-18	18
NOTE: Refer to back of manual for bolt and nut markings and steel classifications.			

**CAUTION: This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.*

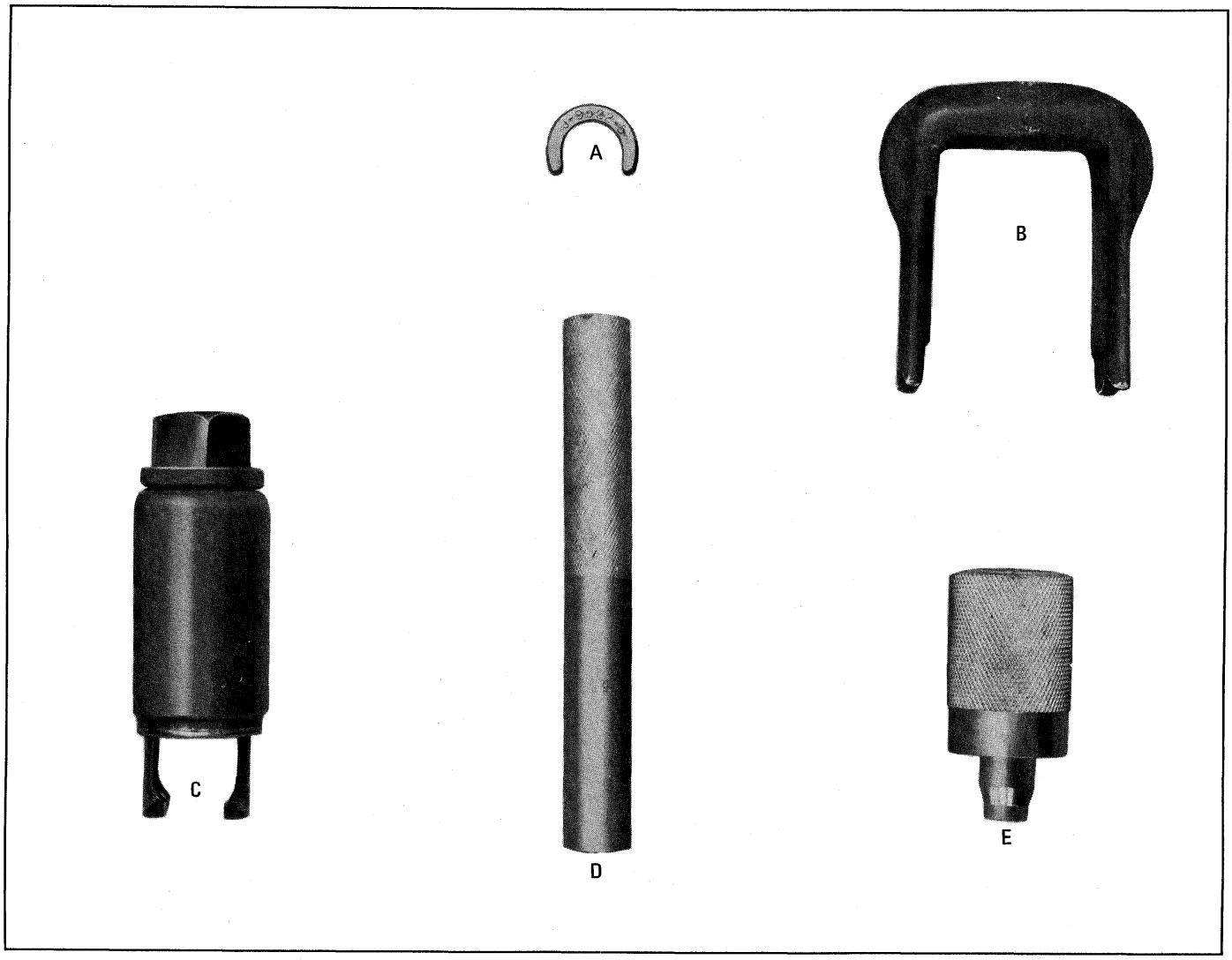


Fig. 4A-22 Special Tools

Key	Tool No.	Name	Key	Tool No.	Name
A	J-9522-5	Spacer	C	J-23996-2	Ball Puller Tool
B	J-9522-3	Cross Remover	D	J-23996-1	Ball Installer Tool
			E	J-23694	Ball Seat Seal Installer

AXLE SHAFTS AND DIFFERENTIAL
TABLE OF CONTENTS

General Description
- Design 4B-1
- Operation 4B-1
- Standard Differential 4B-2
- Controlled Differential 4B-23
- Axle Shafts, Bearings and Oil Seals 4B-2
  - Rear Axle Eldorado 4B-25

Diagnosis
- Gear Noise 4B-4
- Bearing Noise 4B-4
- Knock at Low Speed 4B-5
- Backlash Clunk 4B-5
- Drive Line Squeal and Squeak 4B-5
- Vibration 4B-5
- Oil Leaks 4B-5
- Bearing Problem Conditions 4B-5

On Car Service
- Rear Axle - Except Eldorado and Seville 4B-8
  - Seville 4B-9
- Rear Axle Backlash Measurement 4B-9
- Axle Shaft 4B-9
- Pinion Oil Seal Replacement 4B-11

Unit Repair
- Differential - Standard 4B-12
- Drive Pinion 4B-15
- Gear Tooth Contact Pattern Check 4B-22
- Controlled Differential 4B-23
- Eldorado .....
  - Rear Wheel Bearing Adjustment 4B-25
  - Rear Hub 4B-26
  - Rear Wheel Bearings 4B-26
  - Rear Axle 4B-27

Specifications 4B-28
Torque Specifications 4B-28
Special Tools 4B-29

GENERAL DESCRIPTION

DESIGN

The differential is a device that divides torque equally to both axle shafts. It permits the rear wheels to turn together at the same speed or to turn at different speeds, as when making a turn. It is so designed that it will exert equal force to both wheels, although the amount of force available depends upon the traction under each tire.

The differential assembly is of the semi-floating type in which the car weight is carried on the axle housing. The differential assembly is designed for use with an open drive line and coil springs except Seville which has leaf springs. On Seville, the differential has a hypoid-type ring gear and pinion with the centerline of the pinion gear below the centerline of the ring gear (Fig. 4B-3).

All parts necessary to transmit power from the propeller shaft to the rear wheels are enclosed in a salisbury-type axle housing (a carrier casting with tubes pressed and welded into the carrier to form a complete carrier and tube assembly). A removable steel cover, bolted to the rear of the cover, permits service of the differential case without removing the entire axle assembly from the vehicle.

A double Cardan joint connects the rear end of the propeller shaft to a companion flange, having a spliced end which fits over and drives the hypoid pinion gear. Two preloaded tapered roller bearings support the hypoid pinion gear in the carrier. The inner race of the rear bearing is a tight press fit on the pinion stem. The inner race of the front bearing combines a light press fit to a close sliding fit on the companion flange end of the pinion stem. The outer race of each bearing is pressed against a shoulder recessed in the carrier. Tightening the pinion nut compresses a collapsible spacer, which bears against the inner race of the front bearing and a shoulder on the pinion stem.

This spacer is used to enable accurate bearing preload adjustment and maintain a preload on both front and rear pinion bearings. Adjustment of the fore and aft position of the pinion is obtained by placing shims between the head of the drive pinion and the rear pinion bearing. Torque from the pinion gear is transmitted to a ring gear attached to a differential case.

The differential case is of one piece construction and is supported in the carrier by two tapered roller side bearings. These are preloaded by inserting shims between the bearings and the carrier. The differential case assembly is positioned for proper ring gear to pinion backlash by varying the shim thickness from side to side. The ring gear is bolted to the case. Two side gears have splined bores for driving the axle shafts. They are positioned to turn in counterbored cavities in the case. The two differential pinions have smooth bores and are held in position by a solid pinion cross shaft, mounted and locked in the differential case. All four gears are in mesh with each other and, because the pinion gears turn freely on their shaft, they act as idler gears when the rear wheels are turning at different speeds. The pinions and side gears are backed by steel thrust washers.

OPERATION

Power from the engine is transferred to the transmission. The transmission then provides the transfer of power to its output shaft, which is splined to the propeller shaft by means of a double CV joint, except Seville and a single universal joint on Seville connection. Since the rear of the propeller shaft is connected to the drive pinion gear at the companion flange, the transmission output shaft, propeller shaft and drive pinion all turn at the same speed.

Power from the pinion gear is transmitted to the differential ring gear, which is bolted to the differential case.

When there is equal resistance on each rear wheel, the force through the pinion and ring gear turns the axle shafts at the same rate of speed and there is no movement between differential pinions and side gears.

If the road surface at one rear wheel is soft or slippery, it will offer less resistance to spin for that wheel. When this situation occurs, the differential case still tries to transmit equal power to each side gear but in meeting with greater resistance to motion by one side gear, the pinion gears will rotate or walk around this side gear, which in turn aids the pinion gears and differential case in distributing increased power to the side gear of less resistance, thus causing the one wheel to spin.

The differential acts in the same manner when the car is turning a corner except that both wheels are turning. In this case, the inside wheel and side gear are rotating slower than the outside wheel and side gear. The pinion gears are at this time revolving with the slower side gear and also rotating on the pinion shaft to increase the speed of the outside side gear and wheel.

The differential allows both wheels to be mounted on individual axles and driven by a single shaft, yet it permits each wheel to move independently and at differnt speeds when the need arises.

Ratio	Model	Differential Code	Emission Standards
2.28:1	DeVille	Standard 7VB Controlled 7VS	Except California and Altitude
	Brougham	Standard 7WB Controlled 7WS	
2.73:1	DeVille	Standard 7VE Controlled 7VW	California
	Brougham	Standard 7WE Controlled 7WW	
3.08:1	DeVille	Standard 7VJ Controlled 7VY	Altitude and Trailer Hauling
	Brougham	Standard 7WJ Controlled 7WY	
	Limousine Commercial Chassis	Standard 7XJ Controlled 7XY	All
2.56:1	Seville	Standard ME Controlled MD	Except Altitude
3.08:1		Standard MJ Controlled MG	Altitude and Trailer Hauling

Fig. 4B-1 Rear Axle Ratios

STANDARD DIFFERENTIAL

The rear axle for 1977, except Seville, is an 8-3/4" diameter ring gear. Except Seville, the low engine speeds resulting from the low ratios offers improved fuel economy and operating quietness while retaining acceleration performance levels. Seville uses an 8-1/2" diameter ring gear.

Figure 4B-1 shows the very broad range of axle ratios used for 1977. All axle ratios are designed to meet emission standards for areas of operation. The axle code is located on the axle housing as shown in Fig. 4B-2.

The limousine and Commercial Chassis use the same rear axle assembly. Externally they appear nearly identical to the standard car axle, however internally, they contain larger pinion and wheel bearings, thicker housing walls and bigger axle shafts to provide for the higher rear axle loading imposed by these heavier vehicles.

Rear axle features an integrated carrier casting. The carrier is a lightweight, nodular iron design which provides the pinion bearing support and upper control arm attachments in one-piece construction.

AXLE SHAFTS, BEARINGS AND OIL SEALS

The axle has a "direct-on" bearing which consists of an outer race, 15 rollers and two snap rings which retain the cage

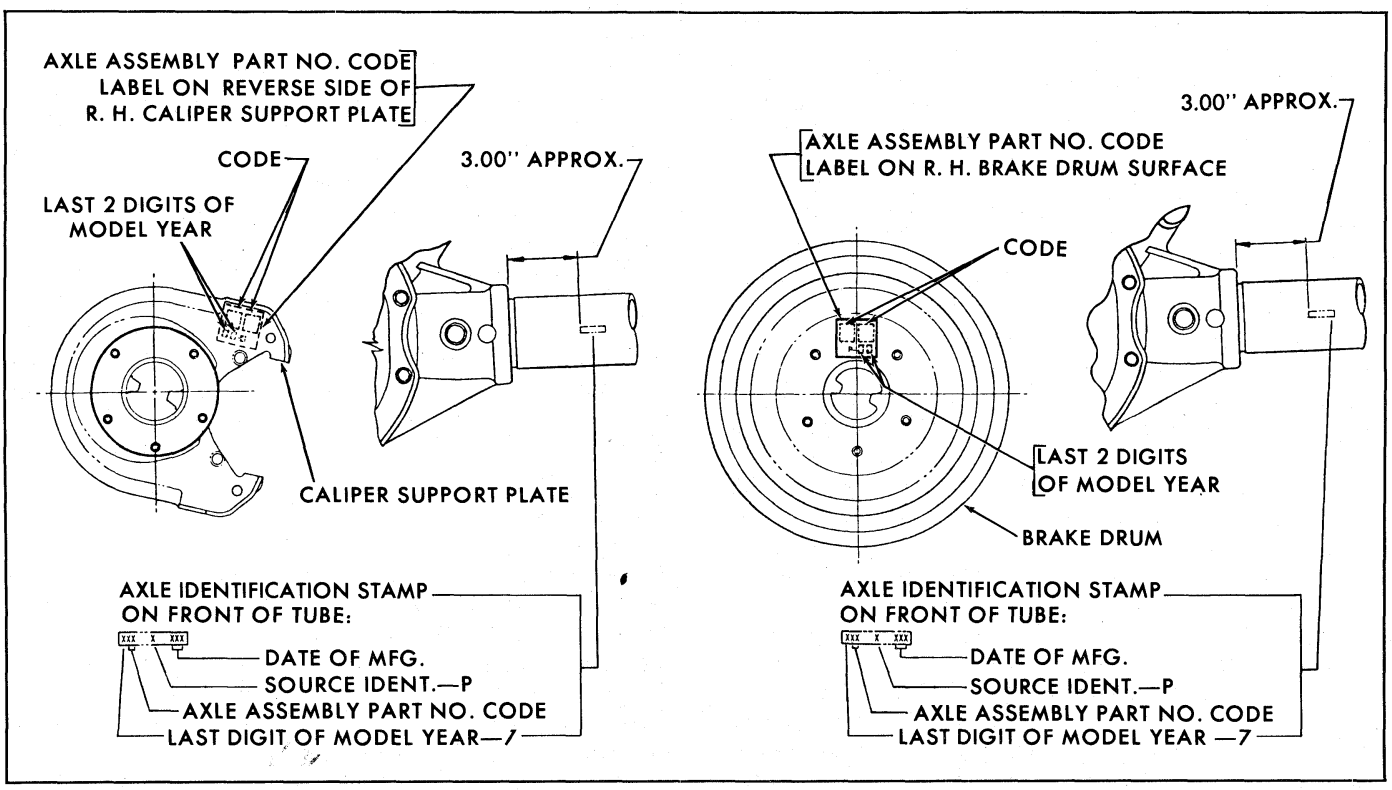


Fig. 4B-2 Rear Axle Code Location

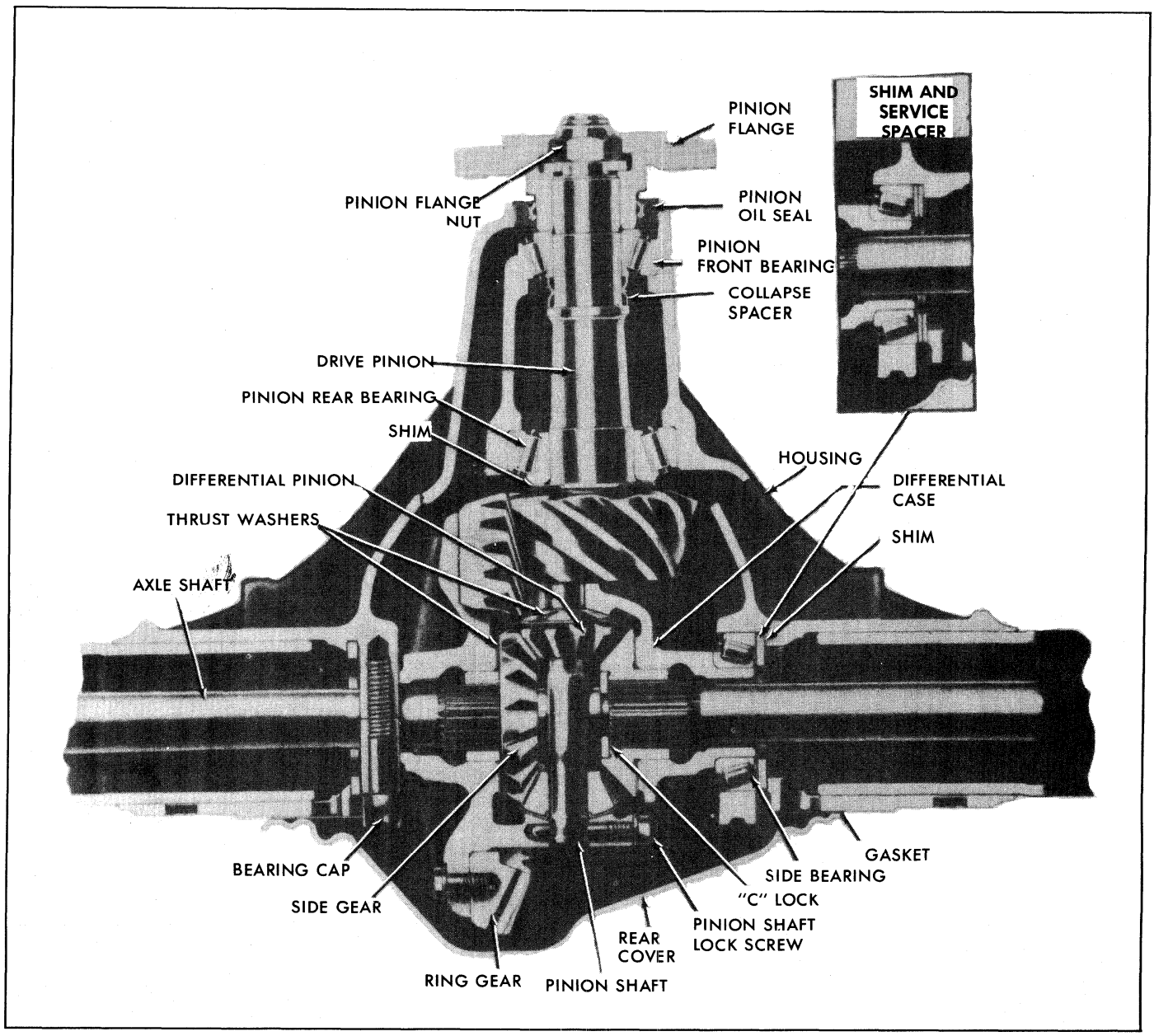


Fig. 4B-3 Axle Shafts and Differential - Cross Section

and rollers in the outer race. The outer race and roller assembly is press fit into the outer end of the axle housing at a pre-determined depth. The oil seal is next pressed into the housing end, outboard of the axle bearing. The axle shaft inner splines engage the differential side gears with a floating fit. The axle shaft has two machined and polished surfaces near the flange end; one surface being a mating or sealing surface for the axle seal and the other being the inner race for the "direct-on" axle bearing. The inner ends of the axle shafts are retained in the differential case by means of "C" locks that are positioned in circular grooves machined near the inner end of the axle shafts (Fig. 4B-3).

When axle shafts and "C" locks are properly installed, a portion of the "C" lock will be positioned in a machined recess in the side gear, which prevents removal of the "C" lock.

PERIODIC SERVICE RECOMMENDATIONS

LUBRICATION

Lubricant change in the differential is not recommended unless repair work is being done or vehicle is used to tow a trailer. The differential lubricant level should be checked every six months or 7,500 miles. If there is evidence of leakage, the leak should be corrected and lubricant added if needed so that level is maintained no lower than 4/10" (10 mm) below filler plug opening. Use SAE 80 or 80-90 (GL-5) multi-purpose hypoid gear lubricant in the standard differential. For those vehicles normally operated in Canada, use SAE 80 (GL-5) gear lubricant.

On cars used for towing trailers, change lubricant every 15,000 miles.

DIAGNOSIS

Many noises reported as coming from the rear axle are actually originating from other sources such as tires, road surfaces, wheel bearings, engine, transmission, muffler or body drumming.

A thorough and careful check should be made to determine the source of the noise before disassembling the differential. Noise which originates in other places cannot be corrected by adjustment or replacement of parts in the rear axle.

It should also be remembered that differential gears, like any other mechanical device, are not absolutely quiet and should be accepted unless some abnormal noise is present.

To make a systematic check for axle noise under standard conditions, proceed as follows:

1. Select a smooth, level asphalt road to reduce tire noise and body drumming.

2. Drive vehicle far enough to thoroughly warm up the rear axle lubricant.

3. Note speed at which the noise occurs. Then stop the vehicle and place transmission in Neutral, run engine slowly up and down through engine speeds that correspond to vehicle speed at which noise was most pronounced, to determine if noise is caused by exhaust, muffler roar or other engine conditions.

Repeat, while engaging and disengaging transmission to determine if noise is in transmission (transmission rear bearing noise can only be isolated by removing the propeller shaft and operating transmission in high gear).

4. Tire noise will vary with different type road surfaces, but rear axle noise does not vary with road surface. Temporarily inflating all tires to approximately 50 p.s.i. (for test purposes only) will materially alter noise caused by tires, but will not affect noise caused by rear axle.

Rear axle noise usually ceases when coasting at speeds under 30 mph. However, tire noise will continue, but with a lower tone, as vehicle speed is reduced. Rear axle noise usually changes between pull and coast, but tire noise remains about the same. Distinguish between tire noise and differential noise by noting if noise varies with various speeds or sudden acceleration and deceleration. Exhaust and axle noise shows variations under these conditions while tire noise remains constant and is more pronounced at speeds of 20 to 30 m.p.h.

Further check for tire noise by driving the vehicle over smooth pavements and then on dirt roads (not gravel) with tires at normal pressure. If noise is caused by tires, it will noticeably change or disappear and reappear with changes in road surface.

5. Loose or rough front wheel bearings will cause noise which may be confused with rear axle noises; however, front wheel bearing noise does not change when comparing pull and coast. Light application of brake while holding vehicle speed steady will often cause wheel bearing noise to diminish, as this takes some weight off the bearing. Front wheel bearings may be easily checked for noise by jacking up the wheels and spinning them, also by shaking the wheels to determine if bearings are loose.

6. Rear suspension rubber bushings and spring insulators dampen out rear axle noise when correctly installed. Check to see that no metallic contact exists between the springs and spring opening in frame or between upper and lower control arm bushings and frame or axle housing brackets. Metal-to-metal contact at those points may result in telegraphing road noise and normal axle noise which would not be objectionable if dampened by a bushing.

7. It is important that a check also be made to ensure that the floor of the body is not in metallic contact with the frame. After the noise has been determined as being in the axle by following the above appraisal procedure, the type of axle noise should be determined to aid in making repairs if necessary.

GEAR NOISE

Gear noise normally appears first as a "whine", audible between 20 and 65 mph and under four (4) driving conditions:

1. Drive - Acceleration or heavy pull.

2. Road Load - Vehicle under steady load or at constant speed.

3. Float - Maintaining constant vehicle speed at light throttle on a level road or using enough throttle so that engine is not actually driving the vehicle (vehicle slows down gradually while engine still pulls slightly).

4. Coast - Throttle closed and vehicle in gear.

Gear noise most frequently has periods where noise is more prominent, usually 30 to 40 mph and 50 to 60 mph. When objectionable axle noise is encountered, note the driving condition and speed range. If the problem is diagnosed as gear noise, remove the differential cover and perform a teeth contact pattern test. Shim and adjust to obtain the best possible tooth pattern. If noise still persists, replace the gear set.

BEARING NOISE

Bad bearings generally produce a rough "gowl" or "grating" sound, rather than the "whine" which is typical of gear noise. Bearings fail by lapping, spalling or locking:

LAPPING - Lapping is caused by fine particles of abrasive material such as scale, sand or emery which are circulated by oil and which cause wearing away of roller and race surfaces. Bearings which are worn loose, but remain smooth without spalling or pitting, are the result of dirty oil.

SPALLING - Spalling failure of bearings is caused by overload or faulty assembly. Bearings that failed by spalling have either flaked or pitted rollers or races. Faulty assembly consists of misalignment, cocking of bearings or adjustments which are too tight.

LOCKING - Locking of bearings is caused by large particles of foreign material becoming wedged between rollers and race, usually causing one of the races to turn. Preloading of taper roller bearings higher than specified can also cause locking of bearings.

1. Pinion Bearing Noise - Rough or brinnelled pinion bearings produce a continuous low pitch "whirring" and frequently "throbs" at bearing rpm. Pinion bearing noise is torque sensitive and usually heard at low speeds.

2. Side Bearing Noise - Since side bearings are pre-loaded, noise should not go away, or diminish appreciably, when the differential is run with wheels off the ground. Noise in this area can easily be confused with rear wheel bearing noise. Inspect and replace as required.

3. Rear Wheel Bearing Noise - A rough, rear axle bearing produces a vibration or "growl" which continues with the vehicle coasting and transmission in Neutral. Since

wheel bearings are not pre-loaded, noise should diminish if differential is run with the wheels off ground. A brinelled rear axle bearing causes a "knock" or "click" approximately every two revolutions of the rear wheels as the bearing rollers do not travel at the same speed as the rear axle and wheel. With rear wheels jacked up, spin rear wheels by hand while listening at hubs for evidence of rough or brinelled axle bearing noise.

KNOCK AT LOW SPEED

1. Worn and brinelled universal joints.
2. Side gear hub counterbore in differential case worn oversize.

BACKLASH CLUNK

1. Worn differential pinion shaft.
2. Excessive clearance between axle shaft and side gear splines.
3. Excessive clearance between side gear hub and counterbore in case.
4. Worn pinion and side gear teeth.
5. Worn thrust washers and excessive drive pinion and ring gear backlash. Replace worn parts and adjust drive pinion and ring gear backlash.

DRIVE LINE SQUEAL AND SQUEAK

"Squeals" and "squeaks" are audible at low speeds (seldom over 20 mph). A continuous "squeal" is from the pinion oil seal. Seal "squeaks" frequently correct themselves. If persistent, seal should be replaced.

VIBRATION

1. Rough rear wheel bearing.
2. Tire unbalance.
3. Unbalanced or damaged propeller shaft.
4. Worn universal joint.
5. Incorrect front or rear U-joint angles.
6. Mis-indexed propeller shaft at companion flange.
7. Companion flange run-out too great.

OIL LEAKS

It is difficult to determine the source of some oil leaks. Even after the point of leakage has been determined, it can be difficult to tell if the oil is leaking past the lip of the seal or past the O.D. of the seal. Replacement pinion oil seals have a non-hardening sealing compound around the O.D. of the new seal.

BEARING PROBLEM CONDITIONS

Whenever a front or rear wheel bearing or a pinion or differential bearing is removed, a careful inspection must be made to determine the cause of the problem and whether any related parts have been damaged.

Before diagnosing a bearing problem, clean the cone assembly thoroughly in solvent and allow to dry completely.

NOTE: If bearing has become magnetized, removal of metal particles from inside cage cannot be accomplished unless bearing is demagnetized.

Compare bearing in question to the examples in Fig. 4B-4 then refer to the corresponding explanation on this page and follow recommendations to prevent a similar problem in the replacement bearing.

Wear

Bearing lubricant is contaminated by fine particles of some abrasive material. The finish on the rollers and outer cup has become dulled in uniform pattern. If wear is very minor the bearing need not be replaced.

Cage Wear

This is a more advanced case of wear in which even the roller cage has been affected. unit must be replaced.

Step Wear

A different kind of wear pattern, affecting only the ends of the rollers, could develop from contaminated lubricant. If bearing is already rough or noisy it must be replaced. In any case, do not preload beyond specification on installation.

Indentations

Surface depressions or pits in the cups or rollers are caused by hard particles of foreign material. If condition is at least as advanced as that shown in the example, discard bearing and outer cap.

Regardless of whether or not replacement is necessary, if any bearing shows signs of indentation or of wear on cup rollers, or cage, the lubricant must be completely removed from the bearing assembly and all associated parts before refilling or repacking. All seals must be examined very carefully for damage that could admit contaminants. If these precautions are not followed, an identical problem could result.

Misalignment

The roller and cage assembly in this example is cocked with respect to the outer cup. Check for small burrs or foreign material lodged between bearing and outer cup or between cup and housing. These surfaces must be absolutely smooth to prevent this type of problem.

Cracked Inner Race

When the press fit is at the inner cup, a cocked assembly will result in a cracked inner cup. This type of failure can be caused by improper removal and installation techniques. Always use the recommended tools when servicing bearings.

Fretting

"Fretting" is the term used to describe corrosion resulting from slight relative movement of parts with no coating of lubricant. Check and clean all related parts during the replacement procedure as these could also be damaged.

Stain Discoloration

Lubricant breakdown can leave brown or black stains. In this case, the unit is not necessarily damaged. If light polishing removes the stain, the bearing can be reused.

Heat Discoloration

An overload on the bearing or deterioration of the lubricant will result in discoloration different from stain discoloration, although the two can be confused.

Stains ranging in color from faint yellow to dark blue indicate the possibility of softening of cups or rollers. Draw a file across the discolored areas. If the file cuts metal, discard the bearing. If it glides readily over the affected parts, the bearing can be reused.

Galling

Metal smears on roller ends render bearings unusable. When installing new bearing, be certain that bearing is properly adjusted and that correct lubricant is used. Conduct a very careful examination of seals. This condition is easily caused when lubricant is allowed to escape.

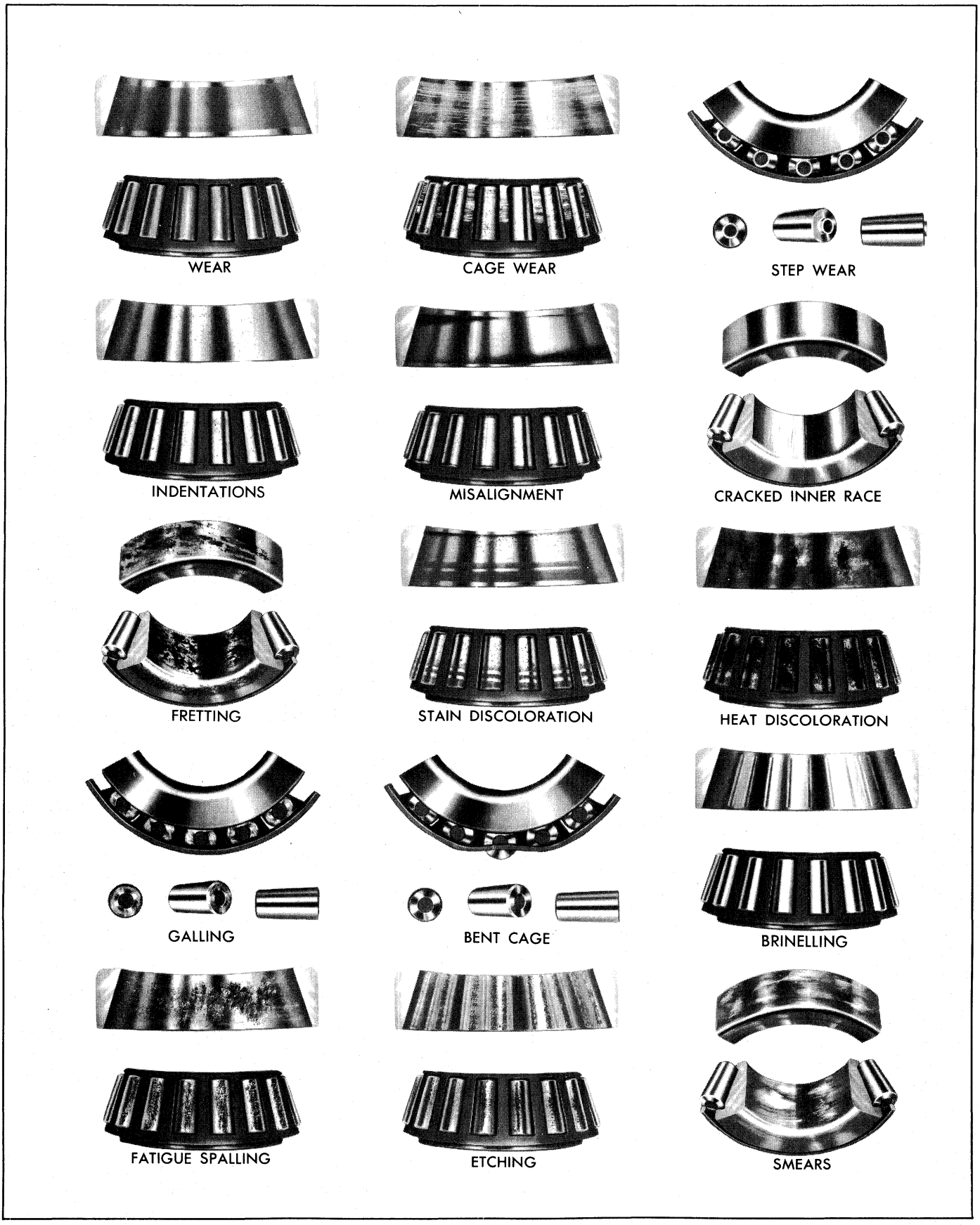


Fig. 4B-4 Bearing Problem Conditions

DIAGNOSIS

DIFFERENTIAL STANDARD AND CONTROLLED	
CONDITION	**CAUSE**
1. Noise is the same in drive or coast.	1. a. Road noise. b. Tire noise. c. Front wheel bearing noise. d. Incorrect driveline angle.
2. Noise changes on a different type of road.	2. a. Road noise. b. Tire noise.
3. Noise tone lowers as car speed is lowered.	3. Tire noise.
4. Noise is produced with car standing and driving.	4. a. Engine noise. b. Transmission Noise. c. Driveline angle.
5. Vibration.	5. a. Rough rear wheel bearing. b. Unbalanced or damaged propeller shaft. c. Tire unbalance. d. Worn universal joint in propeller shaft. e. Incorrect driveline angle. f. Mis-indexed propeller shaft at companion flange. g. Companion flange runout too great.
6. A knock or click approximately every two revolutions of rear wheel.	6. Rear wheel bearing.
7. Noise most pronounced on turns.	7. Differential side gear and pinion noise.
8. A continuous low pitch whirring or scraping noise starting at relatively low speed.	8. Pinion bearing noise.
9. Drive noise, coast noise or float noise.	9. Ring and pinion gear noise.
10. Clunk on acceleration or deceleration.	10. Worn differential pinion shaft in case or side gear hub counterbore in case worn oversize.
11. Groan in Forward or Reverse.	11. Wrong lubricant in differential.
12. Chatter on turns.	12. a. Wrong lubricant in differential. b. Clutch plates worn.
13. Clunk or knock on rough road operation.	13. Excessive end play of axle shafts.

Bent Cage

This kind of damage results from simple mishandling. Bearings are very vulnerable to forces other than those that they were designed to handle. A dent even as minor as the one pictured will ruin a bearing.

Always use a piece of cardboard or other soft covering on workbench when handling bearing parts.

Brinelling

A severe impact on a bearing or vibration while the unit is not rotating causes the rollers to dent the cup surface. Often, this condition is related to extraneous circumstances (such as a collision) rather than a problem in the car.

Fatigue Spalling

Fatigue spalling is the flaking of metal from bearing surfaces. These particles can cause further damage when car is back in service. Remove all lubricant and clean all related parts completely before reassembly with replacement bearing.

Etching

Bearing appears gray or grayish black and there is some erosion of surface metal of the cup at the same spacing as the rollers. As in other cases in which hard particles have contaminated the lubricant, clean all parts thoroughly to prevent future damage. Check seals.

Smears

Smearing of metal can occur on any or all of the bearing surfaces. This is generally due to the overheating related to the unwanted slippage between parts, and this slippage generally stems from either a loose fit, poor lubricant, or an overload on the unit. When installing new bearing, make certain proper amount of correct lubricant is used and that bearing is adjusted to specification.

ON CAR SERVICE

The following caution applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology "See Caution on page 8 of this Section".

CAUTION: *THIS FASTENER IS AN IMPORTANT ATTACHING PART IN THAT IT COULD AFFECT THE PERFORMANCE OF VITAL COMPONENTS AND SYSTEMS, AND/OR COULD RESULT IN MAJOR REPAIR EXPENSE. IT MUST BE REPLACED WITH ONE OF THE SAME PART NUMBER OR WITH AN EQUIVALENT PART IF REPLACEMENT BECOMES NECESSARY. DO NOT USE A REPLACEMENT PART OF LESSER QUALITY OR SUBSTITUTE DESIGN. TORQUE VALUES MUST BE USED AS SPECIFIED DURING REASSEMBLY TO ASSURE PROPER RETENTION OF THIS PART.*

If any mispositioning, incorrect assembly, or failure of components in the area of the brake system pipes, hoses, or cylinders is observed, be sure to check for any brake damage that may have resulted from such a condition and correct as required. Components that could damage the brake system due to mispositioning, incorrect assembly, or failure include the exhaust system, shock absorbers, springs, and stabilizer bar.

When raising rear of car, support vehicle weight at underbody or axle or both. Never use leaf springs as contact points for hoist or jack stands, as damage may result.

Rear Axle - Except Eldorado and Seville

a. Removal

1. Raise car so that both rear axle and frame are supported.

2. If car is equipped with Automatic Level Control, disconnect link at overtravel lever by removing attaching nut. Position overtravel lever in center position.

WARNING: THE SHOCK ABSORBERS ACT AS REBOUND STOPS ON THE REAR SUSPENSION SYSTEM. DO NOT PERFORM THIS STEP UNLESS BOTH AXLE AND FRAME ARE FIRMLY SUPPORTED AS INJURY OR DAMAGE COULD RESULT.

Remove both shock absorber lower retaining nuts and stems from mounts. It will be necessary to hold the stem next to the rubber grommet with one wrench to prevent the stem from turning, while removing retaining nut with a second wrench.

4. Remove rear lower control arm nuts.

5. Place jack under front of differential to relieve tension on lower arm bolts.

6. Remove rear lower control bolts and remove arm.

7. Remove rear mounting nuts from upper control arm bolts.

8. Remove control arm pivot bolt and remove control arm.

9. Remove four screws securing propeller shaft rear flange to pinion flange and support propeller shaft with wire or fan belt, Fig. 4A-5.

10. Remove jack stand from under pinion retainer.

11. Remove brake hose from tee fitting at differential housing and plug hose.

WARNING: IF AXLE IS ALLOWED TO WIND UP AS IT IS LOWERED, SPRINGS MAY SNAP FROM THEIR SEATS AND COULD CAUSE INJURY OR DAMAGE. USE EXTREME CAUTION TO PREVENT WIND-UP CONDITION.

Lower axle slowly and remove springs from car.

b. Installation

1. Position lower rubber insulator on rear axle housing mount.

2. Tape upper rubber insulator to top of spring and position spring so that end of top of spring is properly aligned with recess in upper seat of frame tower. Spring position should be within limits shown in Fig. 4B-4A.

3. Seat bottom of spring on lower rubber insulator.

4. Raise rear axle on hoist and check spring position.

5. Install lower shock absorber stems in mounts.

6. Install one nut at each mount. Torque nuts to 50 foot-pounds.

7. Raise rear axle to on-car position.

8. Position rear upper control arms in axle brackets and secure each with one bolt and nut. Do not torque nuts at this time.

9. On cars equipped with Automatic Level Control, perform the following steps:

a. Install air line fittings at shock absorbers, tightening tube nuts to 30-40 inch-pounds.

b. Inflate reservoir to 140 psi (or maximum pressure available) through compressor service valve.

c. Lift overtravel lever allowing air to enter shock absorbers.

d. Release overtravel lever and secure to axle with one nut.

10. Secure propeller shaft rear flange to pinion flange with four screws, tightening to 70 foot-pounds.

11. Install rear brake hose to tee at differential.

See **CAUTION:** *See "CAUTION" on page 4-8.*

12. Remove jack stands and lower car. Vehicle is now at standing height.

13. Tighten control arm nuts to 75 foot-pounds.

See **CAUTION:** *See "CAUTION" on page 4-8.*

CAUTION: *Pivot bolt and nut in control arms must be torqued when normal vehicle weight is applied to axle. If not, the ride may be adversely affected.*

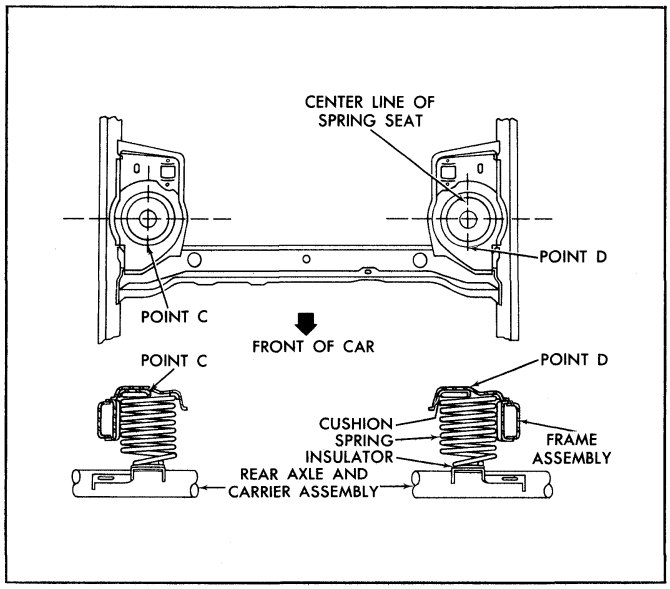


Fig. 4B-4A Coil Spring Indexing

REAR AXLE ASSEMBLY SEVILLE

a. Removal

1. Remove both rear springs as outlined in Section 3.
2. Remove clip securing brake hose to underbody and separate hose from brake line.
3. Remove stabilizer bar link nuts with retainers and bushings.
4. Mark propeller shaft flange to axle pinion flange relationship and remove attaching screws.
5. Position propeller shaft out of way and support to underbody with wire or fan belt. See Fig. 4A-5.
6. Lower axle to ground and remove from car.

b. Installation

NOTE: If stabilizer bar was left below axle on removal, place in same position.

1. Position axle housing on hoist.
2. Raise axle housing up to on car position.
3. Install both rear springs as outlined in Section 3.
4. With stabilizer bar front eyes over links, install bushings, retainers and nuts. Tighten nuts to 150 inch pounds.

CAUTION: *See "CAUTION" on page 4-8.*

5. Route brake hose through underbody bracket, connect to brake line and secure with clip.
6. Remove propeller shaft from support and position to axle pinion flange, observing alignment marks made on removal.
7. Secure propeller shaft flange with four screws and torque to 70 foot pounds.

CAUTION: *See "CAUTION" on page 4-8.*

8. Lower car to ground.
9. Bleed brake system as outlined in Section 5.

REAR AXLE BACKLASH MEASUREMENT

1. Place car on hoist.
2. Disconnect propeller shaft as described on page 4A-5.
3. Install Pinion Flange Holding Tool, J-8614-1, with raised side of tool against pinion flange and secure with two bolts.
4. Secure holding tool to prevent rotation of pinion flange.
5. Pull parking brake cable on one wheel to prevent wheel from turning. (This is not necessary on cars equipped with a Controlled Differential).
6. Measure rotation (backlash) of opposite wheel in inches of outer circumference of tire tread. A stiff wire pointer fastened to the fender or car frame will aid in this measurement. Maximum backlash under this condition should not exceed 1/2 inch on standard differentials and 1/8 inch on Controlled Differentials.

REAR WHEEL DISC BRAKE AND ROTOR

a. Removal

1. Remove rear wheel disc.
2. Loosen wheel mounting nuts.
3. Raise rear end of car and support with jack stands.
4. Remove wheel mounting nuts and remove wheel.
5. Loosen parking brake cable at equalizer.
6. Remove brake line from caliper and plug line.
7. Remove caliper mounting bolts and remove caliper.
8. Support caliper with a wire hook.
9. Remove rotor.

b. Installation

1. Install rotor.
2. Install caliper and secure with two bolts.
3. Install brake line.
4. Install rear wheel and wheel disc.

Tighten wheel mounting nuts to 80 ft. lbs.

5. Adjust parking brake.
6. Lower car.

AXLE SHAFT

a. Removal

1. Raise car on hoist. Remove wheel and tire assembly and brake drums.
2. Clean all dirt from area of differential cover.
3. Drain lubricant from differential by removing cover.
4. Remove the differential pinion cross shaft as shown in Fig. 4B-3.
5. Push flanged end of axle shaft toward center of car and remove "C" lock from button end of shaft.
6. Remove axle shaft from housing, being careful not to damage oil seal.

b. Oil Seal and/or Bearing Replacement (Fig. 4B-5)

1. Remove oil seal by using button end of axle shaft. Insert button end behind the steel case of the oil seal, then pry seal out of bore being careful not to damage seal. If both seal and bearing are being replaced, proceed to Step 2.
2. Using Tool J-22813-01 Axle Shaft Bearing Remover, insert into bore so that tool grasps behind the bearing. See Fig. 4B-6. Slide washer against outside of seal (or bearing) and turn nut finger tight against washer. Attach Slide Hammer J-2619 and remove bearing and seal.

If working on Limousine or Commercial Chassis use Tool J-23689, axle shaft remover.

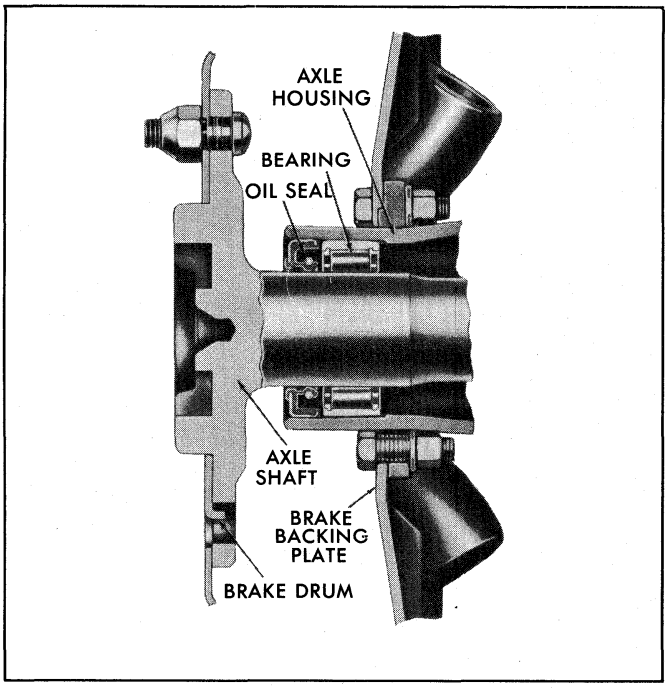


Fig. 4B-5 Axle Housing Detail

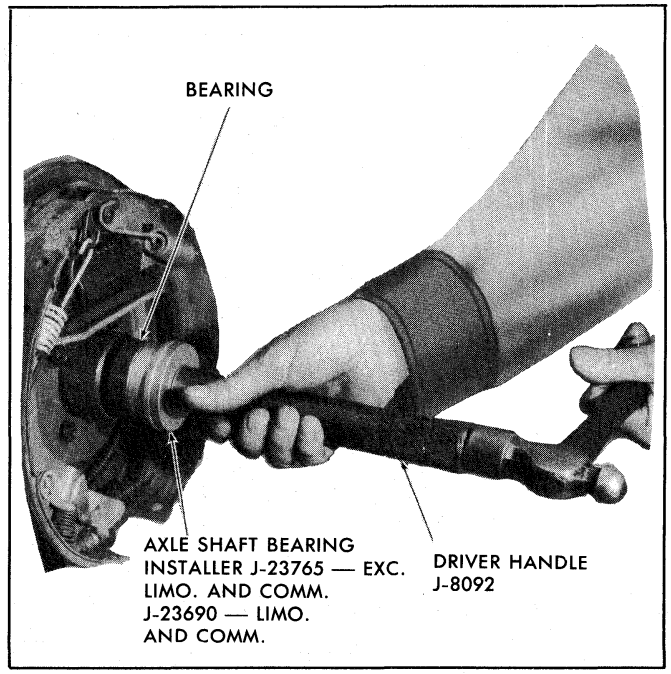


Fig. 4B-7 Axle Shaft Bearing Installation

3. Back off nut and remove bearing and seal from tool.

4. Pack cavity between seal lips with wheel bearing lubricant.

5. To reinstall bearing use Tool J-23765, Bearing Installer, with J-8092, Driver Handle. Install bearing until tool bottoms against tube, Fig. 4B-7.

If working on Limousine or Commercial Chassis use Tool J-23690, bearing installer.

Tool J-23765 and J-23690 installs bearings to a depth of .550″ measured from end of axle tube to bearing. To install seal, Use Axle Shaft Seal Installer, J-23771, as shown in Fig. 4B-8. This tool installs seal square and flush with end of axle tube.

If working on Limousine or Commercial Chassis use Tool J-21128, seal installer.

c. Installation

1. Slide axle shaft into place.

CAUTION: *Exercise care that splines on end of shaft do not damage oil seal and that they engage with splines of differential side gear.*

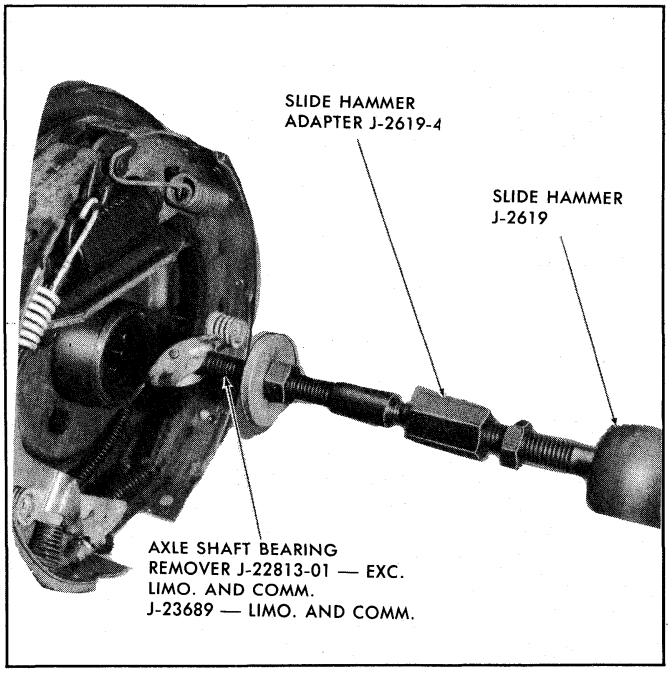


Fig. 4B-6 Axle Shaft Bearing Removal

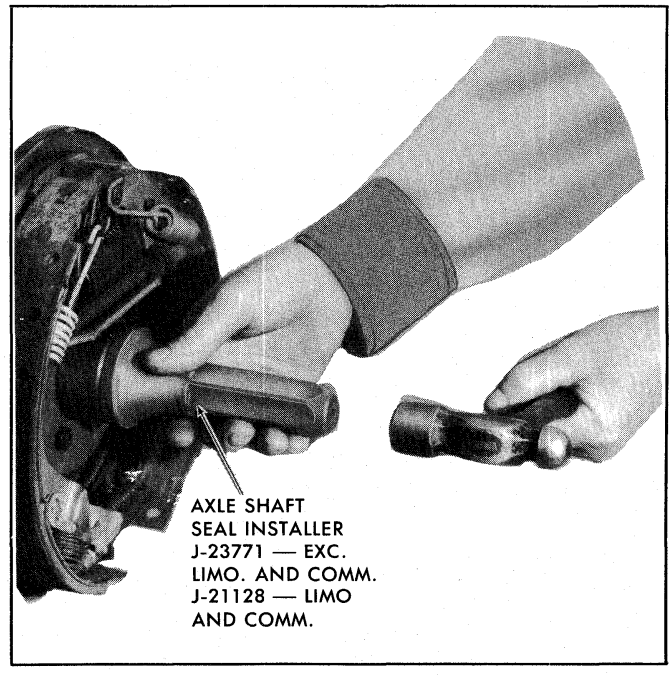


Fig. 4B-8 Axle Shaft Seal Installation

2. Install axle shaft "C" lock on button end of axle shaft and push shaft outward so that shaft lock seats in counterbore of differential side gear.

3. Position differential pinion cross shaft through case and pinions, aligning hole in shaft with lock screw hole. Install lock screw and torque to 25 foot pounds.

4. Using a new gasket, install cover and torque screws to 25 foot pounds.

CAUTION: *Make sure both gasket surfaces on housing and cover are clean before installing new gasket. Torque cover screws in a crosswise pattern to ensure uniform draw on cover gasket.*

5. Fill differential to proper level with the specified lubricant. Refer to Fluid Capacity Chart and Recommended Fluids and Lubricants Chart as outlined in Section 0.

6. Install brake drum and wheel and tire assembly.

7. Lower car to floor.

8. Torque wheel mounting nuts to 80 foot pounds.

CAUTION: *See "CAUTION" on page 4-8.*

PINION OIL SEAL REPLACEMENT (ON CAR)

a. Removal

1. Raise car on hoist.

2. Support car so axle can be raised or lowered.

3. To preserve balance, scribe an alignment mark between propeller shaft rear flange and pinion flange for proper orientation on re-installation. (Presence of hose clamps on rear of propeller shaft indicate that a field rebalancing procedure has been performed.)

4. Remove four ball support yoke attaching screws.

CAUTION: *Do not permit propeller shaft to be supported by the front universal joint only, as damage may result. Rear of propeller shaft must be supported to underbody. A fan belt or piece of wire* may be used, Fig. 4A-5.

5. Install pinion flange holding Tool J-8614-1 to pinion flange using bolts.

6. Mark the position of the pinion flange, pinion shaft and nut so the proper pinion bearing pre-load can be maintained, Fig. 4B-9.

7. Attach Torque Multiplier, J-23410, to a 1-1/4" socket. Attach Torque Multiplier, J-23410, to Pinion Flange Holding Tool, J-8614-1, with Torque Multiplier Link, J-23413, Fig. 4B-10.

8. Install torque wrench or breaker bar on torque multiplier and remove pinion nut.

9. Install Pinion Flange Puller, J-8614-2, on pinion flange. This is done by screwing the puller on its bolt until it reaches the pointed end, then inserting pointed end into end of pinion shaft. Give puller a 1/8" turn. Holding puller stationary, turn bolt until wings of puller fit snugly into recesses of flange holding tool.

10. Tighten bolt until flange can be removed from pinion assembly.

11. Remove puller tools from flange.

12. Remove oil seal by driving it out of retainer with a blunt chisel, Fig. 4B-11. Do not damage retainer.

b. Inspection

1. Examine seal surface of flange for tool marks, nicks, or damage, such as a groove worn by the seal. If damaged, replace flange.

NOTE: If flange is replaced remove retainer assembly. Replace collapse spacer, "O" Ring, and manually preload as described on page 4B-20.

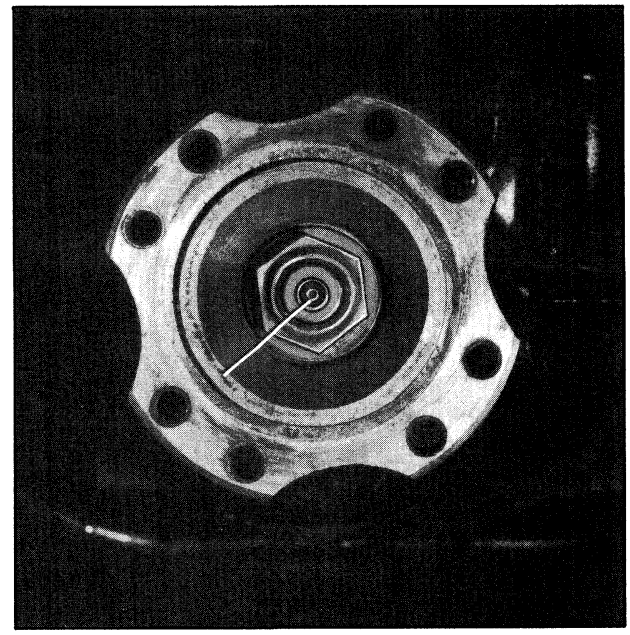


Fig. 4B-9 Pinion Flange, Nut and Shaft Markings

2. Examine carrier seal bore and remove any burrs that might cause leaks around the O.D. of the seal.

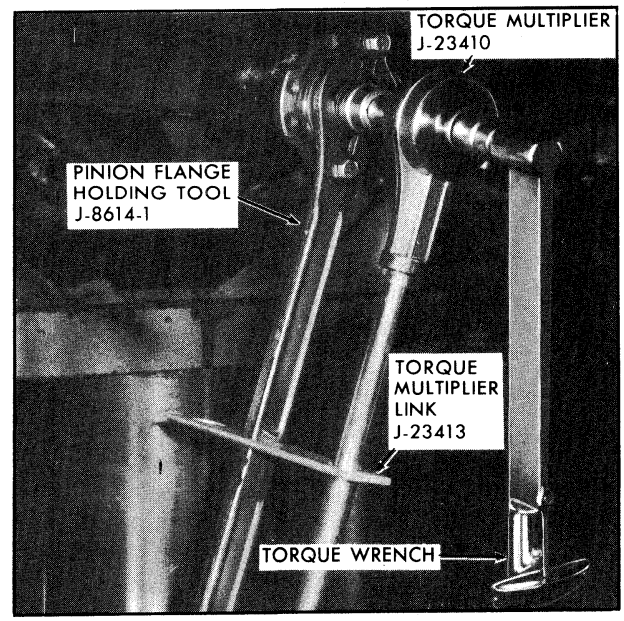
c. Installation

1. Pack inner lip of new pinion oil seal with wheel bearing lubricant.

2. Position seal to carrier. Place oil seal installer, J-22388, against seal. Tap in place with hammer, Fig. 4B-12.

3. Install pinion flange on pinion shaft using alignment marks made on disassembly.

4. Install pinion nut. Tighten nut only enough to remove bearing end play.



Fib. 4B-10 Removing Pinion Nut

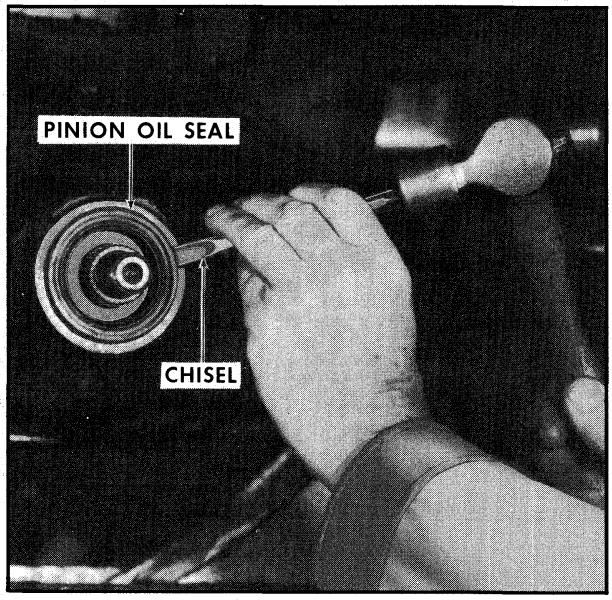


Fig. 4B-11 Removing Pinion Oil Seal

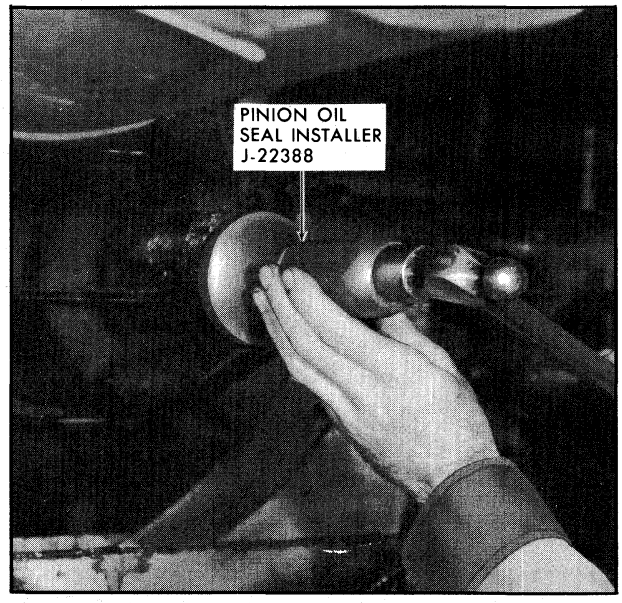


Fig. 4B-12 Installing Pinion Oil Seal

NOTE: If flange did not slip on far enough to start nut and washer, tap gently with a soft hammer until nut can be started.

5. Install Pinion Flange Holding Tool, J-8614-1, with raised side of tool against flange. Secure holding tool with bolts.

6. Attach Torque Multiplier, J-23410, to 1-1/4" socket and install on pinion nut. Attach Torque Multiplier Link, J-23413, Fig. 4B-10.

7. Install torque wrench or breaker bar on torque multiplier.

8. Tighten pinion nut 1/8" beyond alignment marks.

9. Fill differential to proper level with the specified lubricant. Refer to Fluid Capacity Chart and Recommended Fluids and Lubricants Chart as outlined in Section 0.

10. Position ball support yoke flange to pinion flange as marked upon removal and secure with four screws.

CAUTION: *See "CAUTION.. on page 4-8.*

11. Remove supports and lower car to floor.

UNIT REPAIR

DIFFERENTIAL

a. Preparatory Steps

NOTE: Before proceeding with following steps, it is advisable to check the existing ring gear to pinion backlash as described on page 4A-9. This will indicate gear or bearing wear or an error in backlash or pinion depth setting which will help in determining cause of axle noise. Backlash should be recorded so that if same gears are reused, they may be reinstalled at original lash to avoid changing gear tooth contact. If checking for axle "drive" noise, be certain that rear spring dampers on Seville are installed on car, as outlined in Section 3.

1. Raise car on hoist.

2. Support car so axle can be raised or lowered.

3. If car is so equipped, disconnect rear leveling valve overtravel lever from link.

4. Hold lever down in exhaust position to deflate shock absorbers.

5. Remove lower shock absorbers nuts and bolts and position shock absorbers out of way.

6. Mark propeller shaft flange to axle pinion flange relationship and remove attaching screws.

7. Position propeller shaft out of way and support to underbody with wire or fan belt.

8. Remove stabilizer bar link nuts with retainers and bushings.

9. Remove parking brake equalizer nut and disconnect cables at connectors.

10. Open brake pipe clips securing pipe to axle housing.

11. Lower axle just enough so light lifting tension remains under axle.

12. With drain pan under axle housing, loosen rear cover screws and drain axle lubricant.

13. Remove cover screws and cover, discard gasket and remove drain pan.

14. Remove rear wheel discs and wheel and tire assemblies.

15. Remove brake drum retainers, brake drums and/or caliper and rotor.

16. Remove bolt through differential cross shaft and remove shaft.

17. Push in on rear axle shafts and remove "C" washers at shafts inner ends. Back each shaft out about 1".

18. Reinstall cross shaft and retaining bolt so side gears will not drop out or be damaged.

NOTE: Side gears and pinion gears must be installed in their same on-car positions as removed.

19. Remove bearing cap bolts and bearing caps. Mark caps for reinstallation.

20. Remove one ring gear attaching bolt.

NOTE: Ring gear bolts are left hand thread.

21. Install differential case puller tool J-2625, remover tool, on differential case, Fig. 4B-13, and move case out of housing just enough to be able to remove side shims.

22. Remove and mark shims for reassembly and remove differential case from housing.

b. Inspection

1. Clean all parts in cleaning solvent; inspect all bearing cups and rollers for scoring, chipping or evidence of excessive wear.

2. Inspect axle shaft and side gear for evidence of excessive wear.

3. Inspect ring gear and pinion teeth for possible scoring, cracking or chipping.

4. Inspect differential case, pinions, side gears, thrust washers and pinion shaft for cracks, scoring, spalling or excessive wear.

5. Check fit of differential side gears in case. Clearance should be less than .012".

c. Differential Bearing Replacement

1. Install Tool J-22888 and Adapter Plug J-25284 as shown in Fig. 4B-14. Make sure that the puller legs are fitted securely in case notches, against inner cup. Optional Tool J-8107-2 may be used.

2. Tighten puller screw to remove bearing.

3. Place new bearing onto hub, with the thick side of the inner cup toward the case. Drive the bearing into place, using J-22175 except Seville, J-22761 Seville only as shown in Fig. 4B-15.

4. Before bearing installation on opposite hub, support differential case on Adapter Plug J-25284. This allows differential case to rest on adapter plug instead of bearing cage. Install other bearing as done in Step 3. Optional Tool J-8107-2 may be used.

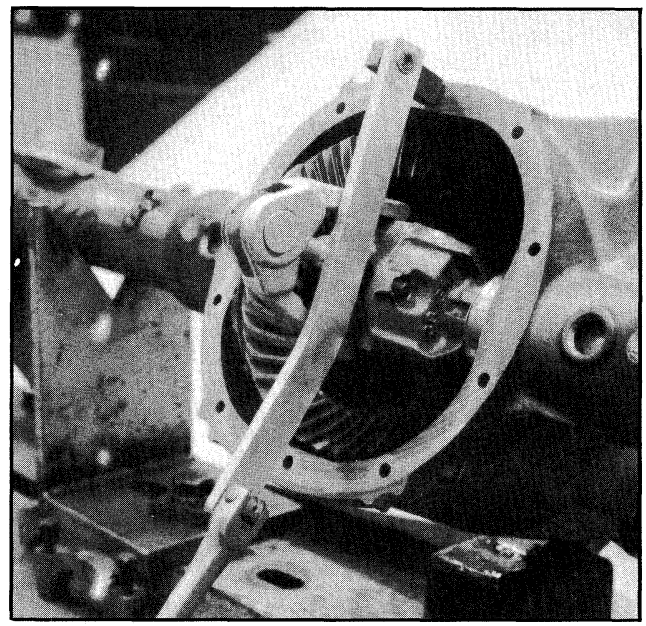


Fig. 4B-13 Removing Differential

d. Ring Gear or Differential Case Replacement

1. Remove the ring gear screws (L.H. thread) and, using a soft drift and a hammer, tap ring gear off the case.

NOTE: Do not attempt to pry ring gear from case. To do so may damage machined surfaces.

2. Remove any nicks or imbedded dirt from case flange surface which mates with ring gear. Clean all surfaces.

3. Liberally coat the differential case pilot with differential lubricant. Pre-align ring gear and differential case bolt holes and press against adapter plug J-25284 to initially start ring gear on case pilot, as shown in Fig. 4B-16. Optional Tool J-8107-2 may be used.

4. Start all ring gear bolts during initial assembly to maintain bolt hole alignment. Draw up all bolts evenly, using a criss-cross pattern to avoid cocking the gear on the case.

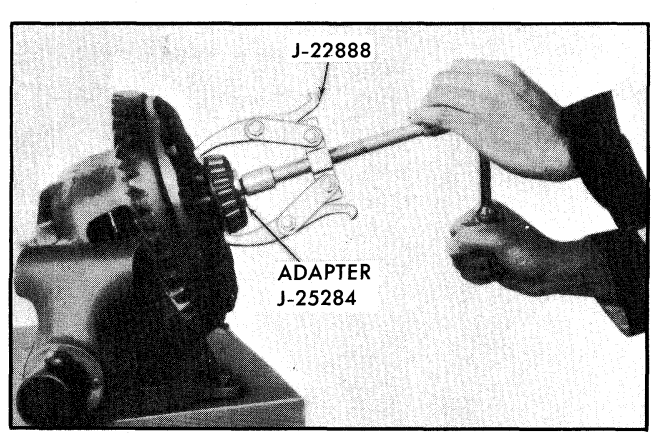


Fig. 4B-14 Differential Side Bearing Removal

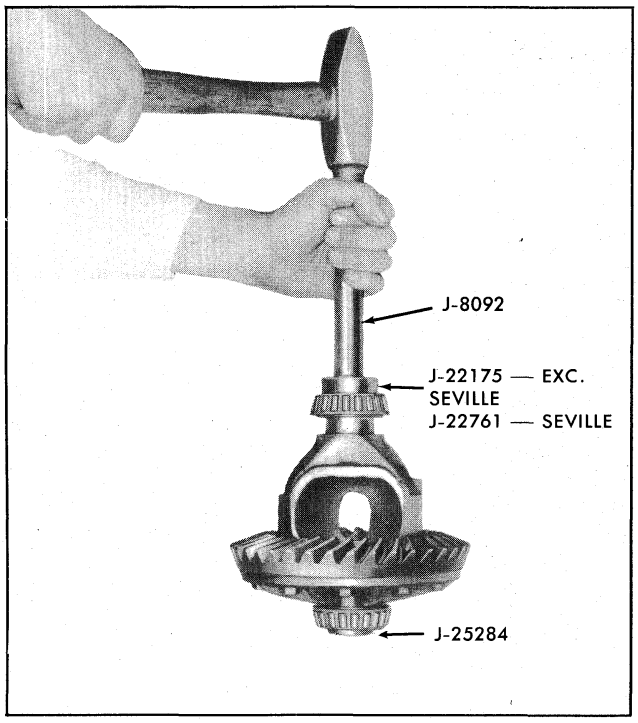


Fig. 4B-15 Differential Side Bearing Installation

5. Insure that gear is seated firmly against the case, then torque all bolts to 90 foot pounds.

e. Reassembly

1. Install thrust washers and side gears into case. If original parts are being re-used replace in original positions.

2. Position pinions and thrust washers through loading hole in case 180° apart so that they engage side gears.

3. Rotate gears until the differential pinion bores and the case shaft holes are aligned.

4. Install pinion shaft and lock screw. It is not necessary to torque lock screw until axle shafts are installed.

5. Differential may be installed in carrier now or after service is performed on the drive pinion.

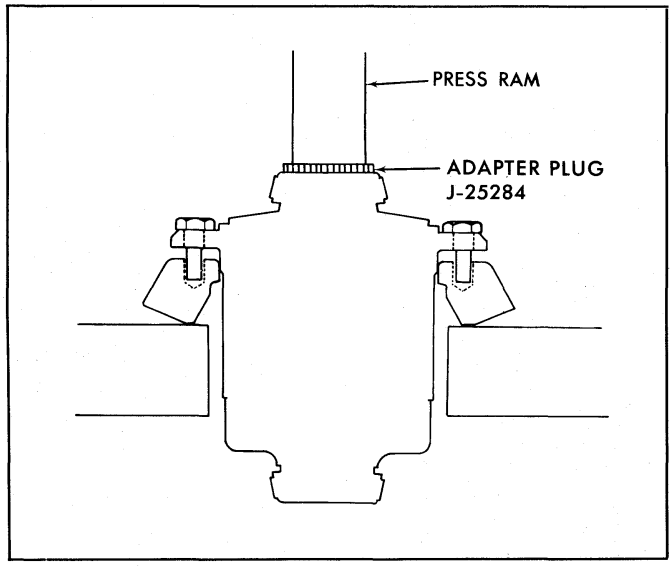


Fig. 4B-16 Ring Gear-To-Case Installation

Ⓐ .170" Service Spacer	
Total Thickness of Both Prod. Shims Removed	Total Thickness of Ⓑ Service Shims to be used as a Starting Point
.420"	.060"
.430"	.070"
.440"	.080"
.450"	.090"
.460"	.100"
.470"	.110"
.480"	.120"
.490"	.130"
.500"	.140"
.510"	.150"
.520"	.160"
.530"	.170"
.540"	.180"
.550"	.190"

f. Installation and Adjustment

1. Check condition of bearing, bearing cups, cup seat in carrier and bearing caps to make sure that they are free from nicks, burrs and foreign material.

2. Lubricate bearings with differential lubricant; position cups on proper bearing, then install differential assembly in carrier and support the assembly to prevent it from falling.

3. Install strap J-22779-6 on left bearing by tightening bearing bolts alternately and evenly to snug fit.

4. With the ring gear tight against the pinion gear (.000" to .001" backlash), insert gage Tool J-22779 between the left bearing cup and carrier housing. See Fig. 4B-17.

5. While oscillating tool, turn adjusting nut clockwise until a noticeable drag is produced.

6. Tighten lock bolt on side of tool.

NOTE: Production shims are cast iron and vary in thickness from .210" to .272" in increments of .002".

Standard service spacers are .170" thick and steel service shims are available from .040" to .082" in increments of .002".

Do not attempt to reinstall the production shims as they may break when tapped into place. If service shims were previously installed, they can be reused, but whether using new or old bearings adhere to following procedure in all cases.

7. Between the right bearing and carrier, install Service Spacer A (.170"), Service Shim B and Feeler Gage C. Thickness of Feeler Gage must be sufficient to produce a slight "drag" when moved between carrier and Service Shim.

8. Now measure the dimensions as shown in Fig. 4B-18.

a. Using a micrometer as in Figure 4B-19. measure the thickness of J-22779 in a minimum of three places and average these readings. Record the result.

b. Add together the dimensions of the Service Shim, Service Spacer and Feeler Gage. Record the result.

9. Use the sample procedure in Fig. 4B-18 to determine the proper thickness for each shim pack.

10. Install service left shim first, then wedge right shim

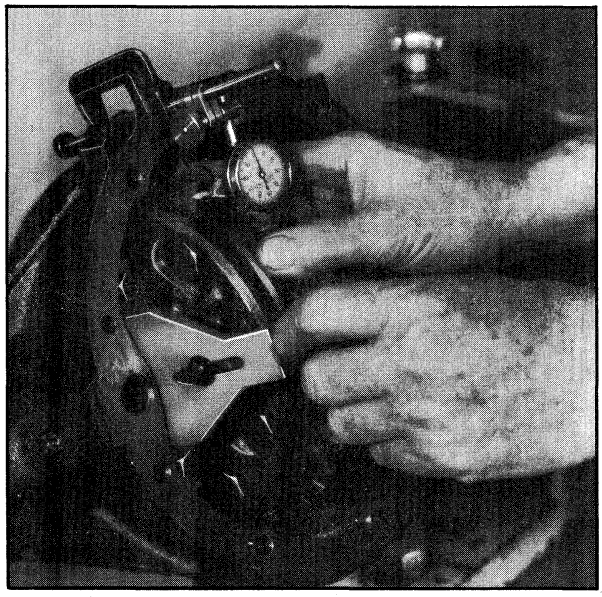


Fig. 4B-17 Installing Gage Tool

between bearing cup and spacer (position shim so that chamfered side is outward or next to spacer). If shim does not have sufficient chamfer or lead around O.D. to allow easy installation without scraping spacer, file or grind chamfer before installing.

11. If difficulty is encountered in installing shim, partially remove case and slide case and shim into position. Tap service shim into position, using Shim Installer, J-25588, and a hammer. See Fig. 4B-20.

12. Install bearing caps in original position and torque to 60 foot pounds.

NOTE: At this point, the differential side bearings are properly preloaded. If any adjustments are required in later procedures, make sure that preload remains established as in Step 9. If backlash is changed, be sure that total thickness of two shim packs does not change.

13. Mount a dial indicator on the housing and check the backlash between the ring gear and pinion, as shown in Fig. 4B-21. The backlash should be within the range of 0.005″-0.008″. Check gear lash at four different equally spaced positions around the gear. Variation in readings should not exceed .002″.

NOTE: Position the dial indicator so that indicator button is perpendicular to tooth angle and in line with gear rotation.

14. If variation in backlash readings exceeds .002″, measure ring gear and case runout as shown in Fig. 4B-22. Gear runout should not exceed .003″; should runout exceed this limit check to see if ring gear and case are distorted and/or foreign matter between case and gear.

15. If gear lash is not within limits, correct by decreasing shim thickness on one side and increasing thickness of other shim the same amount. Total shim thickness must be maintained at all times to maintain proper preload.

16. Backlash changes approximately .002″ for each .003″ change in shim dimensions. If backlash exceeds .008″, increase the shim thickness on ring gear side, while decreasing shim thickness on opposite side an equal amount. If backlash is less than .005″, decrease the shim thickness on ring gear side, while increasing shim thickness on opposite side an equal amount.

DRIVE PINION

a. Removal

1. Remove differential as outlined on page 4B-12.

2. Check torque required to rotate drive pinion as described on page 4B-20. If there is no torque reading, check for looseness of pinion assembly by shaking (push-pull) the companion flange. Looseness indicates the need for bearing replacement.

3. Install Holder J-8614-1 on flange by using two bolts with flat washers, as shown in Fig. 4B-23. Position J-8614-1 on flange so that the four notches are toward the flange.

4. Remove pinion nut and washer.

5. Thread end of J-8614-3 into small O.D. end of J-8614-2. Then with J-8614-1 installed as in Step 3, insert J-8614-2 into J-8614-1 and turn it 1/8 of a turn to locked position. Remove flange by turning J-8614-3 while holding J-8614-1 as shown in Fig. 4B-24.

6. To remove the drive pinion, first thread the original pinion nut half way on the pinion, for thread protection.

7. Place the differential cover temporarily back onto the housing, using two screws. This will prevent the pinion from falling to the floor during removal.

8. Install Pinion Remover J-22536 and drive out pinion, Fig. 4B-25. Apply heavy hand pressure on pinion remover toward differential housing to keep front bearing seated to avoid damage to outer cup.

NOTE: Care must be taken not to damage pinion bearings while removing pinion from carrier. Inspect bearings and cups for damage and replace if needed.

9. Remove the pinion oil seal and the front pinion bearing. Remove the cover and remove the drive pinion from the housing. Discard the pinion oil seal and collapse spacer. Use a new seal and spacer on reassembly.

b. Bearing Removal and Cup Replacement

1. If front pinion bearing is to be replaced, drive outer cup from carrier using a drift in slots provided for this purpose. Tap alternately on opposite sides of bearing cup to avoid cocking.

2. If rear pinion bearing is to be replaced, drive outer cup from carrier using a drift in slots provided for this purpose.

3. Remove rear pinion bearing from pinion shaft using Press Plate J-22912-01,See Fig. 4B-26. Optional Tool J-8612 may be used.

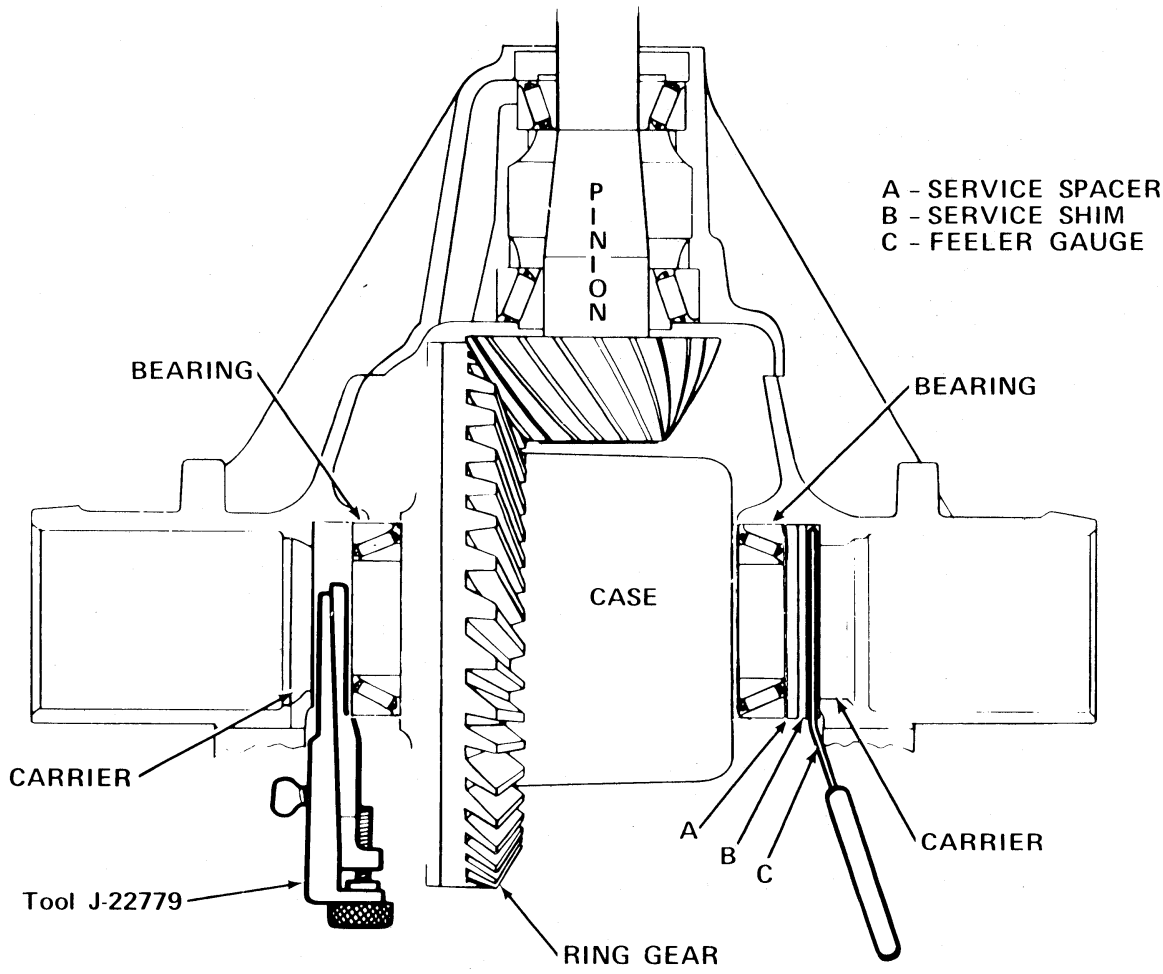
If working on Limousine or Commercial Chassis use Tool J-9746-02.

Tighten nuts on tool until plates are under the bearing inner cup. Then, set tool on press. Make sure the plates straddle opening on press. Do not position bolts across opening. To do so may bend the bolts when pressure is applied. Press bearing from pinion. Record thickness of shim removed from between bearing and pinion head.

4. inspect pinion bearing bores and shoulders for nicks. Remove as necessary. Clean the bores and the installation tools.

5. Lubricate both outer cups with liberal amounts of differential lubricant.

6. Install the rear cup, with the large end against the bore shoulder, using Installer J-8608 as shown in Fig. 4B-27. If



EXAMPLE

RING GEAR SIDE		OPPOSITE SIDE	
.250"	Thickness of Tool J-22779 required to force ring gear into contact with pinion	Combined total of: Service Spacer (A) Service Shim (B) Feeler Gauge (C)	.265"
- .010" / .240"	TO MAINTAIN PROPER BACKLASH (.005" - .008"), ring gear is moved away from pinion by subtracting .010" shims from ring gear side and adding .010" shims to other side		+ .010" / .275"
+ .004"	TO OBTAIN PROPER PRELOAD on side bearings, add .004" shims to each side.		+ .004"
.244"	Shim dimension required for ring gear side	Shim dimension required for opposite side	.279"

Fig. 4B-18 Finding Side Bearing Shim Requirements

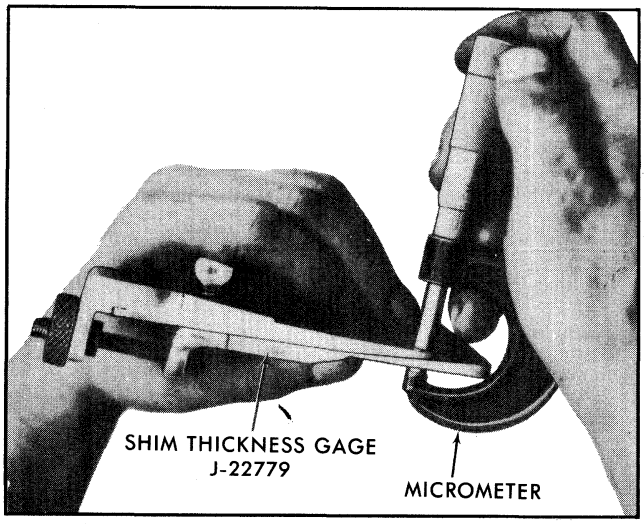


Fig. 4B-19 Measuring Gage Thickness

working on Limousine or Commercial Chassis use Installer J-9745.

7. Install the front cup, with the large end against the bore shoulder, using Installer J-8611-01 as shown in Fig. 4B-28.

8. Check both bores to make sure cups are fully seated.

c. Setting Pinion Depth and Installing Pinion Bearings

NOTE: If the original ring gear and pinion and the pinion rear bearing assembly are to be reinstalled, the original shim thickness may be used.

Ring and pinion gear sets are matched in a special test machine which permits adjustment of pinion depth in ring gear until a point is reached where best operation and proper tooth contact under load is obtained. At this point, the setting of the pinion with reference to the centerline of the ring gear is indicated by the machine. This setting may vary slightly from the design or "nominal" setting due to allowable variation in machining the parts. When a pinion is found

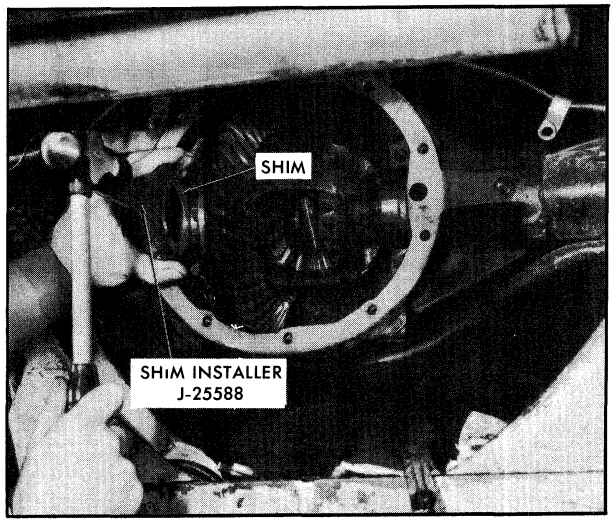


Fig. 4B-20 Installing Differential Shim

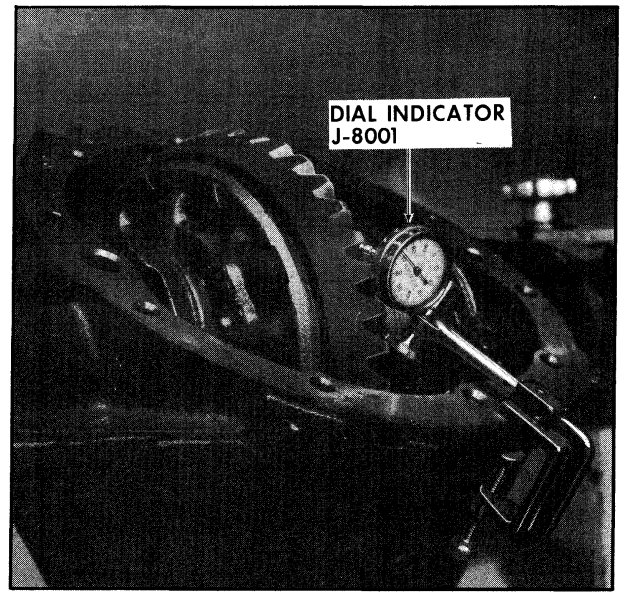


Fig. 4B-21 Checking Ring Gear Backlash

having a plus or minus reading recorded in thousandths on the rear face of the pinion, this indicates that the pinion during testing was found to have best tooth contact at a position varying from design or nominal depth.

In order to compensate for all of the allowable machining variables, a procedure to gage the carrier and shim the pinion has been developed. After this procedure, the assembler must install the appropriate shim between the drive pinion shoulder and rear bearing so that pinion depth can be adjusted to the required position for best tooth contact in each axle assembly.

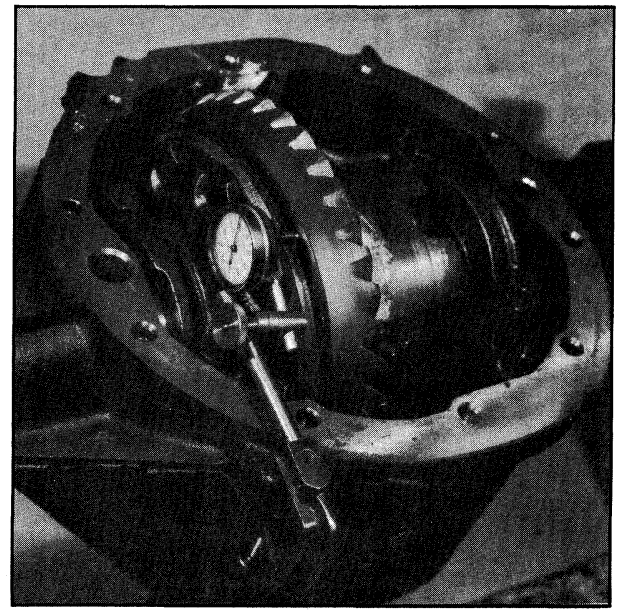


Fig. 4B-22 Checking Ring Gear Run-Out

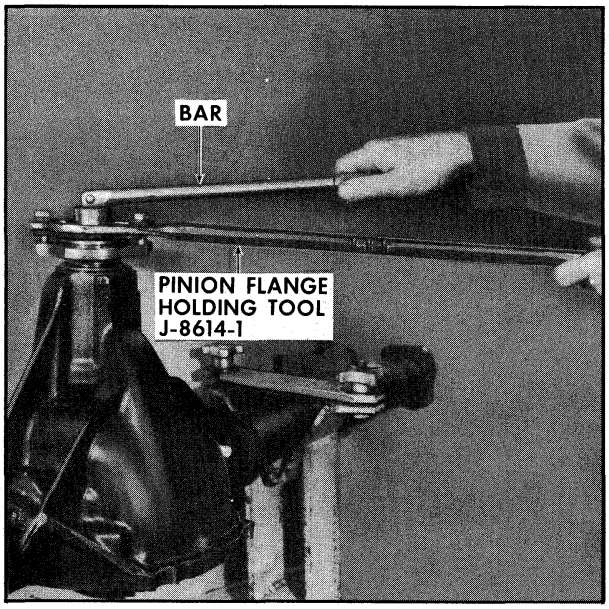


Fig. 4B-23 Drive Pinion Nut Removal

Proper pinion depth is determined with Pinion Setting Gage J-21777-350.

1. Clean the housing assembly and all gage parts to insure accurate measurements.

2. Lubricate front and rear pinion bearings which will be used in final assembly and position them in their respective cups in the carrier.

3. With cloverleaf gage plate J-21777-29 mounted on preload stud J-21777-43, insert stud through rear bearing and pilot J-21777-35, and through front bearing and pilot J-21777-42. Install the hex nut until snug and rotate the bearings to make sure they are properly seated. See Fig. 4B-29 for proper positioning.

4. Hold the preload stud stationary with a wrench on the flats and tighten hex nut until 20 inch pounds of torque are required to rotate the bearings as shown in Fig. 4B-30.

5. Mount the side bearing discs J-21777-45 on the ends of arbor J-21777-1, using the step of the disc that corresponds to the base of the carrier.

6. Place the arbor and plunger assembly into the carrier being sure the side bearing discs are seated properly.

7. Install the bearing caps finger tight to prevent the discs from moving.

8. Position dial indicator J-8001 on the mounting post of the arbor with the contact button resting on the top surface of the plunger.

9. Preload the dial indicator one half revolution and tighten in this position.

10. Select the 8-7/8″ button on the gage plate that corresponds to the 8-3/4″ ring gear size for all cars except Seville and 8-1/2″ ring gear size for Seville, rotate the plate until the plunger rests directly upon that button.

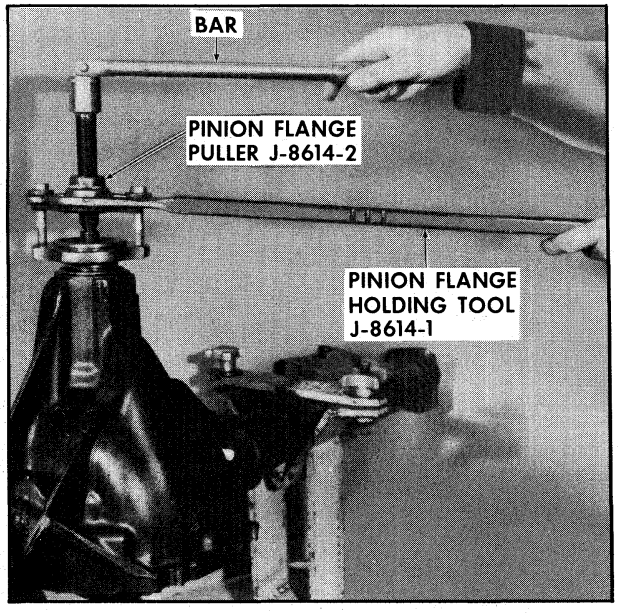


Fig. 4B-24 Drive Pinion Flange Removal

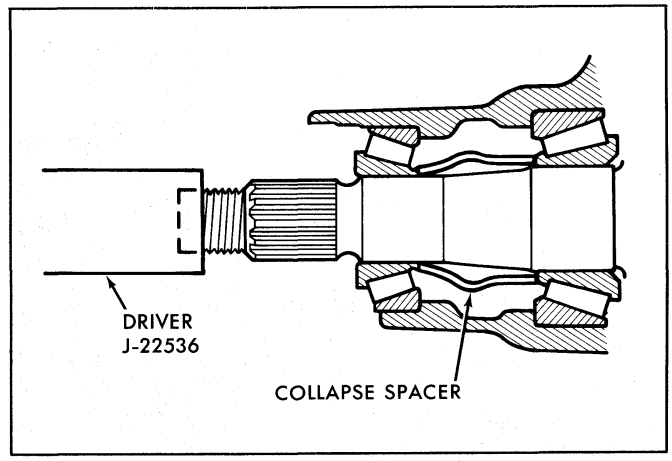


Fig. 4B-25 Removing Drive Pinion

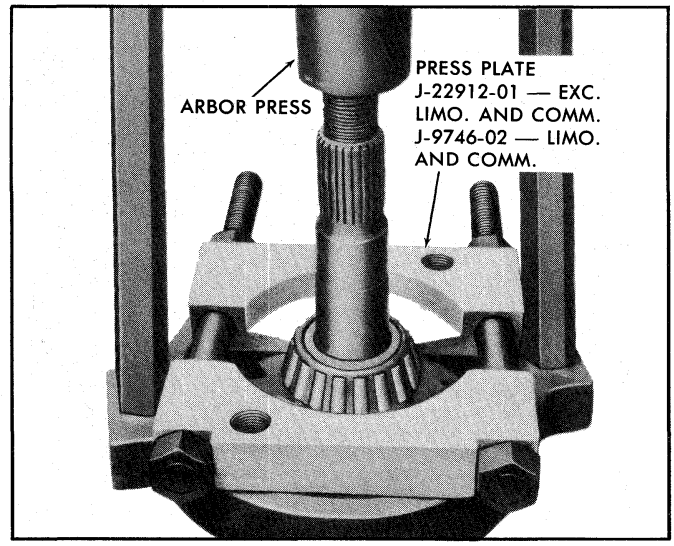


Fig. 4B-26 Removing Drive Pinion Rear Bearing

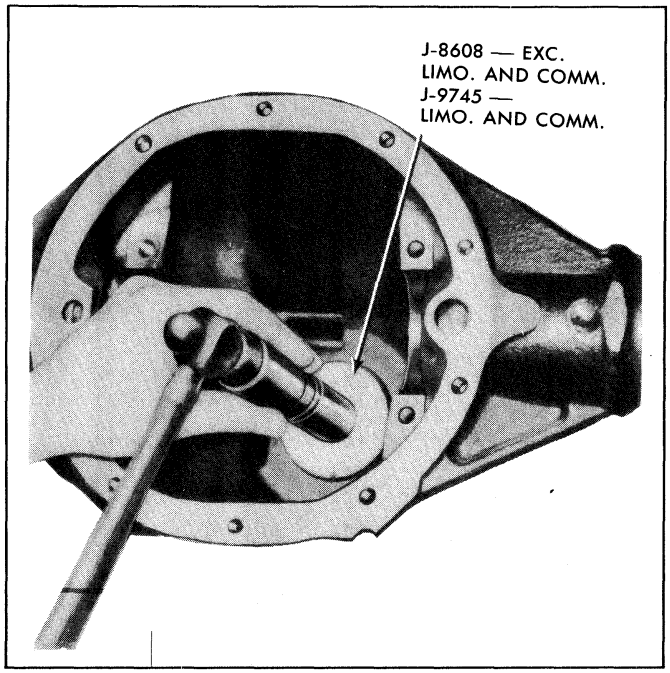


Fig. 4B-27 Installing Pinion Rear Bearing Cup

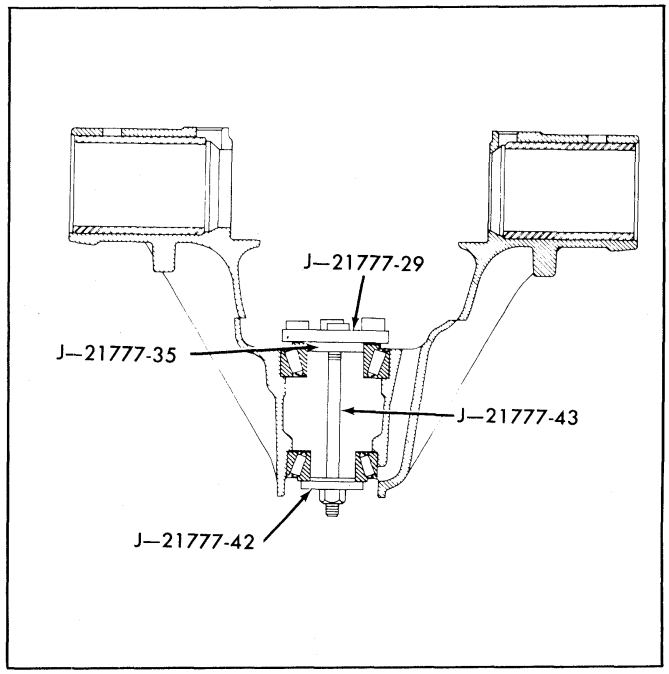


Fig. 4B-29 Gage Plate Installed

11. Rock the plunger rod slowly back and forth across the button until the dial indicator reads the greatest deflection. At this point, set the dial indicator to zero. Tools will now be positioned as shown in Fig. 4B-31.

12. Repeat the rocking action of the plunger several times to verify the setting.

13. Once the zero reading is obtained, swing the plunger until it is removed from the gage plate button.

The dial indicator will now read the required pinion shim thickness for a "nominal" pinion. Record this size.

14. Check the rear face of the drive pinion being installed for a pinion code number. This number indicates the necessary change of the pinion shim thickness as found in step 13.

a. If the pinion is stamped with a plus (+) number, add that many thousandths to the indicator reading. For example, if indicator reading is .019, and pinion is marked (+2), the correct depth shim for installation will be .019 + .002 = .021 inch.

b. If the pinion has not plus (+) or minus (–) number, use the indicator reading as the correct shim thickness.

c. If the pinion is stamped with a minus (–) number, subtract that many thousandths from the indicator reading. For example, if the indicator reading is .031, and the pinion is marked (–3), the correct depth shim for installation will be .031 – .003 = .028 inch.

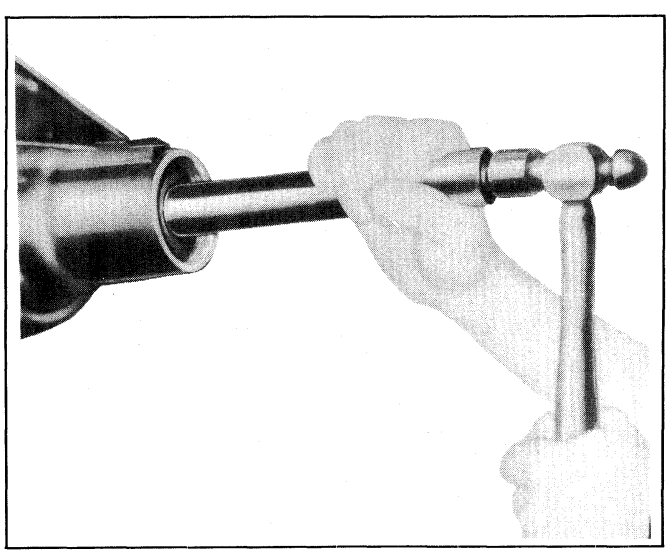


Fig. 4B-28 Installing Pinion Front Bearing Cup

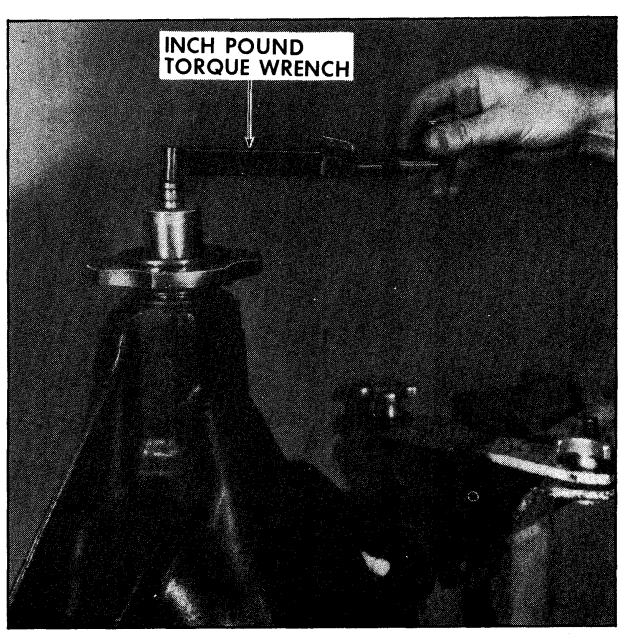


Fig. 4B-30 Measuring Rotating Torque

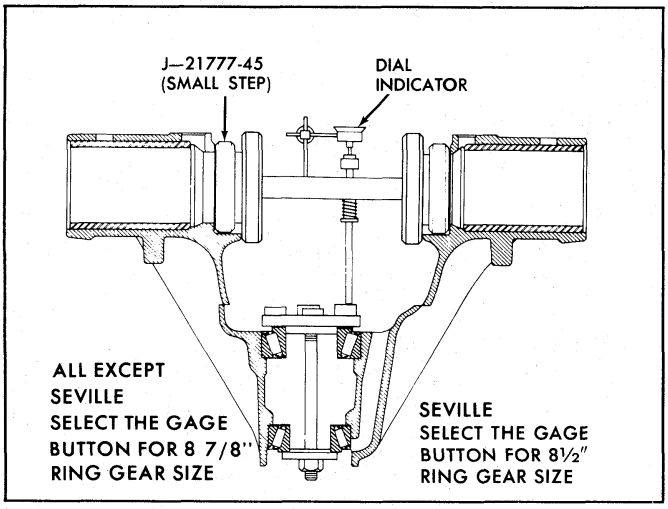


Fig. 4B-31 Depth Gage Installed in Position

15. Remove bearing caps and depth gage from carrier.

16. Position the shim selected in step 14 on the pinion shaft against pinion head.

17. Lubricate the rear pinion bearing with liberal amounts of differential lubricant and install rear bearing onto pinion, using J-8609 as shown in Fig. 4B-32.

If working on Limousine or Commercial Chassis, use Tool J-6547.

d. Drive Pinion Installation

NOTE: Lubricate pinion bearings with Differential Lubricant before installing pinion.

1. Install NEW collapse spacer on pinion and position assembly in carrier, Fig. 4B-33.

2. While holding forward, install pinion blocking fixture, J-22535 and tighten screw to hold rear pinion bearing tight against race, Fig. 4B-34.

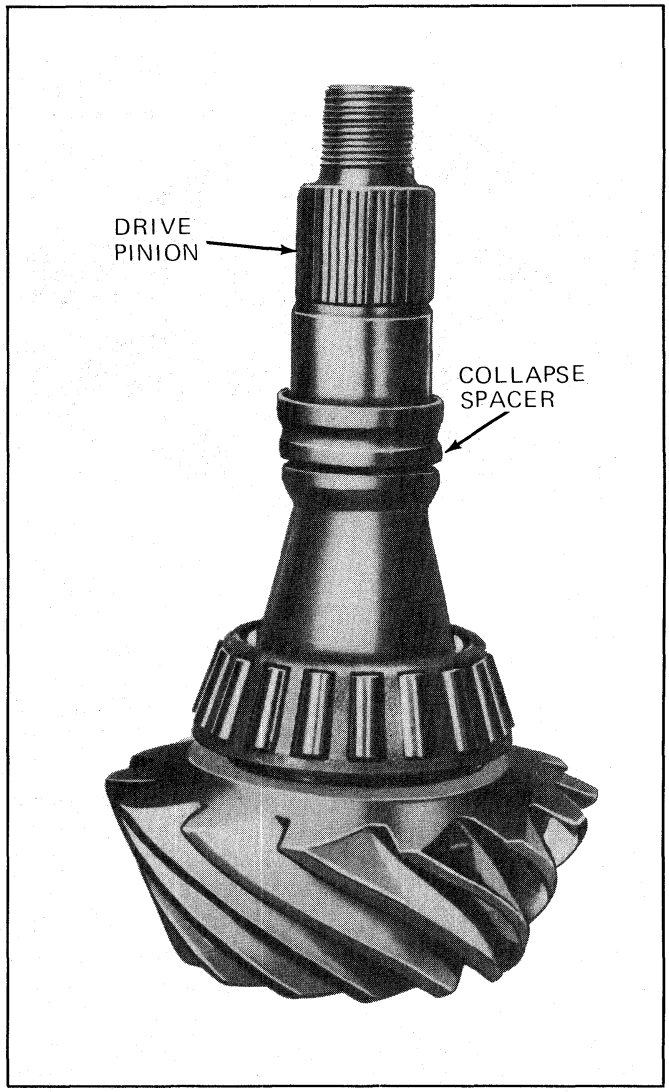


Fig. 4B-33 Collapse Spacer on Pinion

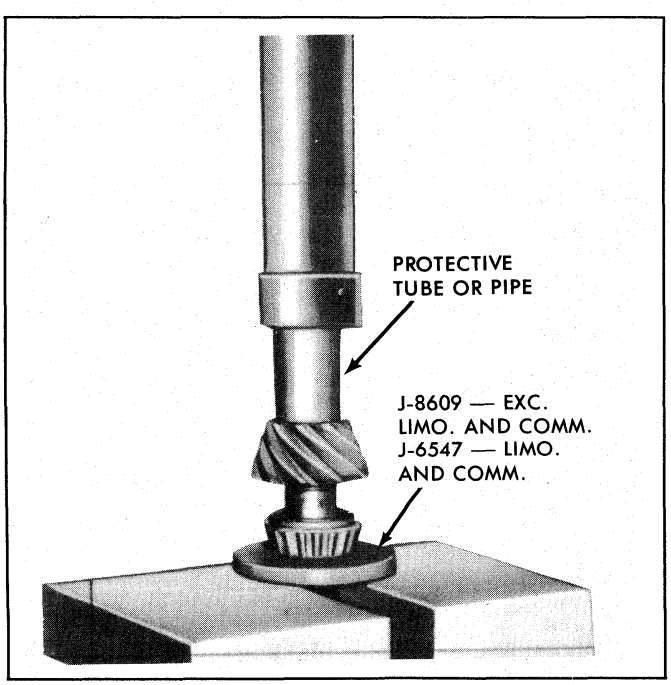


Fig. 4B-32 Drive Pinion Rear Bearing Installed

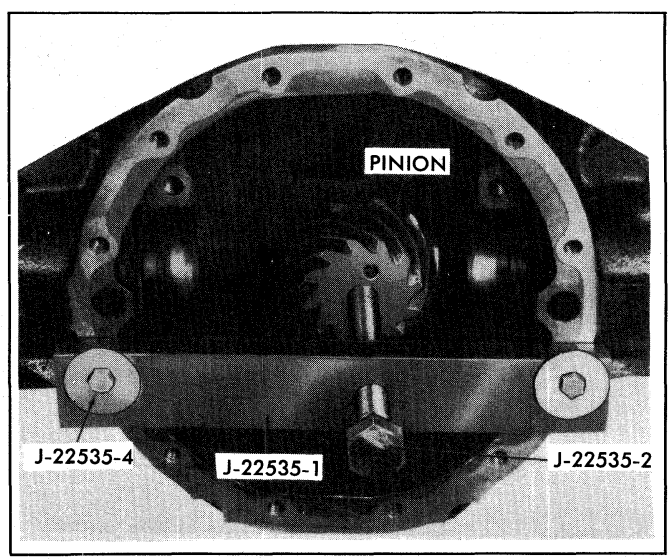


Fig. 4B-34 Pinion Holding Tool

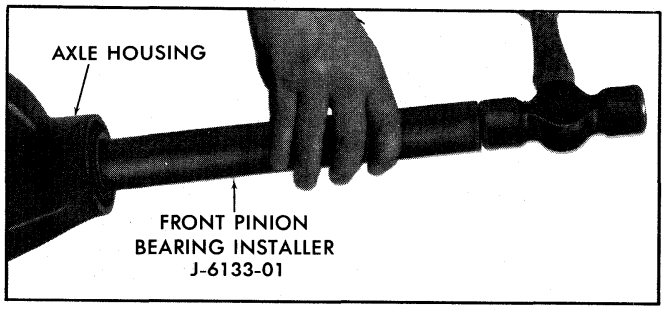


Fig. 4B-35 Installing Front Pinion Bearing

3. Install front bearing on pinion and drive bearing on pinion shaft until seated in cup, using Tool J-6133-01, Fig. 4B-35.

4. Pack inner lip of new pinion oil seal with wheel bearing lubricant.

5. Position seal to case and using Seal Installer, J-22388, tap seal in place with hammer, Fig. 4B-12. Install pinion flange on pinion by tapping with a soft hammer until a few pinion threads show through flange.

6. Install pinion washer and nut. Hold pinion flange as shown in Fig. 4B-10. While intermittently rotating pinion to seat pinion bearings, tighten flange nut until end play begins to be taken up.

NOTE: When no further end play is felt and when holder will no longer pivot freely as pinion is rotated, pre-load specifications are being reached. No further tightening should be done until the pre-load has been checked.

7. Check pre-load by using an inch pound torque wrench as shown in Fig. 4B-36.

NOTE: After pre-load has been checked, final tightening should be done very carefully. For example, if when checking, pre-load was found to be 5 inch pounds, any additional tightening of the pinion nut can add many additional inch pounds of torque. Therefore, the pinion nut should be further tightened only a little at a time and the pre-load should be checked after each slight amount of tightening. Exceeding pre-load specifications will compress the collapse spacer too far and require the installation of a new collapse spacer.

While observing the preceding note, carefully set pre-load at 15 to 30 inch pounds on new bearings or 5 to 10 inch pounds on used bearings.

8. Rotate pinion several times to assure that bearings have been seated. Check pre-load again. If pre-load has been reduced by rotating pinion, reset pre-load to specifications.

e. Differential Backlash Adjustment

1. Install differential case into carrier, using shims as required by the side bearing pre-load adjustment.

2. Rotate differential case several times to seat bearings, then mount dial indicator as shown in Fig. 4B-21. Use a small button on the indicator stem so that contact can be made near heel end of tooth. Set dial indicator so that stem is in line as nearly as possible with gear rotation and perpendicular to tooth angle for accurate backlash reading.

3. Check backlash at three or four points around ring gear. Lash must not vary over .002″ around ring gear.

NOTE: Pinion must be held stationary when checking backlash.

If variation is over .002″ check for burrs, uneven bolting

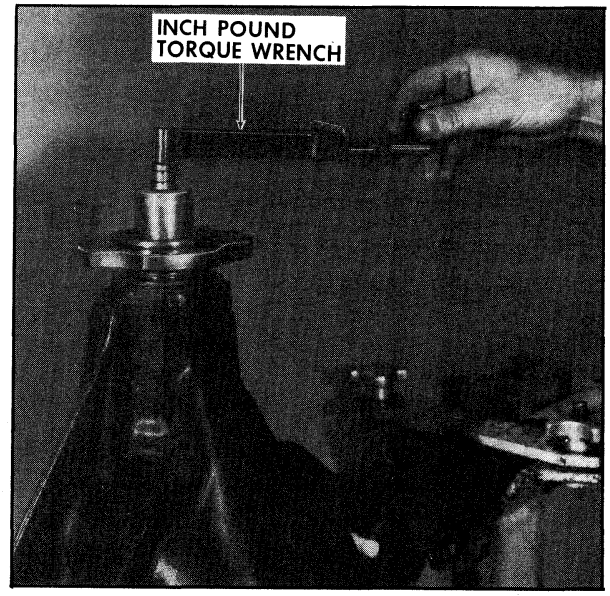


Fig. 4B-36 Checking Pinion Bearing Preload

conditions or distorted case flange and make corrections as necessary.

4. Backlash at the point of minimum lash should be between .005″ and .008″ for all new gears.

5. If backlash is not within specifications, correct by increasing thickness of one differential shim and decreasing thickness of other shim the same amount. This will maintain correct differential side bearing pre-load.

For each .001″ change in backlash desired, transfer .002″ in shim thickness. To decrease backlash .001″, decrease thickness of right shim .002″ and increase thickness of left shim .002″. To increase backlash .002″ increase thickness of right shim .004″ and decrease thickness of left shim .004″.

6. When backlash is correctly adjusted, remove both bearing caps and both shim packs.

NOTE: Keep shim packs in their respective position, right or left side.

Select a shim .004″ thicker than one removed from left side, then insert left side shim pack between the spacer and the left bearing cup. Loosely install bearing cap.

7. Select a shim .004″ thicker than the one removed from right side and insert between the spacer and the right bearing cup. It will be necessary to drive the right shim into position, Fig. 4B-20. Install bearing cap.

8. Torque bearing cap bolts to 60 foot pounds.

9. Recheck backlash and correct if necessary.

f. On Car Reassembly of Axle

CAUTION: *See Caution on page 4-8 of this section regarding fasteners referred to in Steps 8, 10, 12 and 19.*

1. Install left hand thread ring gear bolt that was removed, when differential was removed from housing.

2. Remove differential pinion cross shaft lock screw and remove cross shaft.

3. Slide alxe shafts into place.

CAUTION: *Exercise care that splines on end of shaft do not damage oil seal and that they engage*

with splines of differential side gear.

4. Install axle shaft "C" locks on button end of axle shafts and push shafts outward so that shaft lock seats in counterbore of differential side gears.

5. Position differential pinion cross shaft through case and pinions, aligning hole in shaft with lock screw hole. Install lock screw and torque to 25 foot pounds.

6. Using a new gasket, install cover and torque bolts to 25 foot pounds.

CAUTION: *Make sure both gasket surfaces on housing and cover are clean before installing new gasket. Torque cover bolts in a crosswise pattern to ensure uniform draw on cover gasket.*

7. Raise axle to on-car position.

8. Position shock absorber lower mounts in lower spring brackets and secure with bolts and nuts. Torque to 45 foot pounds.

9. Position brake pipe to axle housing clip and secure in position.

10. With stabilizer bar front eyes over links, install bushings, retainers and nuts as shown in Fig. 4B-3. Tighten nuts to 150 inch pounds.

11. Remove propeller shaft from support and position to axle pinion flange, observing alignment marks made on removal.

12. Secure propeller shaft flange with four screws and torque to 70 foot pounds.

13. Route emergency brake cables and position in equalizer. Adjust cables as outlined in Section 5.

14. Hold rear leveling valve over-travel lever in UP position to inflate shock absorbers.

15. Connect overtravel lever to link.

16. Fill differential to proper level with the specified lubricant. Refer to Fluid Capacity Chart and Recommended Fluids and Lubricants Chart as outlined in Section 0.

17. Install brake drums and wheel and tire assemblies.

18. Lower car to floor.

19. Torque wheel mounting nuts to 80 foot pounds.

20. Install wheel discs.

GEAR TOOTH CONTACT PATTERN CHECK

Prior to final assembly of the differential, a Gear Tooth Contact Pattern Check is necessary to verify the correct relationship between ring gear and drive pinion. Gear sets which are not positioned properly may be noisy, or have short life, or both. With a pattern check, the most desirable contact between ring gear and drive pinion for low noise level and long life can be assured.

a. Gear Tooth Nomenclature

The side of the ring gear tooth which curves outward, or is convex, is referred to as the "drive" side. The concave side is the "coast" side. The end of the tooth nearest center of ring gear is referred to as the "toe" end. The end of the tooth farthest away from center is the "heel" end. Toe end of tooth is smaller than heel end. See Fig. 4B-37.

b. Test

1. Wipe oil out of carrier and carefully clean each tooth of ring gear.

2. Use gear marking compound (yellow lead chromate or equivalent) and apply this mixture sparingly to all ring gear teeth using a medium stiff brush. When properly used, the area of pinion tooth contact will be visible when hand load is applied.

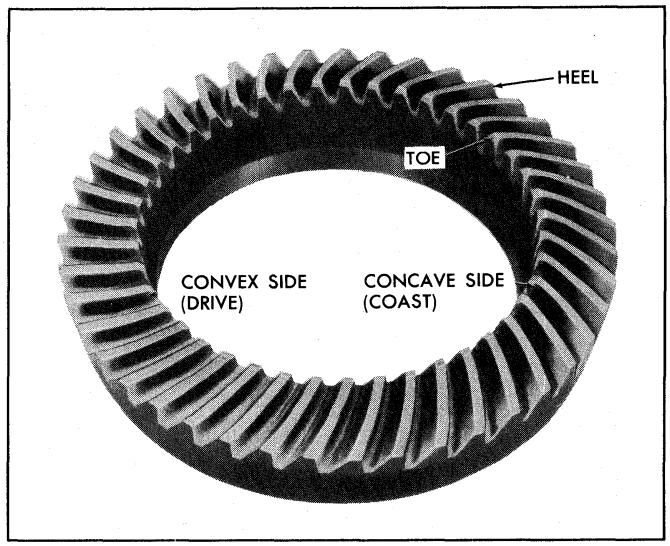


Fig. 4B-37 Gear Tooth Nomenclature

3. Tighten bearing cap bolts to 60 foot pounds.

4. Expand brake shoes until a torque of 25 foot pounds is required to turn the pinion.

NOTE: A test made without loading the gears will not give a satisfactory pattern. Turn pinion flange with wrench so that ring gear rotates one full revolution then reverse rotation so that ring gear rotates one revolution in opposite direction. Excessive turning of ring gear is not recommended.

5. Observe pattern on ring gear teeth and compare with Fig. 4B-38.

c. Adjustments Affecting Tooth Contact

Two adjustments can be made which will affect tooth contact pattern. These adjustments are backlash and position of drive pinion in carrier. The effects of bearing preloads are not readily apparent on hand loaded tooth pattern tests; however, these adjustments should be within specifications before proceeding with backlash and drive pinion adjustments.

NOTE: It may be necessary to adjust both pinion depth and backlash to obtain the correct pattern.

The position of the drive pinion is adjusted by adding or subtracting the shim thickness between the pinion head and inner cup of rear bearing. The shim is used in the differential to compensate for manufacturing tolerances. Increasing shim thickness will move the pinion closer to centerline of the ring gear. Decreasing shim thickness will move pinion farther away from centerline of the ring gear.

Backlash is adjusted by means of the side bearing adjusting shims which moves the entire case and ring gear assembly closer to, or farther from the drive pinion.

(The adjusting shims are also used to set side bearing preload). To increase backlash, add shims to the right side and remove an equal amount from the left side. To decrease backlash, remove shims from the right side and add an equal amount to the left side.

The important thing to note is that the contact pattern is centrally located up and down on the face of the ring gear teeth.

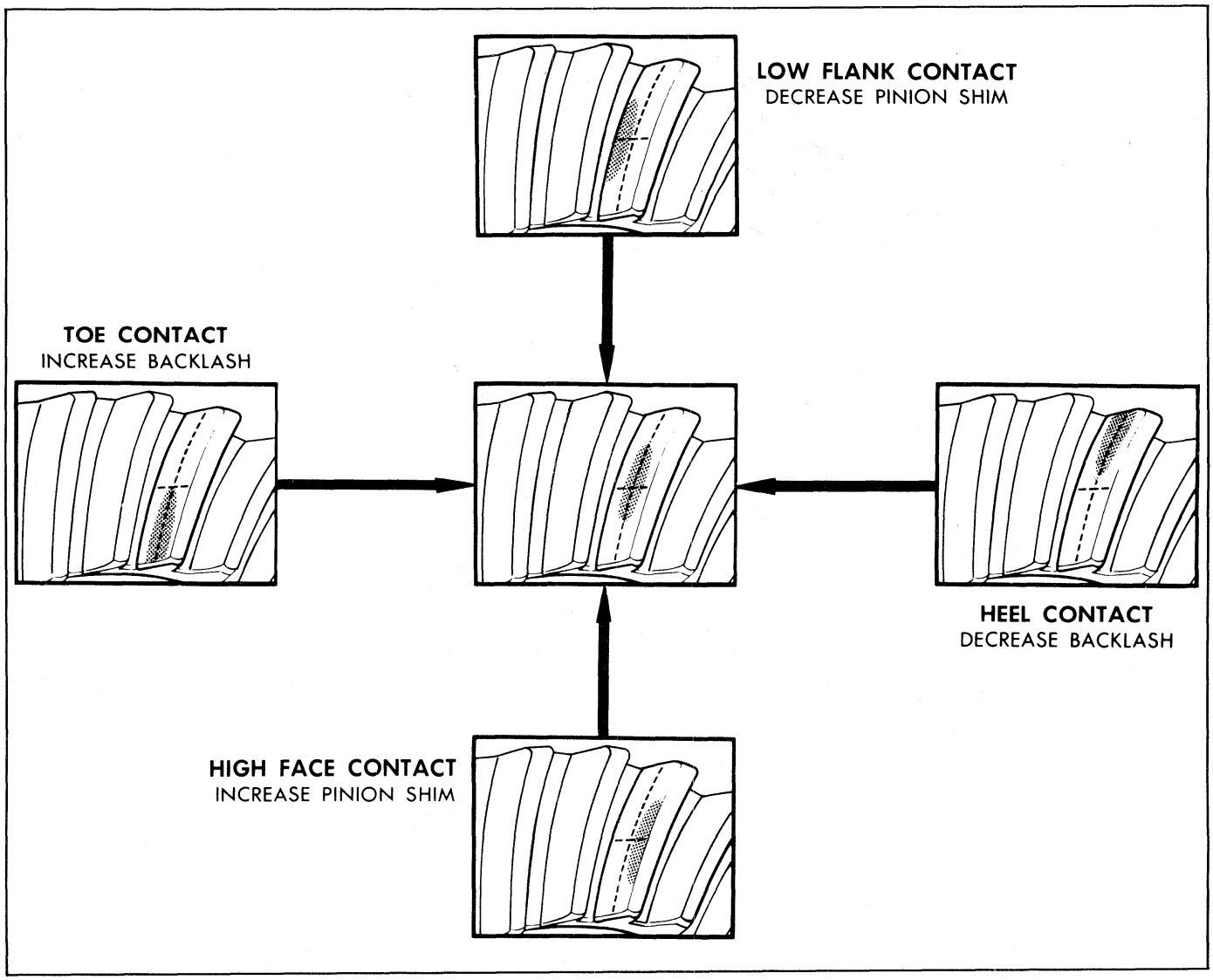


Fig. 4B-38 Gear Tooth Contact Pattern Check

CONTROLLED DIFFERENTIAL GENERAL DESCRIPTION

The controlled differential uses the same gear ratios as the non-controlled unit; 2.28:1, 2.73:1 and 3.08:1 - except Seville. 2:56-1 and 3.08-1 Seville.

Overhaul procedures for the controlled differential are the same as for standard axles, except for the following operations.

CONTROLLED DIFFERENTIAL (Fig. 4B-39)

a. Disassembly

1. Remove ring gear and side bearings following the procedures used for the standard differential unit. Remove pinion shaft.

2. Using a wide, blunt instrument such as a drift or block of wood, drive the preload spring from the case.

3. Support an axle shaft in a vise and slide the case over the shaft; then turn the case to remove both pinions and thrust washers.

NOTE: The pinion shaft may be partially installed to aid in rotating the case.

4. Remove the case from the axle shaft and remove both side gears, clutch packs and shims for reinstallation in same positions.

b. Inspection

Check the clutch plates and discs for wear and signs of overheating. Check the condition of the preload spring. Check the gear teeth for signs of wear. Clean all parts to be used for assembly.

Excessive wear means assembly will have to be replaced.

NOTE: The force required to compress the preload spring to 1-5/16 inches should be 300 pounds $\pm$ 30 pounds.

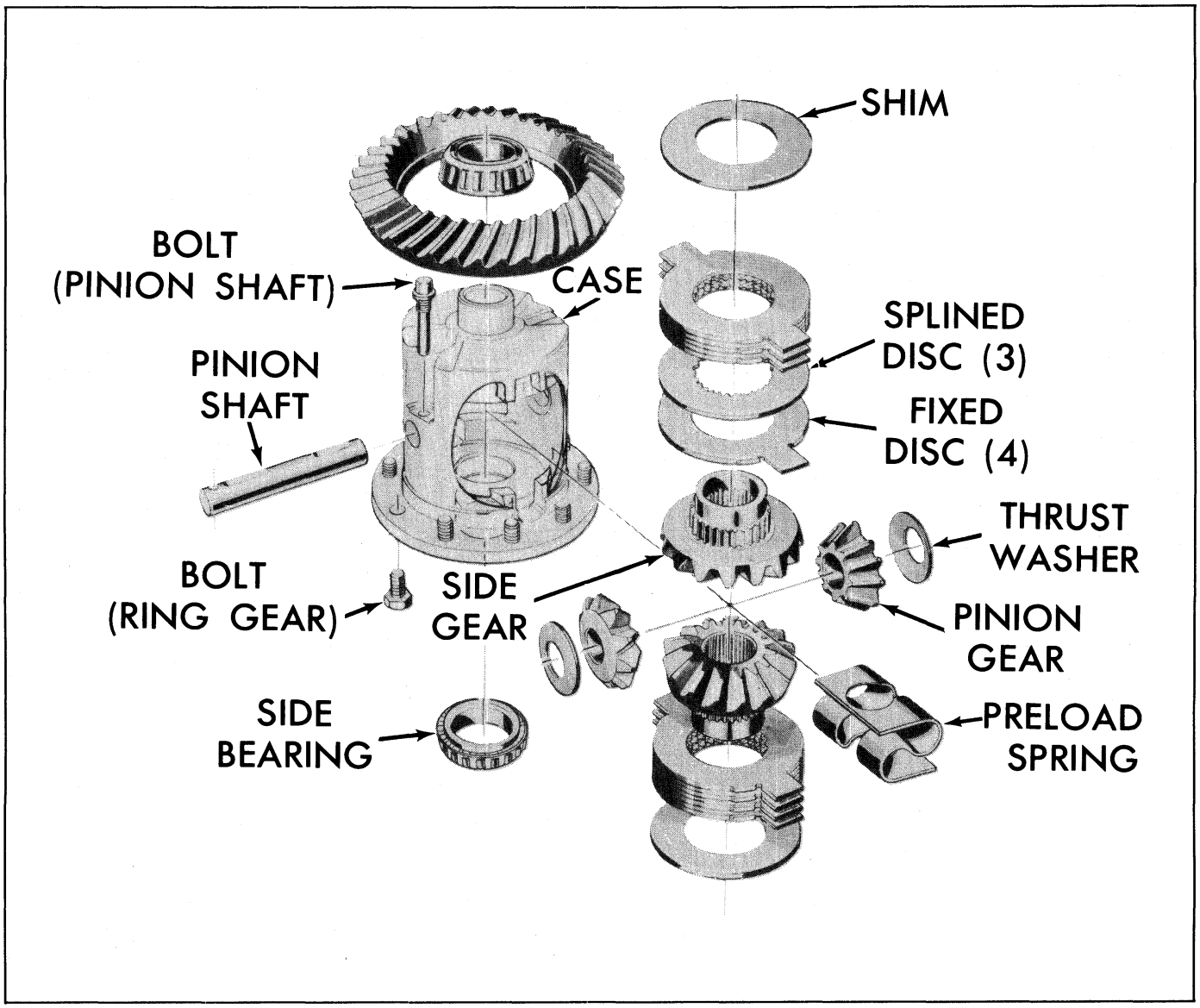


Fig. 4B-39 Controlled Differential - Disassembled

c. Reassembly

1. Lubricate the clutch discs and plates with differential lubricant.

2. Alternately position clutch plates and discs on a side gear, beginning and ending with a clutch plate.

3. Position the side gear, clutch pack and original shim into the case.

4. Install both pinion gears and thrust washers into the case, and install pinion shaft.

5. Place the case onto an axle shaft supported in a vise.

6. Insert a screwdriver between the pinion shaft and the face of the side gear. Force the screwdriver in until the clutch pack is compressed.

7. Check the backlash between side gear and pinion gears. If backlash does not fall into the range of .005" to .008", replace the unit.

8. Mount the case onto the axle shaft locked in a vise. Place both pinions and thrust washers into position–180° apart–and carefully "roll in" by turning the case on the shaft.

NOTE: A large "C" clamp may be used to apply slight compression against pinion gears to aid the "rolling in" procedure.

9. Tap the preload spring into place with a hammer.

10. Install the pinion shaft and lock screw.

11. Install the side bearings and ring gear using the procedure outlined for conventional units.

12. Place the differential unit in the carrier and adjust ring gear and pinion backlash, and gear tooth pattern.

REAR AXLE ELDORADO GENERAL DESCRIPTION

The rear axle used on the Eldorado is a straight, hollow tube, Fig. 4B-40. The rear wheel spindles are pressed into and bolted to the axle tube assembly.

Tapered roller bearings are used in the rear hubs. For diagnosis information pertaining to this type of bearing, refer to Fig. 4B-4 and the corresponding text.

SERVICE INFORMATION

The following service information pertains only to the Eldorado rear axle. For service procedures not given, refer to the forward portion of the appropriate subsection as the procedures are the same as on other Cadillacs.

CAUTION: *If any mispositioning incorrect assembly, or failure of components in the area of the brake system pipes, hoses, or cylinders is observed, be sure to check for any brake damage that may have resulted from such a condition and correct as required. Components that could damage the brake system due to mispositioning, incorrect assembly, or failure include the exhaust system, shock absorbers, springs, and suspension control arms.*

When raising rear of car, support vehicle weight at frame or axle or both. Never use control arms as contact points for hoist or jack stands, as damage may result.

REAR WHEEL BEARING ADJUSTMENT

Regularly scheduled rear wheel bearing repacking is not required. When major brake service is being performed, however, it is recommended that the rear wheel bearings be cleaned and repacked with a high melting point grade 2 lithium grease.

Adjustment of the rear wheel bearings should be made while revolving the wheel at least three times the speed of nut rotation when taking the torque readings.

1. While rotating hub assembly, tighten spindle nut to 25-30 foot-pounds.

2. Back nut off 1/2 turn, then retighten nut to 2 foot-pounds and install cotter pin.

3. If cotter pin cannot be installed in either of the two available holes in the spindle, with the nut at 2 foot-pounds, back nut off until cotter pin can be installed.

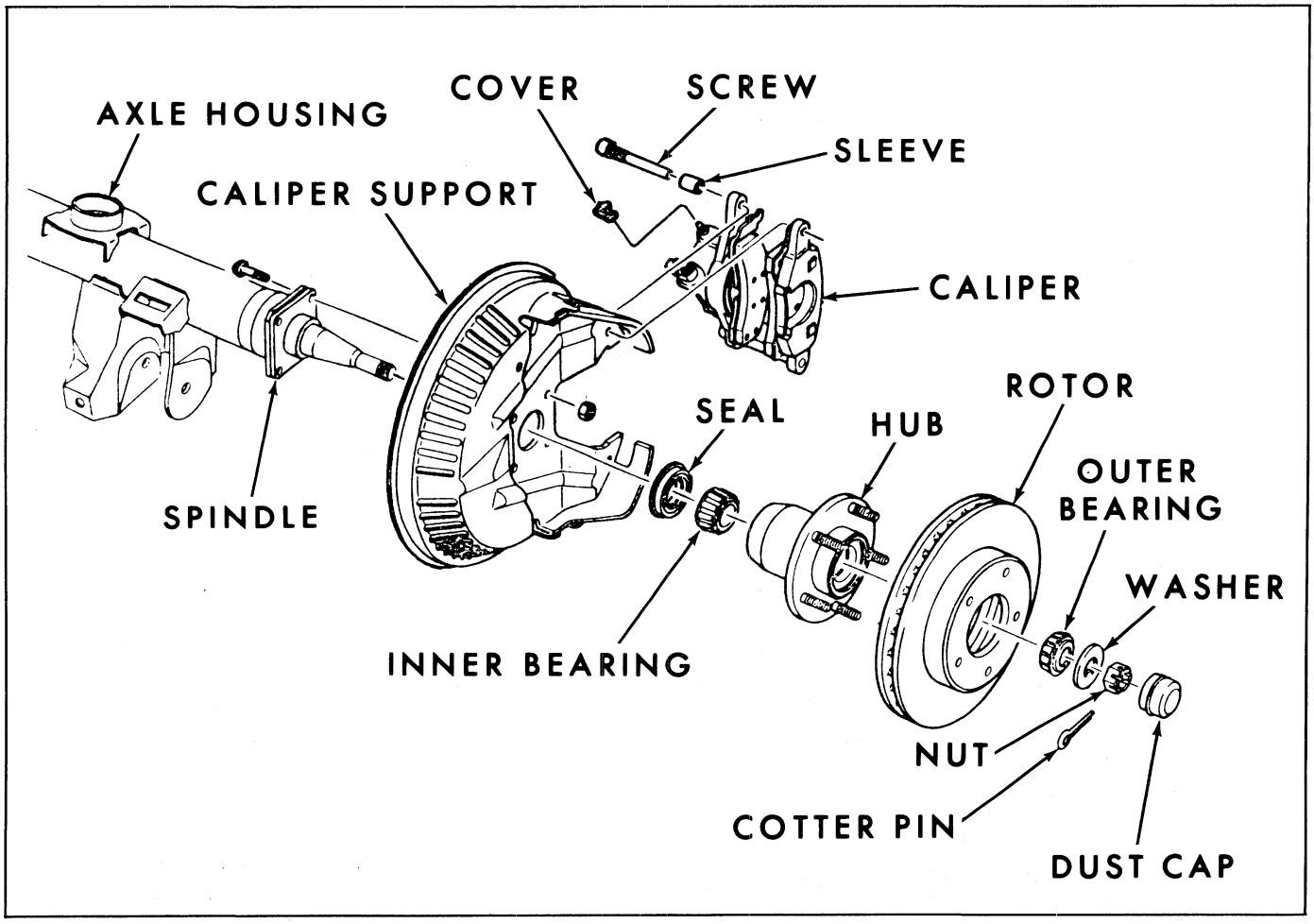


Fig. 4B-40 Rear Wheel Disassembled - Eldorado

4. The rear hub must be rotated at least three revolutions during tightening of spindle nut. The final adjustment to be 2 foot-pounds nut torque to .004 bearing end play.

5. Peen end of cotter pin over sufficiently against side of nut. Cotter pin must be tight after installation. If it can be moved with finger, vibration may cause it to wear and break.

6. Install dust cap.

REAR HUB

a. Removal

1. Remove wheel disc and loosen wheel mounting nuts.
2. Raise rear end of car.
3. Remove wheel and tire assembly.
4. Remove caliper and disc as described in Section 5.
5. Remove dust cap, cotter pin, spindle nut, washer and outer cone and roller assembly, Fig. 4B-40.
6. Carefully pull hub off of spindle.

b. Installation

1. Install rear hub on spindle, after wiping any accumulated grease from spindle, leaving only a light film.
2. Install outer cone and roller assembly and washer over spindle into hub, and install spindle nut fingertight.
3. Adjust rear wheel bearing as described on page 4B-25, steps 1 through 6.
4. Install rear brake disc and caliper as described in Section 5 on page 00.
5. Position wheel assembly on hub, installing wheel mounting nuts finger tight.
6. Lower car.
7. Tighten wheel mounting nuts to 130 foot-pounds.

CAUTION: *See "CAUTION" on page 4-8.*

REAR WHEEL BEARINGS AND GREASE RETAINER (Fig. 4B-40)

Removal

1. Remove hub assembly as described above.
2. Pry grease retainer from inner side of hub.

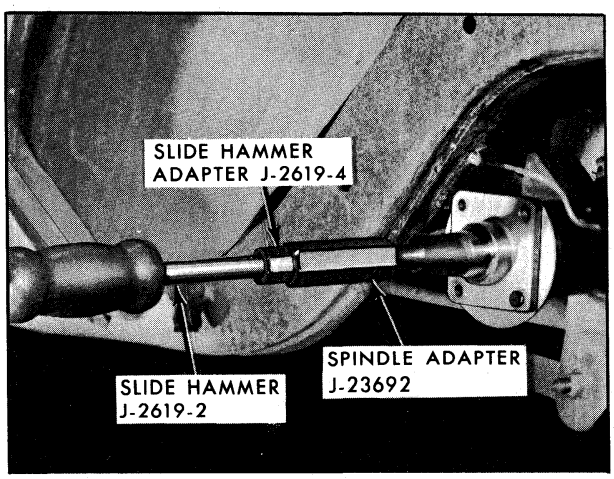


Fig. 4B-41 Removing and Installing Rear Spindle

NOTE: The inner bearing grease retainer tool, Section 3C, Fig. 3C-6, may be used to remove the grease retainer.

3. Remove inner cone and roller assembly from hub.
4. Inner and outer bearing cups are press fitted in hub, and can be removed, if necessary, by driving out from opposite side with a brass drift.

b. Inspection

1. Thoroughly clean all parts in clean solvent.
2. Check bearings for cracked separators and worn or pitted rollers.
3. Check bearing races for defects, using Fig. 4B-4 as a guide.

c. Installation

1. If inner bearing cup was removed, drive or press cup, small I.D. side first, into inner side of hub, using Universal Handle, J-8092 and Inner Bearing Cup Installer, J-8458.
2. If outer bearing cup was removed, drive or press cup, small I.D. side first, into outer side of hub, using Universal Handle, J-8092, and Outer Bearing Cup Installer, J-8849.
3. Pack bearing cage with high melting point grade 2 lithium grease. Use a commercial bearing packer or pack bearings by hand, forcing grease in at large end of cage until it protrudes from the small end.
4. Install inner cone and roller assembly into inner side of hub.
5. Drive or press new grease retainer into inner side of hub, using Universal Handle, J-8092, screwed into a flat sided tool, such as J-23114.

NOTE: If J-23114 is used, screw Universal Handle into reverse side of tool.

6. Wipe spindle clean and apply a thin film of wheel bearing grease to spindle.
7. Install rear hub as described on this page.

REAR WHEEL SPINDLE–ON CAR

a. Removal

1. Raise rear of car.
2. Remove rear hub.
3. Remove four nuts securing spindle to axle housing.
4. Start one brake axle housing to spindle nut just far enough to engage threads.
5. Attach Adapter, J-2619-4, to Slide Hammer, J-2619, and attach Spindle Adapter J-23692 to Adapter J-2619-4, and install assembly on spindle, Fig. 4B-41.

NOTE: Make sure all threads are fully seated.

6. Use slide hammer assembly to drive spindle from axle.
7. Remove remaining spindle to housing bolt and nut and remove spindle.
8. Remove slide hammer assembly from spindle.

b. Installation

NOTE: If spindle threads were damaged on removal, use a 3/4"-20 thread chaser to correct damage.

1. Attach slide hammer assembly to new spindle, making sure threads are fully seated.
2. Drive new spindle into axle until spindle is fully installed, Fig. 4B-41.
3. Install new gasket on wheel spindle.
4. Install rear hub.
5. Bleed brakes, Section 5.

REAR AXLE

a. Removal

1. Remove wheel discs, and loosen wheel mounting nuts.
2. Raise car on hoist and place jack stands under frame side rails.
3. Lower hoist.
4. Raise hoist just enough to support weight of axle (about 3/8").
5. Remove wheel mounting nuts and both wheel and tire assemblies.
6. Remove rear hub assemblies as described on page 4B-26, steps 3 through 6.
7. Disconnect rubber brake hose and cap the hose to minimize fluid leakage.
8. Disconnect overtravel link from bracket on rear axle.
9. Deflate shock absorbers by disconnecting air line at height control valve.
10. Remove wheel spindles following procedure outlined on page 4B-26.
11. Disconnect shock absorbers at lower mounts and position out of way.
12. Raise axle to relieve tension on upper control arms and remove bolt and nut securing each upper control arm to axle brackets.

WARNING: STAND CLEAR OF AXLE ASSEMBLY WHEN PERFORMING NEXT STEP. SPRINGS COULD SNAP FROM THEIR SEATS RESULTING IN POSSIBLE INJURY OR DAMAGE.

13. Carefully lower axle until spring tension is relieved, then remove springs by hand.
14. Remove bolt and nut securing each lower control arm to its axle bracket.

NOTE: Axle may have to be rotated slightly in order to remove bolts.

15. Remove rubber bumpers from top of axle housing.
16. Lower axle and remove from car.
17. Remove brake pipes and etc. from axle housing.

b. Installation

1. Install rubber bumpers on top of new axle.
2. Secure brake pipes to axle using four clips.
3. Position brake pipe distributor to axle and secure with screw.
4. Position new axle under car.
5. Raise axle only as far as necessary to insert lower control arms in axle brackets. Install lower arms and bolts and nuts but do not torque at this time.

NOTE: It may be necessary to rotate axle slightly to align bolt holes. If so, use a jack stand at front or rear of one of the lower control arm brackets while adjusting axle height with hoist.

6. Pivot upper control arms upwards and secure arms temporarily in this position.
7. Fully extend shock absorbers; then raise axle until shock absorbers lower mounts are aligned. However, do not install shock absorbers at this time.
8. Install spring insulators and install springs, indexing as shown in 4B-4A. Raise axle just enough to compress springs slightly.
9. Drop upper control arms into axle brackets and install bolts and nuts. Do not torque at this time.
10. Position shock absorbers in lower mounts and install nuts.
11. Connect white air line to superlift port of height control valve.
12. Raise overtravel lever briefly to allow air into shock absorbers.
13. Connect overtravel lever to axle bracket. Shock absorbers will exhaust to residual pressure of 8-15 psi.
14 Raise axle until weight of car is supported by front and rear suspensions. Remove jack stands.
15. Torque lower control arm bolts while holding nuts to 145 foot-pounds, upper control arm bolts at frame to 145 foot-pounds, upper control arm bolts at axle to 110 foot-pounds, and shock absorber lower mounting nuts to 50 foot-pounds.

CAUTION: *See "CAUTION" on page 4-8.*

16. Uncap rubber hose and connect to brake pipe distributor.
17. Install wheel spindles as described on page 4B-26, Steps 1 through 6.
18. Install rear wheel hubs as described on page 4B-26.
19. Using service valve, inflate Automatic Level Control system to 140 psi, or maximum pressure available.
20. Bleed brakes, Section 5.
21. Remove jack stands and lower car.
22. Tighten wheel nuts to 130 foot-pounds.
23. Install wheel discs and wheel shields.

SPECIFICATIONS

Pinion Flange Combined Face and Radial Runout	.005"
Side Bearing Preload	Slip Fit Plus .008"
Pinion Bearing Preload	
Used Bearings	5-10 Inch-Pounds
New Bearings	15-30 Inch-Pounds
Ring Gear to Pinion Backlash	
Vehicle Mileage Less than 3000 (New Gears)	.005" - .008"
Vehicle Mileage Greater than 3000	Re-establish Reading Found on Disassembly

TORQUE SPECIFICATIONS

Material No.	Application	Size	Foot-Pounds
300-M	Bearing Cap Bolts	7/16—14	65
300-M	Ring Gear-to-Gear Case Bolts	7/16—20	90
Special	Carrier Rear Cover Screws	5/16—18	30
286-M	Wheel Mounting Nuts	1/2—20	80*
286-M	Pinion Nut	7/8—14	See Pinion Assembly
300-M	Pinion Cross Shaft Lock Screw		20
300-M	Pinion Flange to Ball Support Yoke Flange Attaching Screws	7/16—20	70*
1112	Differential Filler Plug	1/2—14	30

NOTE: Refer to back of Manual for bolt and nut markings, and steel classifications.

***CAUTION:** *These fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. Each must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque valuesmust be used as specified during reassembly to assure proper retention of these parts.*

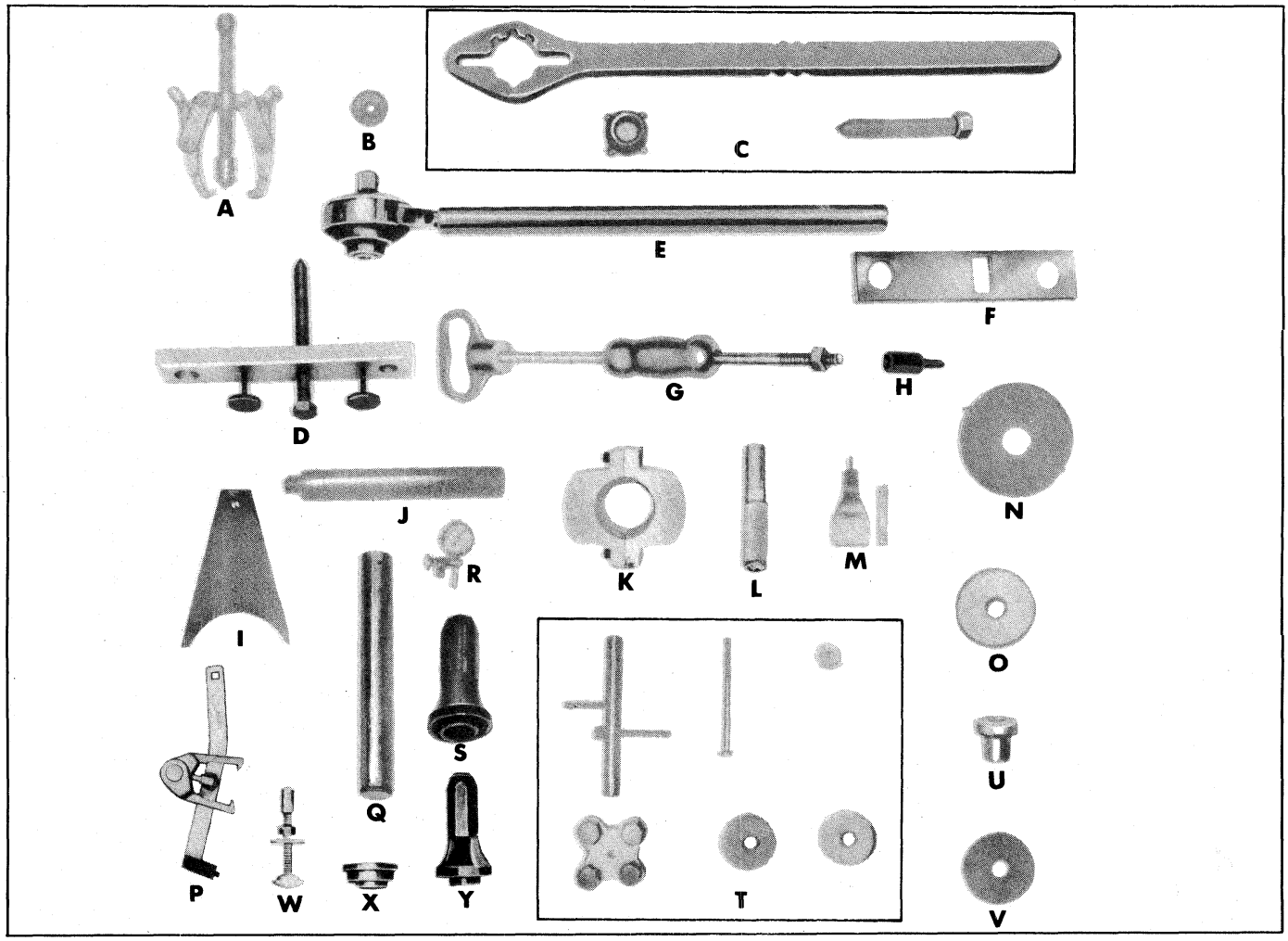


Fig. 4B-42 Special Tools

Key	Tool No.	Name	Key	Tool No.	Name
A	J-22888	Differential Side Bearing Remover	Q	J-6133-01	Front Pinion Bearing Installer
			R	J-8001	Dial Indicator
B	J-22175	Adapter Plug	S	J-22388	Pinion Oil Seal Installer
C	J-8614	Companion Flange Remover	T	J-21777-350	Pinion Setting Gage
		J-8614-1 Holder			J-21777-45 Side Discs
		J-8614-2 Screw			J-21777-1 Arbor
		J-8614-3 Nut			J-21777-29 Gage Plate
D	J-22535	Pinion Holding Tool			J-21777-42 Front Bearing Plug
E	J-23410	Torque Multiplier			J-21777-43 Stud
F	J-23413	Torque Multiplier Link			J-21777-35 Pilot
G	J-2619	Slide Hammer	U	J-22761	Differential Side Bearing Installer
H	J-2619-4	Slide Hammer Adapter			
I	J-25588	Differential Shim Installer	V	J-8608	Rear Pinion Bearing Cup Installer
J	J-8092	Drive Handle			
K	J-8612	Rear Pinion Bearing Remover		J-9745	Rear Pinion Bearing Cup Installer — Limo & CC
	J-9746-02	Rear Pinion Bearing Remover-Limo & CC			
L	J-22536	Drive Pinion Remover	W	J-22813-01	Axle Shaft Bearing Remover
M	J-22779	Side Bearing Shim Gage		J-23689	Axle Shaft Bearing and Seal Remover — Limo & CC
		J-22779 Strap			
N	J-8609	Rear Pinion Bearing Installer	X	J-23765	Axle Shaft Bearing Installer
	J-6547	Rear Pinion Bearing Installer-Limo & CC		J-23690	Axle Shaft Bearing Installer — Limo & CC
O	J-8611-01	Drive Pinion Front Bearing Cup Installer	Y	J-23771	
				J-21128	Axle Shaft Oil Seal Installer
P	J-26725	Differential Puller			Axle Shaft Seal Installer Limo & CC

FRONT WHEEL DRIVE
TABLE OF CONTENTS

General Description 4C-1
Diagnosis 4C-1
On Car Service
Output Shaft and Drive Axle
Right 4C-3
Left 4C-4
Unit Repair
Outer Constant Velocity Joint (Ball Type) 4C-5
Inner Joint 4C-6
Right Output Shaft Bearing 4C-9
Output Shaft Seal Replacement 4C-9
Final Drive - Removal and Installation 4C-11
Pinion Bearing Oil Seal Replacement 4C-12
Specifications 4C-13
Special Tools 4C-14

GENERAL DESCRIPTION

NOTE: The following information is applicable only to the Eldorado.

The front wheel drive system consists of a final drive unit, right and left output shafts, and right and left drive axles.

The final drive assembly includes a spiral bevel ring and pinion gear set with a ratio of 2.73:1 and 3.07:1. The function of the unit is similar to that of a standard differential. The pinion gear is splined directly to the transmission, and the housing is secured to the transmission by eight fasteners: six screws, and two nuts that attach to studs in the transmission. The final drive housing is secured at its forward end by a support bracket which in turn is fastened to an engine mount bracket.

A twin gasket assembly is used between the final drive housing and cover to provide a controlled vent for excess lubricant.

Torque from the final drive is transmitted to the output shafts which connect to the drive axles. The output shafts are splined to the side gears in the final drive. The longer right output shaft requires a special support brace.

The drive axles, Fig. 4C-1, are flexible assemblies, consisting of an axle shaft with a ball-type constant velocity joint at the outboard end and a tri-pot constant velocity joint at the inboard end. Tri-pot joints flex not only in respect to the angle through which they operate, but also in and out. This provides a means of lengthening and shortening of the drive axles as required by the front suspension as it travels through its ride motion.

The right drive axle incorporates a torsional damper.

DIAGNOSIS

CONDITION	CAUSE	CORRECTION
Clicking noise in turns.	Excessive wear or broken outboard joint.	Inspect and replace outboard joint if necessary.
Coast to drive "clunk".	Drive Axle to Output Shaft Screws.	Tighten to specified torque.
	Idle speed too high.	Adjust to specification.
	Inoperative rubber damper (RH side).	Replace right shaft and damper assembly.
	Loose spline RH damper to shaft.	Replace right shaft and damper assembly.
Shudder or vibration on acceleration.	Incorrect U-joint angle.	Check front standing height and correct if necessary.
	Excessive wear on inboard joint housing.	Check for brinelling of housing bores and replace if necessary.
	Worn spider assembly.	Check for wear or free rotation of balls on spider. Replace spider assembly if necessary.
Shimmy vibration at highway speeds.	Tires out of balance or out of round.	Balance front wheels. Replace if out of round.

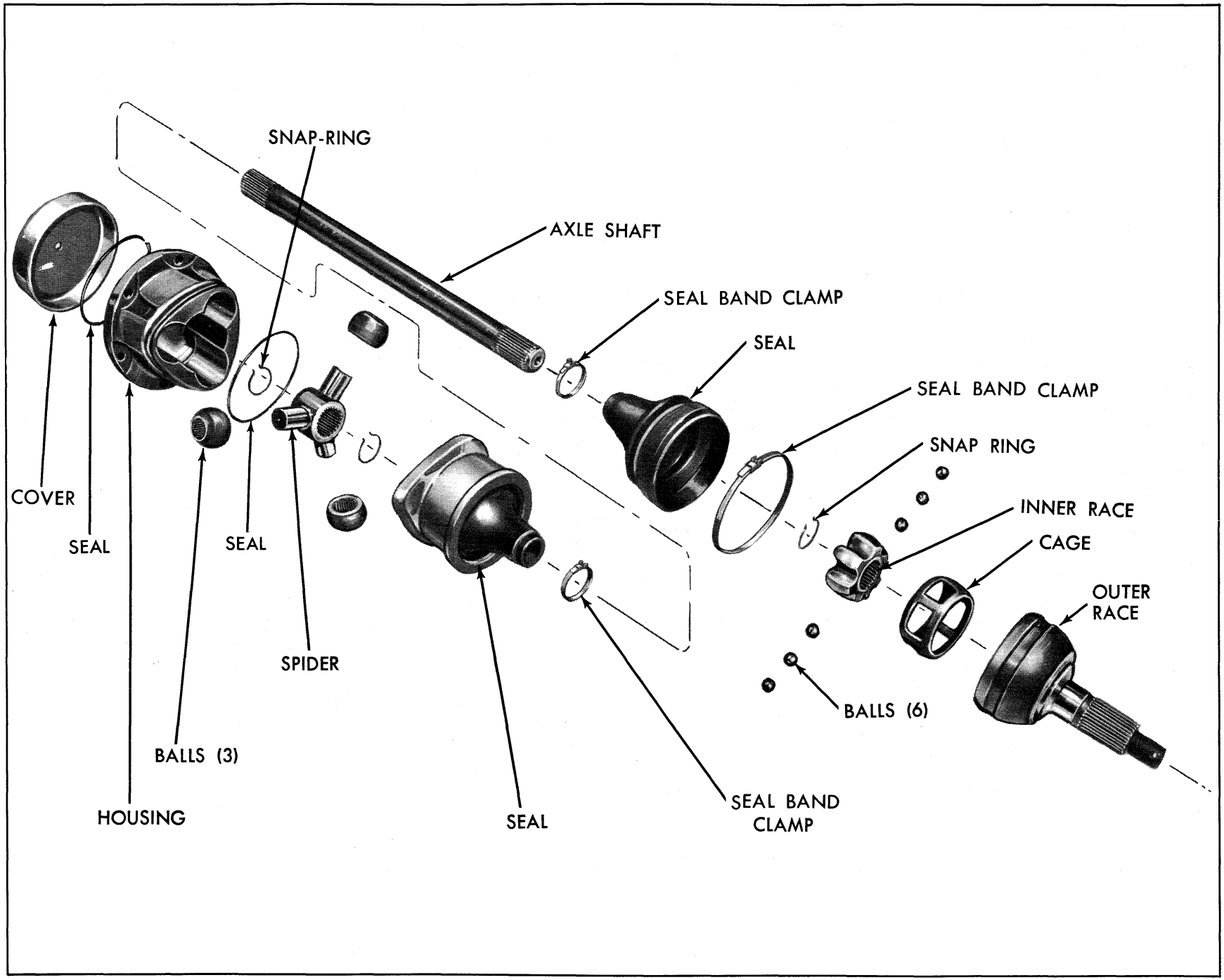


Fig. 4C-1 Drive Axle Disassembled

ON CAR SERVICE

The final drive unit is not serviced but is replaced as an assembly, with the exception of the following parts, which are serviced separately: pinion oil seal, output shaft seal, pinion bearing housing O-ring, vent pin, seal cover gasket, and filler plug gasket.

The drive axle outer constant velocity joints can be disassembled for repacking and replacement of seals. If any other defect is found, replace the joint as an assembly. The inboard tri-pot joints can be disassembled for repacking and replacement of the spider components, seals, and housing end cover O-ring.

CAUTION: *Whenever any operations call for disconnection, connection, removal, or installation of the drive axles, extreme care must be exercised to prevent damage to the seals. When performing these operations, install a short length of rubber hose on the lower control arm torsion bar connector to prevent inboard tri-pot joint seals from being damaged.*

CAUTION: *When removing or installing the right drive axle, be sure to disconnect the negative battery cable. It is possible to short out the starter motor by making contact between the wrench and the starter motor terminals.*

CAUTION: *If any mispositioning, incorrect assembly, or failure of components in the area of the brake system pipes, hoses, or cylinders is observed, be sure to check for any brake damage that may have resulted from such a condition and correct as required. Components that could damage the brake system due to mispositioning, incorrect assembly, or failure include the exhaust system, shock absorbers, torsion bars, suspension control arms, stabilizer bar, power steering pump hoses, and transmission cooler pipes.*

The following caution applies to certain steps in the assembly procedure of components in this section. The critical fasteners to which this caution applies are identified by the terminology "Caution: See "caution" on Page 4C-3.

CAUTION: *This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.*

RIGHT OUTPUT SHAFT AND DRIVE AXLE

a. Removal

1. Disconnect negative battery cable.
2. Remove wheel disc.

NOTE: If drive axle is to be removed, remove cotter pin and loosen but do not remove spindle nut.

3. Raise car so that front vehicle weight is supported at lower control arms.
4. Loosen but do not remove right front shock absorber lower mounting nut and, using a screwdriver on the mount inner sleeve, pry shock absorber along lower mounting stud until it reaches nut.

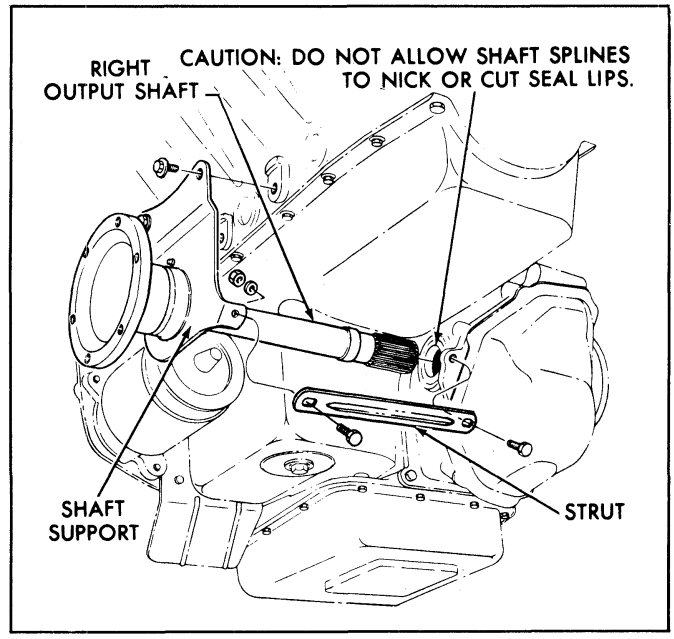


Fig. 4C-2 Right Output Shaft

CAUTION: *Do not remove shock absorber from lower mount, because this may allow the lower control arm to drop.*

5. Install a short length of rubber hose on both lower control arm torsion bar connectors.
6. Remove six screws and lockwashers securing right drive axle to output shaft.
7. Move inboard end of drive axle rearward toward starter motor to gain access to output shaft.
8. Remove screw securing output shaft support strut to final drive housing, Fig. 4C-2.
9. Remove two screws and flat washers securing right output shaft support to engine, Fig. 4C-2.
10. Remove right output shaft, support, and strut as an assembly as follows: first, slide output shaft outboard to disengage splines; then move inboard end of assembly forward and downward until clear of car.

CAUTION: *Take care to protect output shaft seal surface and splines from nicks or scratches.*

11. If drive axle is to be removed, perform the following:

a. Using a block of wood and a hammer, strike end of drive axle to unseat axle at hub.

NOTE: Spindle nut should be left on to retain axle but loose enough to allow unseating.

b. Rotate axle inboard and toward front of car, guiding axle over front cross member and out from underside of car.

NOTE: If drive axle was not removed, begin with Step 3.

1. Guide drive axle into position from underside of car.

NOTE: Guide axle up and over front cross member and engage drive axle splined end in knuckle and hub.

2. Rotate inner end of the drive axle rearward toward starter motor.

3. Apply clean front wheel bearing grease between lips of output shaft seal, then install output shaft into final drive unit from underside of car, indexing splines of output shaft with final drive.

4. Install two bolts and washers securing output shaft support to engine. Tighten bolts to 50 foot-pounds.

NOTE: Seat washers in old grooves in output shaft support. If a new output shaft support is being installed, perform the following procedure: when attaching the right hand output shaft support to the engine block, do not let the shaft and support assembly hang in the final drive unit. Install support bolts and washers loosely, and by moving the flange end of the shaft up and down and back and forth, find the center location. Hold the shaft in this position and then tighten bolts to 50 foot-pounds.

5. Install self-tapping screw securing output shaft support strut to final drive housing.

6. Rotate drive axle toward front of car and into position.

7. Install six new screws and lockwashers securing drive axle to output shaft. Tighten screws to 65 foot-pounds. Have a helper apply the brakes to prevent the drive axle from turning when installing screws.

8. Install drive axle spindle nut. Do not tighten nut at this time.

9. Lower car.

10. Tighten drive axle spindle nut. After reaching 110 foot-pounds minimum, nut must always be tightened further, never backed off, to install cotter pin. If cotter pin cannot be installed, tighten nut to next hole.

CAUTION: *See "caution" on Page 4C-3.*

11. Connect negative battery cable.

12. Check final drive oil level and check for oil leaks at output shaft.

LEFT OUTPUT SHAFT AND DRIVE AXLE

a. Removal

1. Remove wheel disc.

2. Loosen wheel mounting nuts.

3. Remove drive axle spindle nut cotter pin and loosen nut.

4. Raise car.

5. Remove wheel mounting nuts and drive axle spindle nut.

6. Remove wheel and tire.

7. Remove six drive axle to output shaft screws and lockwashers and discard screws and washers. Have a helper apply the brakes to prevent drive axle from rotating when removing screws.

8. Loosen shock absorber upper mount bolt.

9. Remove upper spherical joint cotter pin and nut, and remove brake hose clip from joint stud.

10. Using a hammer, strike knuckle in area of upper spherical joint. Lift up on upper arm and remove joint stud from steering knuckle.

CAUTION: *Use extreme care to prevent hammer from slipping and damaging brake hose.*

11. Remove brake hose bracket from frame.

12. Carefully tip disc and knuckle assembly out at upper end to extent of brake hose.

CAUTION: *To prevent damaging the brake hose, wire assembly to upper control arm so that brake hose does not support the weight of the knuckle assembly.*

13. Rotate inner end of drive axle toward front of car.

14. Guide drive axle out of knuckle and remove drive axle from car.

15. Remove left output shaft retaining bolt.

NOTE: To remove bolt, install two screws in output shaft flange to prevent output shaft from rotating.

16. Remove output shaft by pulling straight out toward side of car.

CAUTION: *Use extreme care when removing output shaft to protect oil seal surface on shaft from nicks and scratches.*

b. Installation

1. Apply clean wheel bearing grease between lips of final drive output shaft seal.

2. Install output shaft from underside of car.

CAUTION: *Use extreme care when indexing output shaft splines with splines in final drive unit to prevent damage to the splines.*

3. Install output shaft retaining bolt. Tighten bolt to 40 foot-pounds.

NOTE: To install bolt, install two screws in output shaft flange to prevent output shaft from rotating.

4. Guide drive axle into car and install drive axle spindle into steering knuckle.

5. Align drive axle inner joint flange with output shaft flange.

6. Install six new drive axle to output shaft screws and lockwashers. Tighten screws to 65 foot-pounds. Have helper apply brakes to prevent axle from rotating when installing screws.

7. Carefully remove wire supporting knuckle assembly, then lift up on upper control arm and install upper spherical joint stud in steering knuckle.

8. Install brake hose clip on upper spherical joint stud.

9. Install nut on upper spherical joint stud. Tighten nut to 60 foot-pounds and install cotter pin.

CAUTION: *See "caution " on Page 4C-3.*

10. Install brake hose bracket on frame.

CAUTION: *Be careful not to twist brake hoses or otherwise damage the brake system.*

11. Tighten shock absorber upper mount nut to 75 foot-pounds.

12. Install drive axle spindle washer and nut. Do not tighten nut at this time.

13. Install wheel and wheel mounting nuts. Do not tighten nuts at this time.

14. Remove rubber hose from lower control arm torsion bar connector and lower car.

15. Tighten wheel mounting nuts to 130 foot-pounds.

CAUTION: *See "caution" on Page 4C-3.*

16. Tighten drive axle spindle nut. After reaching 110 foot-pounds minimum, nut must always be tightened further, never backed off, to install cotter pin. Install new cotter pin. If cotter pin holes do not line up at this position, tighten nut further until pin can be installed.

CAUTION: *See "caution" on Page 4C-3.*

17. Install wheel disc.

18. Check final drive oil level and check for leaks at output shaft.

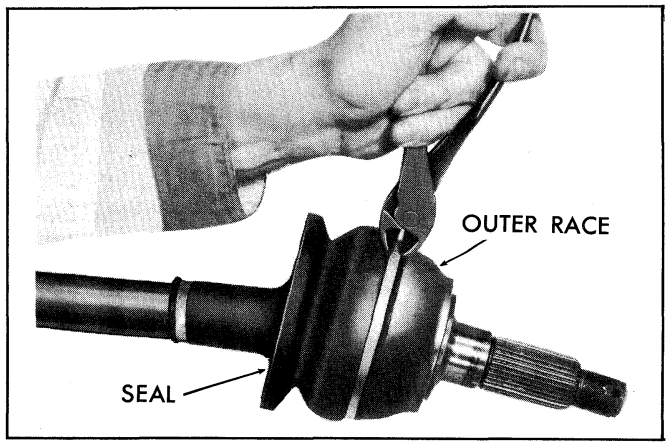


Fig. 4C-3 Removing Seal Clamp Bands

OUTER CONSTANT VELOCITY JOINT (BALL TYPE)

The outer constant velocity joints are replaced as an assembly and are disassembled for repacking and replacement of seals only.

a. Disassembly

1. Insert axle assembly in vise. Clamp on midportion of axle shaft.

CAUTION: *Protect axle shaft to prevent jaw marks from vise. If right drive axle is being worked on, use extreme caution when clamping on torsional damper.*

2. Remove inner and outer seal band clamps as shown in Fig. 4C-3.

3. Slide seal down axle to gain access to the constant velocity joint. Wipe excess grease from joint to permit access to the snap ring.

4. Using Snap Ring Pliers, J-8059, spread snap ring and slide joint off axle spline as shown in Fig. 4C-4.

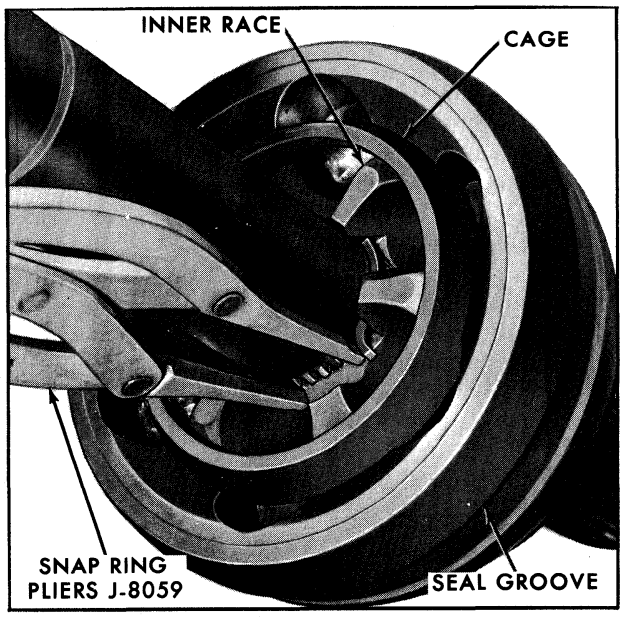


Fig. 4C-4 Removing Outer Joint From Axle

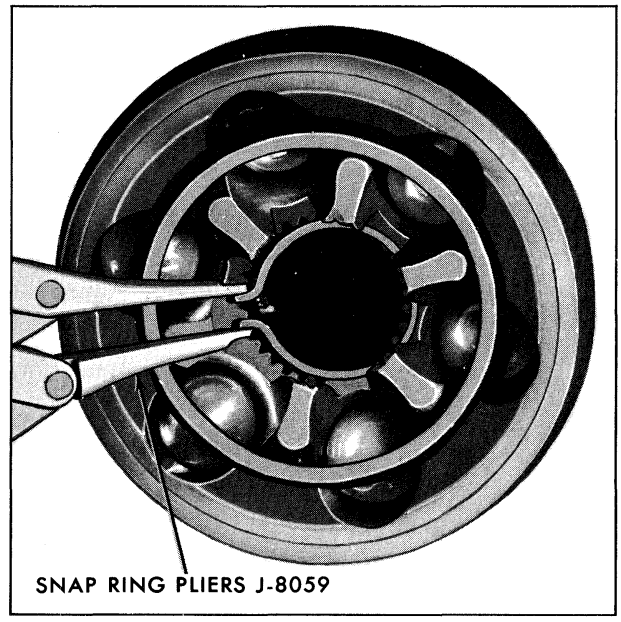


Fig. 4C-5 Removing and Installing Inner Snap Ring

5. Remove inner race snap ring as shown in Fig. 4C-5.

6. Slide seal off axle shaft.

7. Insert joint in vise, clamping on shank. Use jaw blocks to prevent damage to joint shank.

8. Using a hammer and brass drift, tap on inner race until one ball can be removed, Fig. 4C-6. Tip race in this manner to remove each ball. It may be necessary to pry last ball from cage with screwdriver.

9. Turn cage 90° as shown in Fig. 4C-7, with slot in cage aligned with short land on outer race and lift cage out with inner race.

10. Turn short land of inner race 90° in line with hole in cage. Lift land on inner race up through hole in cage, then turn up and out to separate parts as shown in Fig. 4C-8.

b. Cleaning and Inspection (Outer Joint)

Wash all parts thoroughly in a cleaning solvent and dry with compressed air. Inspect rubber seals for damage or wear. If seals are damaged or worn, replace with new seals.

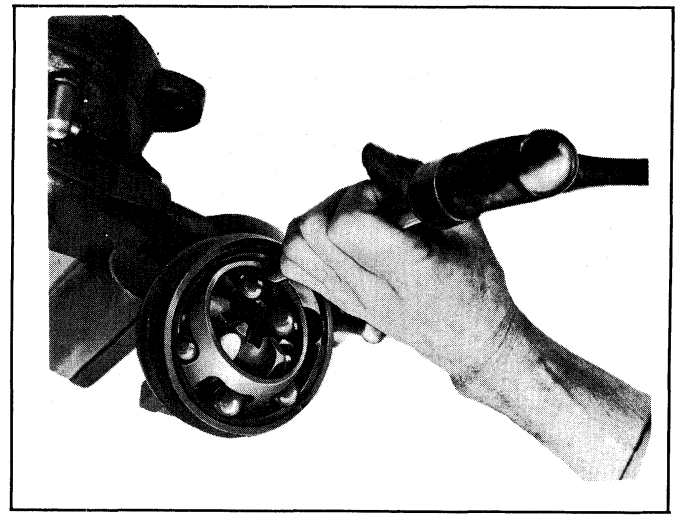


Fig. 4C-6 Removing Balls From Outer Joint

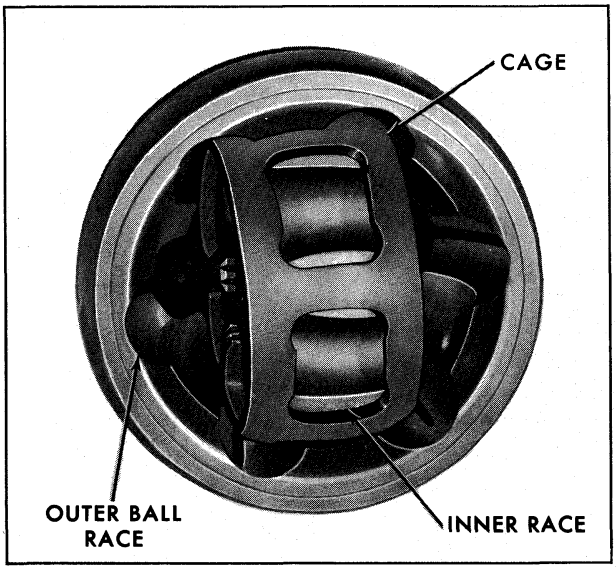


Fig. 4C-7 Removing Cage and Inner Race

NOTE: If any of the first four defects are found, the constant velocity joint assembly must be replaced as a unit.

1. Inspect outer race for excessive wear or scoring in the ball grooves. Check housing splines and threads for any damage.

2. Inspect balls (six) for nicks, cracks, scores, or wear. Slight scuffing or nicking is considered normal.

3. Inspect cage for cracks, breaks, or excessive brinelling of the window flats.

4. Inspect inner race for excessive wear, scores, or cracks.

NOTE: Inner and outer races may show a definite polished area where the balls travel but the CV joint need not be replaced. However, if the wear pattern is suspected to be the cause of a noisy or vibrating joint, replace joint.

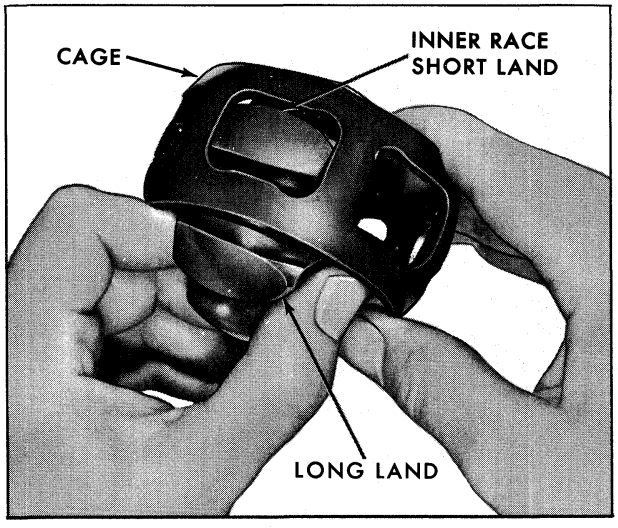


Fig. 4C-8 Removing Inner Race From Cage

5. Inspect snap ring.

c. Assembly

1. Insert short land of inner race into slot in cage and pivot to install in cage shown in Fig. 4C-8.

2. Pack constant velocity joint with special drive axle joint lubricant, Part No. 105 0802, or equivalent.

NOTE: One can of lubricant will service one complete drive axle joint only.

3. Insert cage and inner race into outer race by aligning windows on cage with lands on outer race, Fig. 4C-7. Pivot cage and inner pace 90°.

NOTE: Be certain that step on cage bore is positioned to inside of joint and snap ring groove on inner race is facing outside.

4. Apply lubricant to the inner and outer race and insert balls into outer race one at a time until all six balls are installed. Inner race and cage will have to be tilted so that each ball can be inserted. Use of a hammer and brass drift may be helpful if a tight fit is encountered.

5. Position small end of seal in groove on axle shaft.

When installing outer joint seal on axle shaft, position small end of seal in outer groove in axle shaft, or groove nearest end of seal in outer groove in axle shaft, or groove nearest end of axle shaft, Fig. 4C-9, and proceed as follows:

a. Loop seal clamp band around seal end twice with strap passing through its own retainer each time a loop is completed.

b. After completion of second loop, feed extra length of strap into small end of Seal Clamp Band Installer, J-22716. Be sure to have the open side of tool facing up.

c. Slide bolt through holes in side of tool and, at the same time, secure strap in slot in the bolt.

d. Lift end of strap up and out of the open side of tool.

e. Place a wrench on bolt and draw band up tight; NOTE: Hold torque on wrench while bending seal clamp to the final position; then torque bolt to 6-8 foot-pounds.

f. Rotate Seal Clamp Band Installer, J-22716, back over the band retainer.

g. Back tool off just enough to permit tapping band with a hammer until it lies flat across top of retainer. Tap the tabs down until they retain strap.

CAUTION: *Tap lightly to avoid damaging seal.*

h. Unwind the excess strap and cut it off close to retainer.

6. Pack inside of seal with approximately 1/4 pound of special drive axle joint lubricant, Part No. 105 0802, or equivalent.

7. Install snap ring into inner race as shown in Fig. 4C-5.

8. Insert axle shaft into splines of outer constant velocity joint until snap ring secures shaft in second snap ring groove.

NOTE: Snap ring must be spread to facilitate mating of axle shaft into splines of outer constant velocity joint.

9. Position seal in groove of outer race.

NOTE: Mating area of seal and outer race must be free of lubricant to obtain proper sealing.

10. Install large seal clamp band over seal and install band.

NOTE: Maximum diameter of band should be 4.52".

INNER JOINT

a. Disassembly

1. With axle assembly lying on a bench, pry up staked areas on seal retainer and drive off housing with hammer and chisel, Fig. 4C-10.

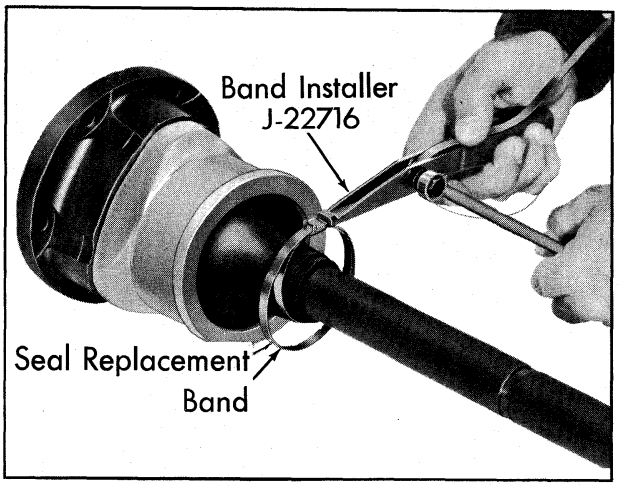


Fig. 4C-9 Positioning Seal Clamp Band

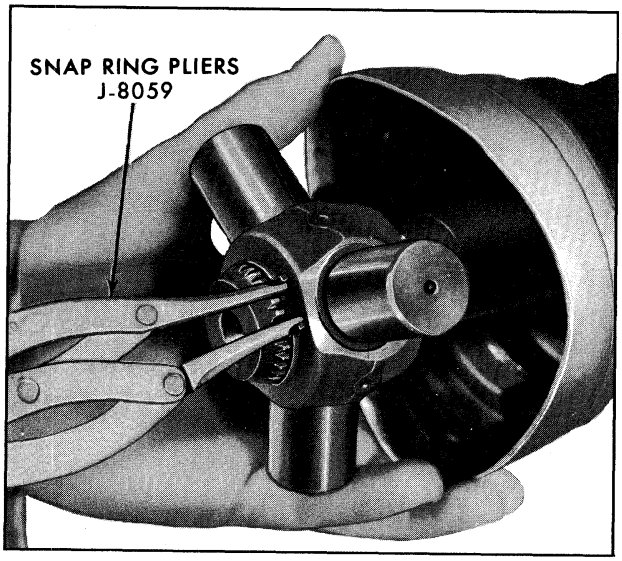


Fig. 4C-11 Removing Spider Snap Ring

2. Grasp axle assembly with one hand and joint housing with the other and stand both vertically on bench. Carefully withdraw axle from housing, being certain not to lose balls and needles from axle.

NOTE: It may be helpful to place a rubber band over ends of spider to retain the three balls and needle bearings. Wipe all excess grease from joint. Set housing aside.

3. Insert axle assembly in vise. Clamp on midportion of axle shaft.

CAUTION: *Be careful when clamping to avoid damage to axle.*

4. Remove snap ring from end of axle shaft, Fig. 4C-11.
5. Slide spider assembly, Fig. 4C-12, from axle shaft.
6. Remove inner snap ring from axle shaft.
7. Remove small seal clamp.
8. Slide boot seal off axle shaft.
9. Remove three balls from spider, being careful not to lose any of the 53 needle bearings in each of the balls.
10. If necessary to remove tri-pot housing end cover or O-ring, proceed as follows:
    a. Secure housing in vise.
    b. Place a block of wood (approximately 2″ x 2″ x 8″) in housing.
    c. Drive on wood block to push end cover out of housing.
    d. Remove housing O-ring and discard O-ring.

b. Cleaning and Inspection (Inner Joint)

Wash all parts thoroughly in a cleaning solvent and dry with compressed air. Inspect rubber seal and O-rings for damage or wear. If seal or O-rings are damaged or worn, replace with new seal or O-rings.

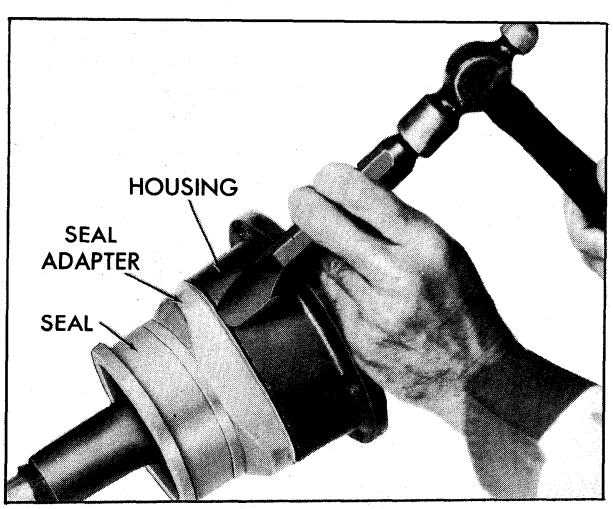


Fig. 4C-10 Removing Seal Adapter from Joint Housing

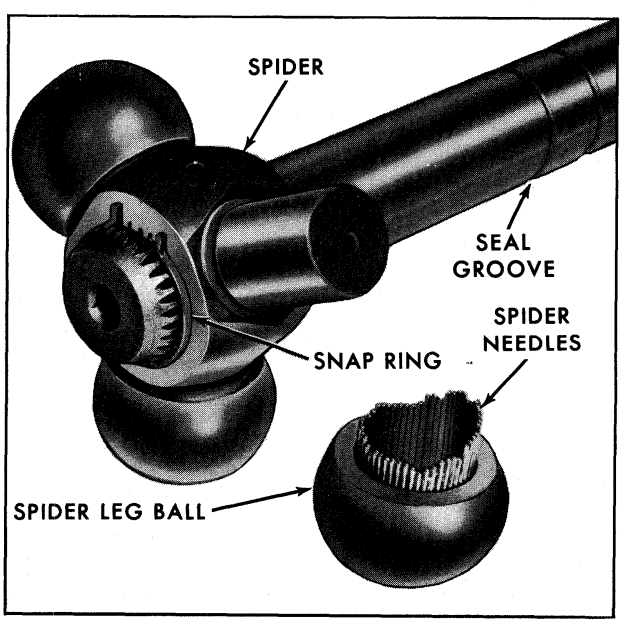


Fig. 4C-12 Spider Assembly

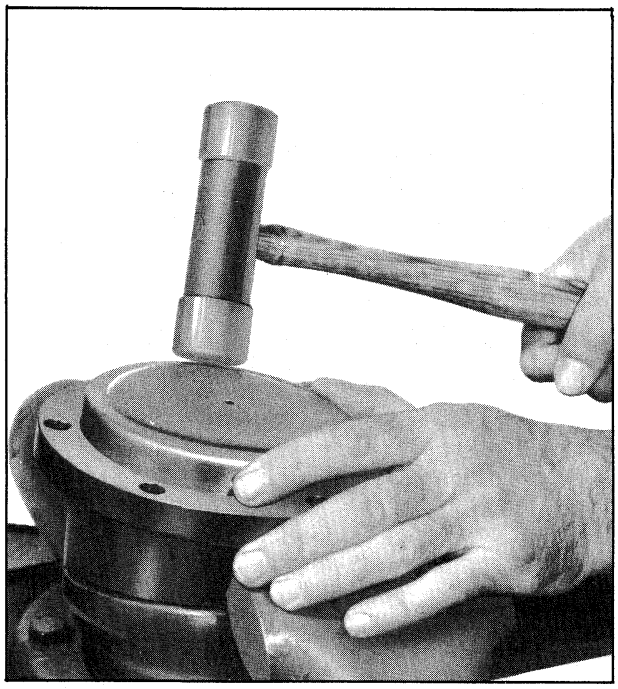


Fig. 4C-13 Installing Tri-Pot Housing End Cover

1. Inspect seal adapter band for bent or cracked condition.

2. Inspect tri-pot housing for excessive wear and brinelling.

NOTE: Housing may show a definite polished area where the balls travel but joint need not be replaced. However, if this wear pattern is suspected to be the cause of noise or vibration complaint, replace joint.

3. Inspect snap rings for distortion or damage.

4. Inspect spider leg balls for excessive wear, cracks, nicks, scores, or breaks.

5. Inspect spider leg ball needles for chips, breaks, or bends.

6. Inspect spider for excessive wear, scores, or cracks.

c. Assembly

1. Slide new clamp onto axle shaft to be used after seal positioning.

2. Slide seal onto axle shaft.

3. Install inner snap ring on axle shaft.

4. If spider needles were removed, load 53 needles into each ball, lubricating with special drive axle lubricant, Part No. 105 0802, or equivalent.

5. Carefully install balls on each of the spider journals.

NOTE: A rubber band may be used to retain balls in position until spider assembly is installed in housing.

6. Position spider assembly on axle shaft and retain with outer snap ring.

7. If end cover and O-ring were removed, install new O-ring in housing, lubricate O-ring and install cover by tapping around outer edge of cover, Fig. 4C-13.

8. Install O-ring in outer groove in housing.

9. Pack housing approximately one-half full with lubricant.

10. Remove rubber band, if used, from spider assembly.

11. Position spider assembly in line with housing assembly and push into housing until bottomed.

12. Fill housing with remainder of lubricant.

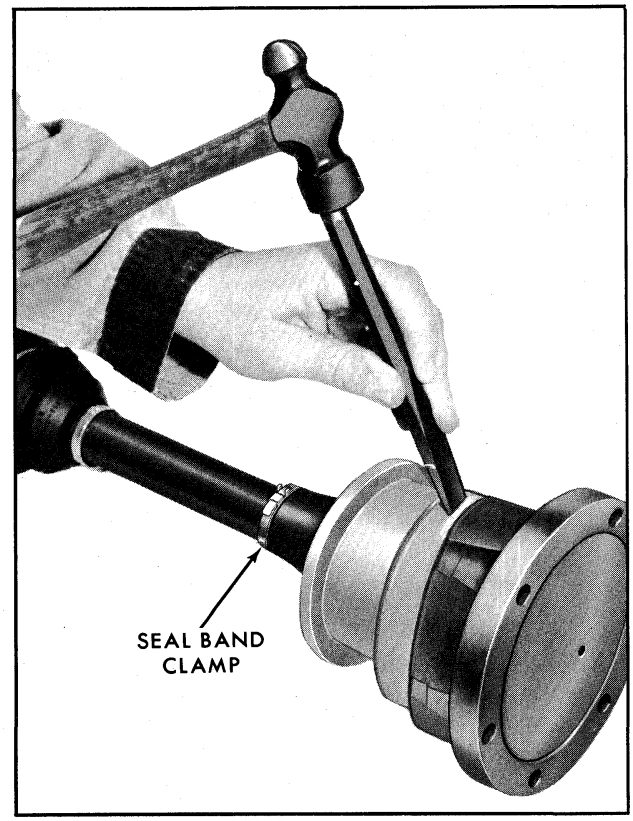


Fig. 4C-14 Installing Seal Adapter on Joint Housing

13. Swab inside of boot seal retainer and housing outer groove O-ring with lubricant.

CAUTION: *Be careful that seal retainer is positioned so that O-ring is not cut.*

14. With housing positioned as shown in Fig. 4C-14 tap seal retainer on three lobes alternately with plastic hammer as shown until firmly bottomed, then stake three places into staking groove.

15. Extend inboard joint to maximum length and position seal into furthest groove from joint in axle.

16. Install seal clamp band on small end of seal, Fig. 4C-14. Proceed as follows:

a. Loop seal clamp band around seal twice with strap passing through its own retainer each time a loop is completed, Fig. 4C-9.

b. After completion of second loop, feed extra length of strap into small end of Seal Clamp Band Installer, J-22716.

NOTE: Be sure to have the open side of the tool facing up.

c. Slide bolt through holes in side of tool and at same time secure strap in slot in the bolt.

d. Lift strap up and out of open side of tool.

e. Place a wrench on bolt and draw band up tight, then torque bolts to 6-8 foot-pounds.

f. Rotate Seal Clamp Band Installer, J-22716, back over band retainer.

g. Back tool off just enough to permit tapping band with hammer until it lies flat across top of retainer. Tap tabs down until they retain strap.

h. Unwind excess strap and cut it off close to retainer.

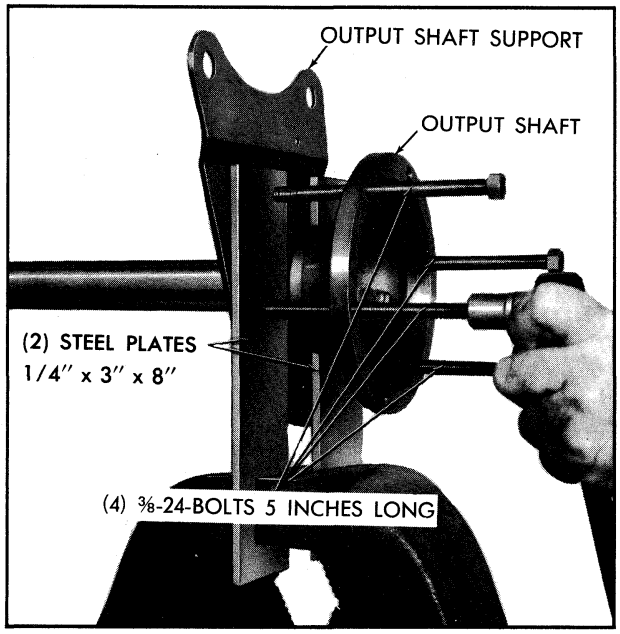


Fig. 4C-15 Removing Right Outer Shaft Support and Bearing

RIGHT OUTPUT SHAFT BEARING

a. Removal

1. Remove output shaft as described on page 4C-3 Steps 1 through 10.

2. Remove three self-tapping screws securing output shaft bearing retainer to support.

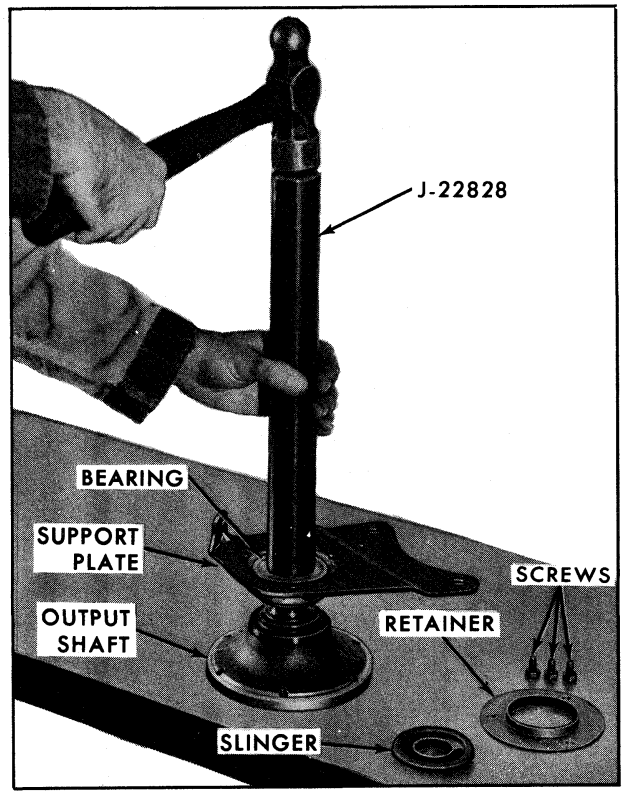


Fig. 4C-16 Installing Right Outer Shaft Support and Bearing

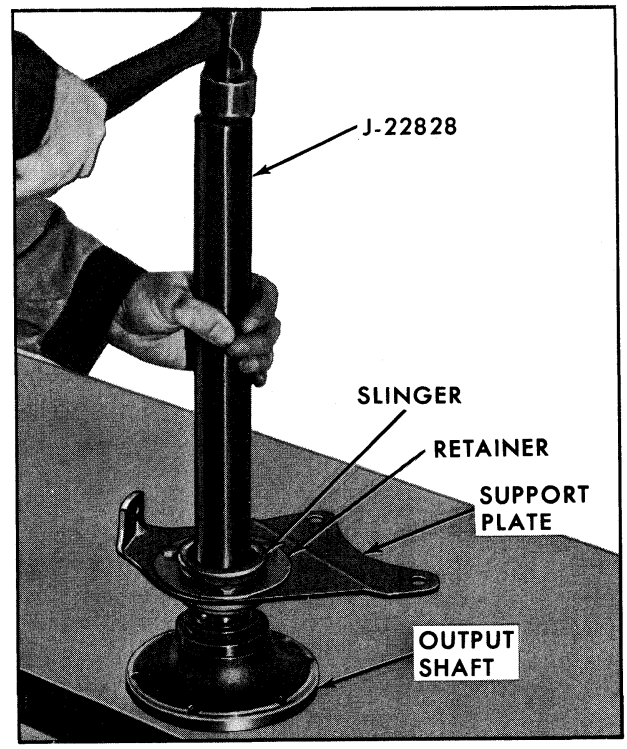


Fig. 4C-17 Installing Right Output Shaft Support Slinger

3. Make two steel plates 1/4" x 3" x 8" and install in a vise as shown in Fig. 4C-15.

4. Install four 3/8"-24 bolts (five inches long) on output shaft and install output shaft between steel plates in vise as shown in Fig. 4C-15.

CAUTION: *Use extreme care to prevent damage to seal surface on output shaft.*

5. Remove bearing assembly by tightening bolts alternately.

b. Installation

1. Position output shaft on flange end on a work bench, Fig. 4C-16.

2. Lubricate output shaft support and install over splined end of output shaft.

3. Lubricate bearing and install, using a hammer and Bearing Installer, J-22828, Fig. 4C-16.

4. Lubricate exposed face of bearing and install bearing retainer. Secure bearing retainer with three self-tapping screws.

5. Using a hammer and Bearing Installer, J-22828, install slinger as shown in Fig. 4C-17.

6. Install output shaft as described on page 4C-3 beginning with Step 3.

OUTPUT SHAFT SEAL REPLACEMENT

a. Removal

1. To replace right output shaft seal, remove right output shaft as described on page 4C-3 Steps 1 through 10. Then remove seal from final drive unit with a pry bar and discard seal.

CAUTION: *When removing seal, use extreme care*

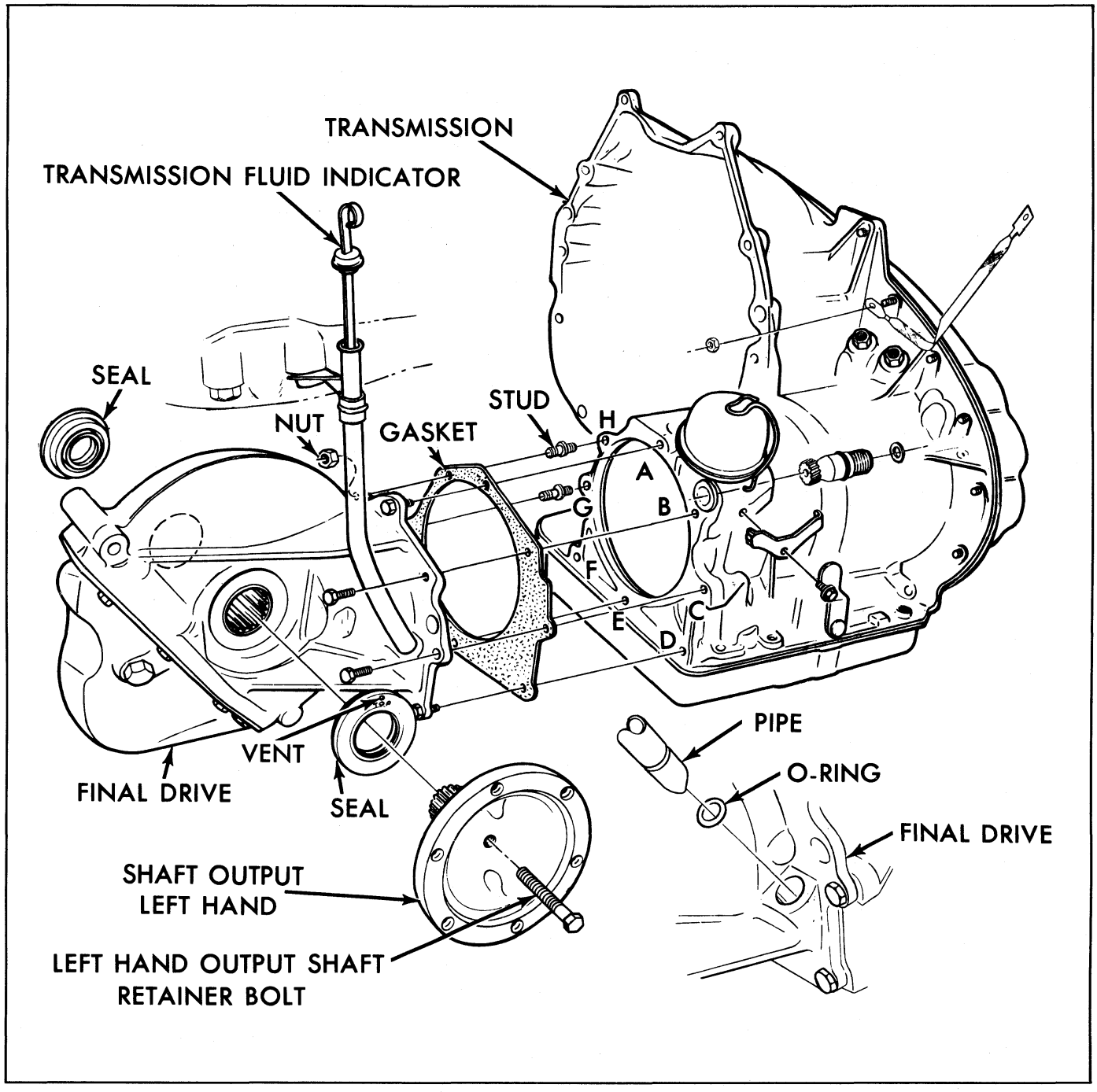


Fig. 4C-18 Final Drive Attachment

to prevent damaging seal surface in final drive unit.

2. To replace left output shaft seal, remove left output shaft as described on page 4C-4. Then remove seal from final drive unit with a pry bar and discard seal.

CAUTION: *When removing seal, use extreme care to prevent damaging seal surface in final drive unit.*

b. Installation

1. To install right hand output shaft seal in final drive, attach Universal Handle, J-8092, to Seal Installer, J-22760. Then place seal in final drive unit and drive on Universal Handle, J-8092, until seal is installed. Apply clean front wheel bearing grease between lips of seal.

CAUTION: *Rotate tools to maintain proper alignment when installing seal.*

2. Install right hand output shaft as described on page 4C-3 beginning with Step 3.

3. To install left hand output shaft seal in final drive, attach Universal Handle, J-8092, to Seal Installer, J-22199. Then place seal in final drive unit and drive on Universal Handle, J-8092, until seal is installed.

NOTE: The left hand output shaft seal contains a hole for venting the final drive unit. The top of the seal is identified by the word "Top" and must be installed with the word "Top" positioned up so that vent will be in proper position.

4. Install left hand output shaft as described on page 4C-5.

FINAL DRIVE

a. Removal

1. Raise hood and disconnect negative battery cable.

2. Remove bolt securing transmission filler tube bracket to final drive bracket and remove transmission filler tube.

3. Remove screws "A" and "B" and nut "H" securing upper part of final drive housing to transmission housing. Fig. 4C-18.

NOTE: The use of a box end wrench with a crescent-shaped handle, such as a starter and manifold wrench, will facilitate removal of nut "H".

4. Remove self-tapping screw securing transmission cooler lines and clip to final drive support bracket, Fig. 4C-19, and slide clip out of way.

5. Remove locknut, washer, and long bolt securing final drive support brace to engine mount bracket, Fig. 4C-19. (Use a second wrench to hold locknut in place while turning bolt.

6. Remove right output shaft, following page 4C-3, Steps 3 through 10.

WARNING: THE SHOCK ABSORBERS ACT AS REBOUND STOPS ON THE ELDORADO FRONT SUSPENSION. BEFORE PERFORMING THE FOLLOWING STEP, BE CERTAIN THAT RIGHT SHOCK ABSORBER LOWER SLEEVE CANNOT BE DISLODGED FROM MOUNTING STUD. REMOVING THE SHOCK FROM THE LOWER MOUNT MAY ALLOW THE LOWER CONTROL ARM TO DROP DOWN.

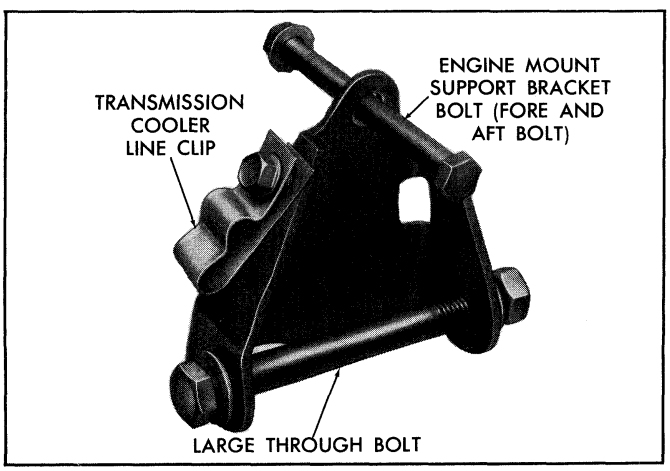


Fig. 4C-19 Final Drive Support Bracket and Fasteners

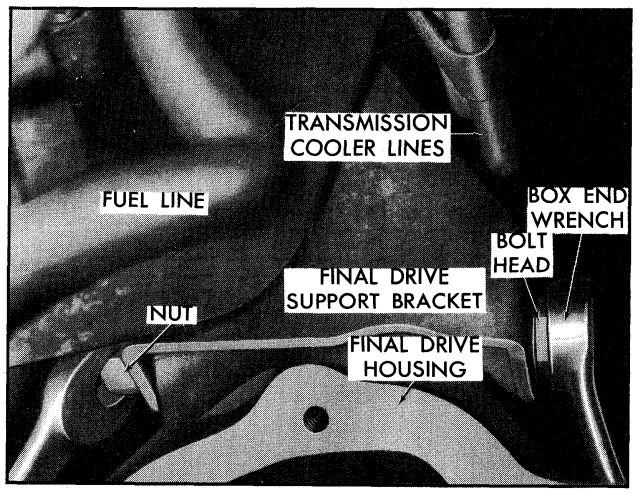


Fig. 4C-20 Removing and Installing Through Bolt

Place jack stands under front frame side rails. Lower hoist and move hoist equipment away from work area.

7. Place a drain pan under final drive cover. Loosen ten final drive cover screws and pull cover away from housing. Allow lubricant to drain while performing next four steps.

8. Remove six screws securing left drive axle to output shaft. Compress drive axle inner constant velocity joint and secure in this position to permit clearance for removal of final drive unit with left output shaft installed.

9. Remove bolt, washer, and nut securing left tie strut to frame cross member, loosen bolt securing strut to side rail, and rotate strut outboard until clear of final drive area.

10. Remove large through bolt, nut, and washers securing final drive support bracket to final drive. (Use a second wrench to hold nut stationary while turning bolt, Figs. 4C-19 and 4C-20).

11. Remove final drive support bracket by lifting upward and outward.

12. Remove ten final drive cover screws and remove cover and cover gaskets.

13. The final drive assembly should be removed and installed with a transmission lift and a special adapter. Adapters are available commercially through lift equipment manufacturers. One such mechanism is shown in Fig. 4C-21. All such adapters feature pivot points to provide a safe means of rotating the unit during lifting and lowering. Consult the instructions and recommendations of the manufacturer.

WARNING: TO AVOID PERSONAL INJURY, BE ABSOLUTELY CERTAIN THAT LIFT EQUIPMENT INDEPENDENTLY SUPPORTS AND HOLDS FINAL DRIVE UNIT BEFORE PERFORMING THIS STEP.

Place a drain pan under transmission and remove screws "C", "D", "E", and "F" and "G", Fig. 4C-18.

14. Disengage final drive splines from transmission, Fig. 4C-21, and allow unit to drain.

15. Remove final drive unit from underside of car by sliding unit toward front of car, permitting ring gear to rotate over steering linkage, and lowering housing from car.

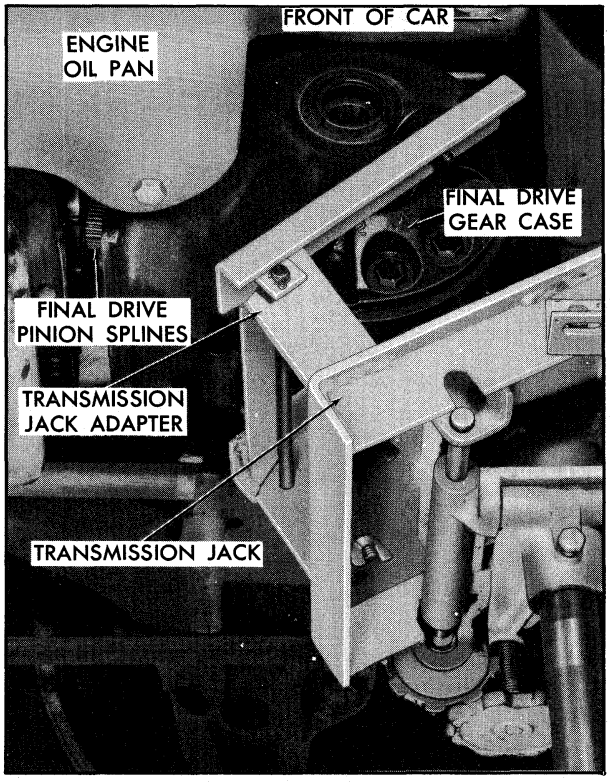


Fig. 4C-21 Removing and Installing Final Drive

16. Remove and discard final drive to transmission gasket.

b. Installation

1. Apply transmission fluid to transmission side of new gasket and place gasket on studs.

2. Attach final drive unit securely to transmission jack adapter. Lift unit to on-car position, aligning unit with two studs and aligning final drive and transmission splines, Fig. 4C-21.

NOTE: If splines do not line up, rotate left output shaft until splines can be engaged. Do not allow gasket to become mispositioned.

3. Insert final drive support bracket as near as possible to proper installed position.

4. Insert large through bolt, nut, and washers and tighten with fingers, Fig. 4C-19. Insert long bolt, washer, and locknut securing final drive support bracket to engine mount support and tighten with fingers. (If this "fore and aft" bolt cannot be installed, perform step 5; then insert bolt and proceed to step 6).

5. Install screws "C", "D", "E", and "F" and nut "G"; tighten to 25 foot-pounds, Fig. 4C-18.

6. Tighten large through bolt to 70 foot-pounds. (This torque is to be applied to head of bolt while nut is held, Fig. 4C-20).

7. Remove transmission jack and adapter assembly from final drive housing and remove assembly from work area.

8. Install final drive cover and new cover gaskets, tightening ten screws to 156 inch-pounds.

NOTE: Two gaskets are used at the final drive cover to provide a vent for the unit. Thin, dark gray gasket must be installed next to housing, with slotted, light gray gasket on top-next to cover-for vent to be effective.

9. Position left drive axle on output shaft and fasten with six screws, tightening to 65 foot-pounds.

NOTE: Have a helper apply brakes to prevent axle from turning while tightening screws.

10. Remove rubber hose previously installed on left torsion bar connector.

11. Install left tie strut on frame cross member, securing with bolt, nut, and washer. Tighten tie strut fastener at frame side rail.

12. Install right output shaft, support, and strut as an assembly, employing technique described on page 4C-3, Steps 3 through 8.

13. Fill final drive unit with lubricant Part No. 7805942 or equivalent until within 1/2" of filler hole.

14. Lower car.

15. Tighten long bolt and locknut securing final drive support bracket to engine mount support to 20 foot-pounds, Fig. 4C-19. (This torque is to be applied to locknut while holding bolt stationary).

16. Install screws "A" and "B" and nut "H" securing upper part of final drive housing to transmission. Tighten to 25 foot-pounds, Fig. 4C-18.

17. Install a new O-ring on transmission filler tube, Fig. 4C-18.

18. Remove plug and install transmission filler tube, securing to exhaust manifold.

19. Slide transmission cooler line clip into place and secure clip to final drive support bracket with one screw, Fig. 4C-19, tightening to 96 inch-pounds.

20. Connect negative battery cable.

21. Check engine oil level, start engine, and check transmission fluid level. Add fluid as required.

22. Check output shaft seals, final drive to transmission connection, and final drive cover for oil leaks.

PINION BEARING OIL SEAL REPLACEMENT

a. Removal

1. Remove final drive unit from car as described on page 4C-10.

2. Working on bench, remove six pinion bearing housing to final drive case bolts.

3. Remove pinion bearing housing by applying a steady pull on splined end of pinion gear with one hand and gently rotating pinion bearing housing with other hand.

4. Remove pinion bearing housing O-ring and discard.

5. Inspect vent pin O-ring seal and replace if necessary.

6. Drive pinion gear oil seals from pinion bearing housing with a screwdriver.

CAUTION: *Use extreme care to prevent damage to pinion bearing housing oil seal surface.*

b. Installation

1. Place pinion gear oil seals back to back with spring on seals exposed.

2. Install oil seals on Seal Installer, J-22212.

3. Drive on Seal Installer, J-22212, until tool bottoms against housing.

4. Install a new pinion bearing O-ring in final drive case.

5. Install pinion gear in final drive case.

6. Install Seal Protector, J-22236, over splined end of pinion gear.

7. Install pinion bearing housing over pinion gear. Gently rotate pinion bearing housing until properly seated in final drive case.

8. Install six pinion bearing housing to final drive case bolts. Tighten bolts to 35 foot-pounds.

9. Remove Seal Protector, J-22236.

10. Install final drive unit in car as described on page 4C-12.

TORQUE SPECIFICATIONS

Material No.	Application	Thread Size	Foot-Pounds
286-M	Drive Axle Nut	1"-20	See Below**
GM 6010-M	Stabilizer Bracket to Frame Screw	3/8-16	35
301-M	Shock Absorber (upper) Nut	9/16-12	75
301-M	Shock Absorber (lower) Nut	9/16-12	75
300-M	Lower Control Arm Bushing Bolts	1/2-13	80*
300-M	Upper Control Arm Bushing Bolts	1/2-20	95*
301-M	Lower Spherical Joint Nut	9/16-18	80*
301-M	Upper Spherical Joint Nut	1/2-20	60*
286-M	Tie-Rod to Knuckle Nut	1/2-20	40*
300-M	Drive Axle to Output Shaft Screw	3/8-20	65
275-M	Output Shaft Support to Engine Block Screw	7/16-14	50
300-M	Left Hand Output Shaft Retainer Bolt	3/8-24	40
280-M	Bearing Retainer to Knuckle Screw	3/8-16	30
301-M	Final Drive Support Bracket to Engine Mount Support Nut	1/2-13	20
301-M	Upper Control Arm Spherical Joint to Arm Nut	5/16-18	25*
300-M	Final Drive Support Bracket to Final Drive Bolt	1/2-13	70
300-M	Final Drive to Transmission	3/8-16	25
301-M	Nut - Upper Control Arm Cam to Frame	1/2-20	95*
286-M	Tie Rod Adjuster Clamp Nut	3/8-24	22
286-M	Wheel Mounting Nuts	1/2-20	130*
			Inch-Pounds
GM 601	Transmission Cooler Line Clip to Final Drive Support Bracket Screw	5/16-12	96
GM 6010-M	Output Shaft Support to Brace Screw	5/16-18	144
GM 6010-M	Output Shaft Support Brace to Final Drive Screw	5/16-18	144
275-M	Final Drive Cover Screws	5/16-18	156
GM 6010-M	Bearing Retainer to Support Plate Screw	5/16-18	144
280-M	Torsion Bar Crossmember Bolt Nuts	5/16-18	120
SAE 1020-1022	Stabilizer Link Bolt Nuts	5/16-18	156

(NOTE: Refer to back of Manual, Page 10-1, for bolt and nut markings, and steel classifications.)

**After reaching 110 foot-pounds minimum, nut must always be tightened further, never backed off, to insert cotter pin.

**CAUTION: These fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. Each must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.*

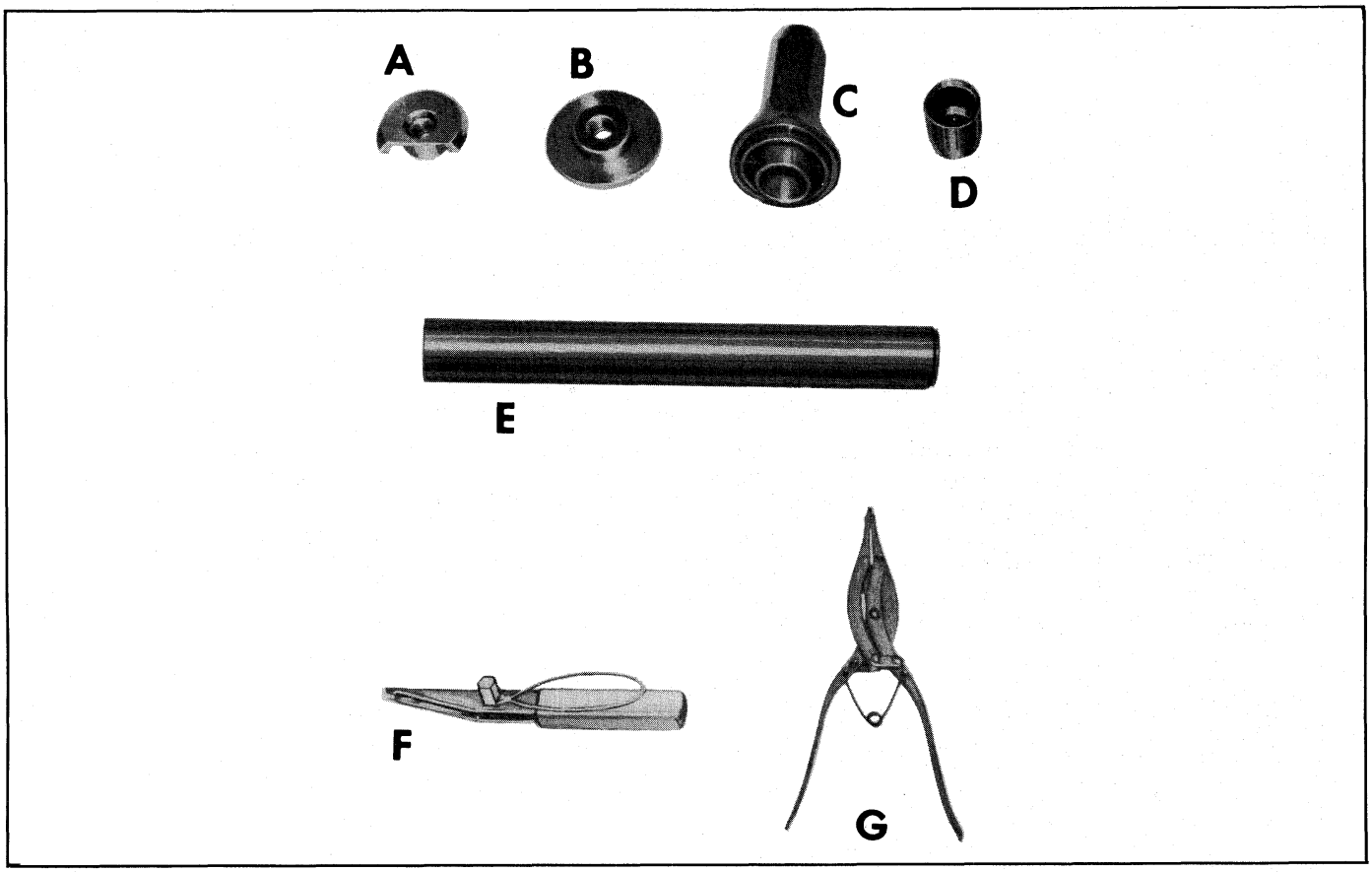


Fig. 4C-22 Special Tools

Key	Tool No.	Name	Key	Tool No.	Name
A	J-22760	Right Output Shaft Seal Installer	D	J-22236	Pinion Oil Seal Protector
B	J-22199	Left Output Shaft Seal Installer	E	J-22828	Output Shaft Bearing Installer
C	J-22212	Pinion Oil Seal Installer	F	J-22716	Band Installer
			G	J-8059	Snap Ring Pliers

BRAKES–DISC-DRUM SYSTEMS

The following caution applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations.

CAUTION: *This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.*

TABLE OF CONTENTS

General Description - Disc Drum Systems 5-1
Diagnosis 5-5
On-Car Service 5-9
Bleeding Brakes 5-9
Rear Drum Brake Shoe Adjustment 5-9
Parking Brake Adjustment 5-10
Stop Light Switch Adjustment 5-10
Front Disc Brakes 5-10
Rear Drum Brakes 5-15
Parking Brakes 5-19
Hydraulic Lines 5-21
Brake Combination Valve 5-21
Brake Tubing 5-22
Power Brake Unit 5-24
Master Cylinder 5-24
Unit Overhaul 5-24
Tandem Diaphragm (Power Head) 5-24
Specifications Torque 5-32
General Description - Four Wheel Disc Systems 5-32
Diagnosis 5-34
On-Car Service 5-36
Parking Brake Adjustment 5-36
Rear Brake Caliper 5-37
Lining Replacement 5-37
Unit Overhaul 5-41
Rear Brake Caliper Disassembly and Assembly 5-41
General Description - Eldorado 5-46
Diagnosis - Eldorado 5-48
On-Car Service - Eldorado 5-48
Rotor Assembly Removal and Installation (Front) 5-48
Rear Brake Caliper Removal and Installation 5-48
Specifications 5-43
General Description - Hydro-Boost 5-56
Diagnosis 5-56
On-Car Service 5-59
Unit Overhaul 5-59
Spring Accumulator Overhaul 5-59
Pneumatic Accumulator Overhaul 5-62
Bleeding Procedure 5-59
Specifications Torque 5-67

GENERAL DESCRIPTION

BRAKES

The brake systems used on 1977 model Cadillac cars are described below.

The DeVille series features 12″ x 1″ front disc brakes and 11″ x 2″ rear drum brakes. Service in this section.

The Limousine and Commercial Chassis utilize 12″ x 1-1/4″ front disc brakes (not the same as the Brougham and DeVille 12″ x 1″ front rotor) and 12″ x 2-1/2″ rear drum brakes.

The Brougham has 12″ x 1″ front disc brakes, Fig. 5-1, and 11″ x 1″ rear disc brakes. The Brougham rear brake calipers are mounted forward of the axle on the right side and behind the axle on the left. A simplified caliper support plate mounting is used that does not require a stone shield, as used on Eldorado Fig. 5-54. Service begins on page 5-37.

The front brake rotors on the Seville are 12″ x 1″. The rear rotors are 11″ x 1″. The Seville rear brake calipers are mounted forward of the axle on the left side and behind the axle on the right, Fig. 5-55. Service begins on page 5-37.

A four wheel disc brake system with Hydro-boost is used exclusively on the Eldorado.

New 11 inch diameter single, piston-type disc brakes with an integral parking brake with automatic adjusting provisions and new brake linings are used in the rear. The front and rear brake caliper and lining are not interchangeable.

Front Disc Brakes (Fig. 5-77)

The single piston sliding caliper front disc brake used on the Eldorado is serviced in the same manner as those installed on other Cadillac cars. The following items are distinctive to the Eldorado.

All rear disc brake calipers include an integral parking brake with automatic adjusting provisions.

BOOSTER

Three different tandem diaphragm vacuum boosters are used in 1977, in addition to the carryover hydraulic booster on the Eldorado. A (200mm) 8″ tandem vacuum booster is used on the Brougham and DeVille. A (216mm) 8-1/2″ tandem vacuum booster is used on Limousines and Commercial Chassis, and a specific (200mm) 8″ tandem unit is used on the Seville, Fig. 5-41 and 5-42. Vacuum booster service is discussed in this section while hydroboost is on page 5-56.

PARKING BRAKE

A vacuum parking brake release is used on all series cars. The parking brake assembly on the Seville and Eldorado is carryover and differs from the parking brake assembly used on "C" and "D" cars and Commercial Chassis, Fig. 5-12.

The parking brake cable system on "C" cars utilizes a single cable type system with a force multiplying equalizer which unites the two wheel conduits. The right wheel conduit

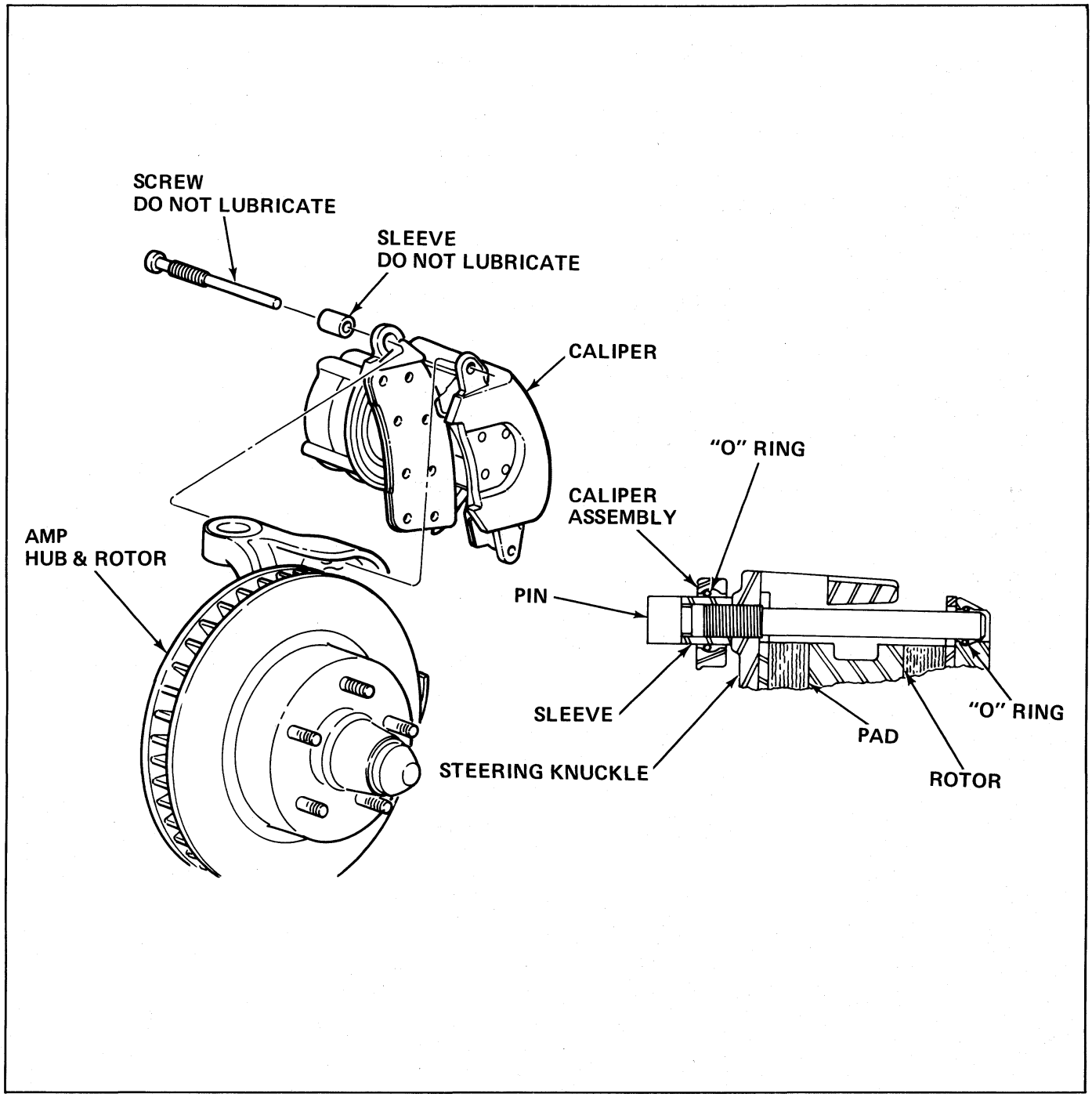


Fig. 5-1 Front Disc Brake

passes over the axle tube on the left side and behind the differential cover then enters the brake backing plate assembly from the rear or attaches to the caliper from the rear on Brougham series.

MASTER CYLINDER AND COMBINATION VALVES

Dual master cylinders and combination valves are used on all cars. The combination valve incorporates a proportioning valve and a pressure differential switch. Rear drum brake cars also include a metering valve integral with the combination valve, Fig. 5-4.

Single Piston Sliding Caliper Front Disc Brakes Exc. Eldorado (Fig. 5-1 and 5-2)

The major components of the single piston sliding caliper front disc brake mechanism are the hub and rotor assembly, the caliper assembly, the shoe and lining assemblies and the splash shield. The hydraulic system also utilizes a combination valve.

The dual hydraulic service brake system is actually two separate and independent braking systems. Should a malfunction occur in either the front or rear system the other is capable of stopping the vehicle. A malfunction will, however, cause both the travel and effort of the service brake

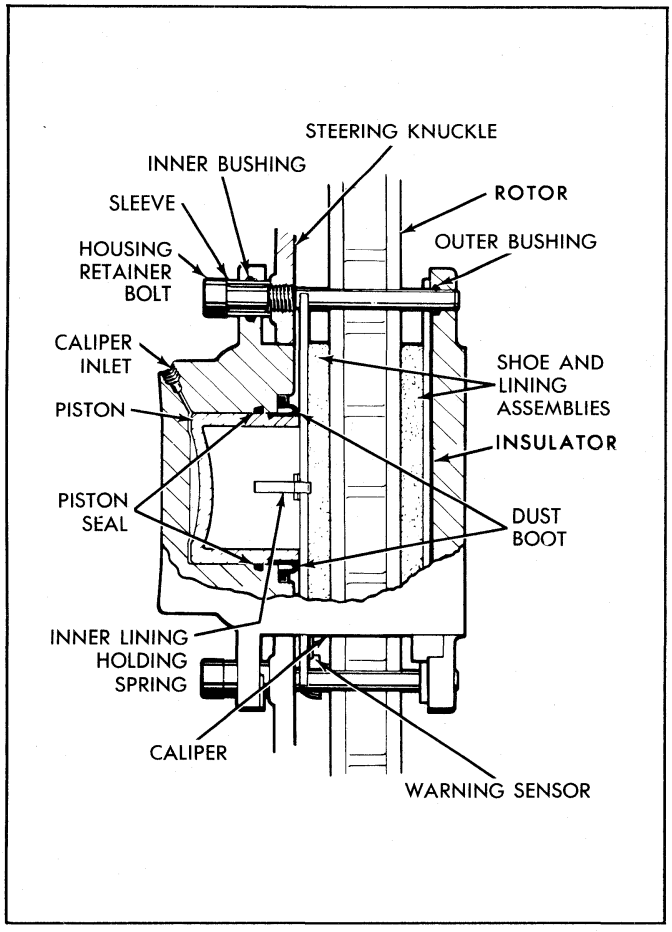


Fig. 5-2 Caliper Cutaway View

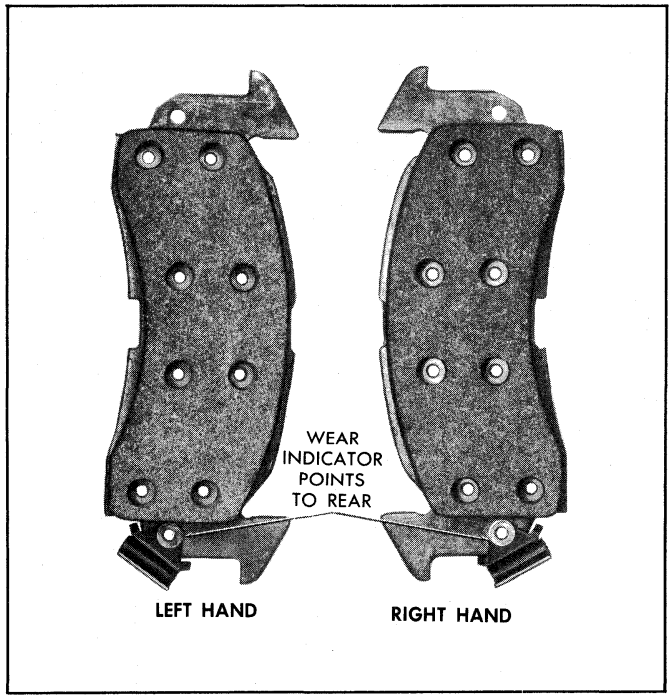


Fig. 5-3 Inboard Disc Brake Shoes

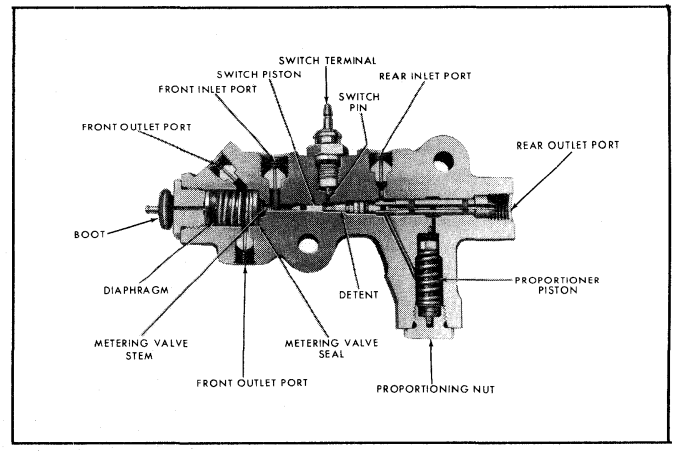


Fig. 5-4 Brake Combination Valve

pedal to increase. A service brake system malfunction will be indicated by a BRAKES warning lamp illumination in the instrument panel telltale housing. Lamp illumination is controlled by a switch within the brake combination valve which is located beneath the dual master cylinder.

a. Hub and Rotor Assembly

The cast iron hub and rotor assembly is fully ventilated with 35 cooling fins cast integrally between the machined braking surfaces. When the wheel is in motion the rotation of the rotor fins increases the air circulation for more efficient cooling of the unit. On sizes see specification on page 5-43.

b. Caliper Assembly (Front)

The caliper provides a means of applying the shoe and lining assemblies to the rotor. It is hydraulically connected to the system by a tube and flexible hose leading from the brake combination valve to each caliper inlet port. It is mounted to the integral steering knuckle by two allen head retainer bolts, two sleeves and four rubber bushings. An inner caliper bushing is installed between each sleeve and groove in the housing, and an outer caliper bushing is installed between each bolt and groove in the housing. Inner and outer shoes and lining assemblies are positioned on the caliper so they straddle the rotor.

c. Shoe Lining Assemblies

The brake linings are attached to the shoes with steel eyelets to form front shoe and lining assemblies.

The inner shoe includes a spring steel wear indicator, Fig. 5-3, which will deliver a squealing or cricket-like warning noise when the linings have reached a point where replacement is necessary. The sound occurs when wheels are turning, but will disappear when the brake pedal is applied firmly.

The outer shoe and lining assemblies have an insulator attached to the shoes. The function of the insulator is to reduce brake squeak.

BRAKE COMBINATION VALVE (Fig. 5-4)

The combination valve houses not only the hydraulic pressure malfunction switch, but also a metering valve and a proportioning valve. Therefore, the combination valve serves as a junction block, hydraulic pressure problem detector and a brake fluid control point.

Parking brake control is provided by a foot operated silent operating pedal. It is released automaticaly by a vacuum controlled diaphragm when the engine is running and the shift selector is placed in any position other than

neutral or park. A manual release lever is located on the inboard side of the parking brake assembly. When park brake is applied a *brake* warning lamp illumination in the instrument panel housing is lighted.

The combination valve is located on the frame side rail extension at the left side of the car. The combination valve incorporates three functions as follows:

1. The metering valve (hold-off section) incorporates lines leading to the caliper assemblies. The purpose of the hold-off valve is to limit pressure to the front disc brakes until the rear drum brakes are activated (rear line pressure must overcome the rear brake shoe return spring tension before the rear brakes actuate).

NOTE: Only cars with rear drum brakes include the metering valve section.

2. The pressure differential section monitors the front and rear brake systems to measure any difference in pressure from the master cylinder. If a sufficient pressure differential exists between the systems an electrical ground is made energizing the *BRAKES* tell-tale light on the right side of the instrument cluster if the ignition switch is on. The valve and switch are so designed that the switch will latch in the "warning" position once a failure has occurred. The only way the light can be turned off is to repair the failure and apply pedal force as required to develop up to 450 psi line pressusre.

3. The proportioning section of the valve proportion outlet pressure to the rear brakes after a predetermined rear input pressure has been reached. This is done to prevent rear wheel lock-up on a vehicle with light rear wheel loads. The valve is designed to have a "by-pass" feature which assures full system pressure to the rear brakes in the event of a front brake system malfunction.

NOTE: The brake combination valve on Limousine and Commercial series does not include the proportioning valve section.

REAR DRUM BRAKES

The rear drum brake system consists of brake shoes (two per wheel) with riveted composition linings acting on cast iron-steel brake drums. The linings are forced against the drums by hydraulic pressure for normal braking and by a foot lever, through a mechanical linkage to the brake shoes, for the parking brake.

The automatic adjusters can engage when the brakes are applied while the car is moving rearward with light pedal application, or after an uphill stop. Adjustment actually occurs only when there is excessive clearance between the lining and the drum.

Parking Brake

The parking brake pedal assembly is mounted on the cowl to the left of the service brake pedal. The parking brake will release automatically when the transmission selector lever is moved into any drive position with the engine running. It will not release automatically, however, with the engine running and the selector lever in Neutral or Park, or in any position with the engine off. A manual release lever, located on the inboard side of the parking brake assembly, may be used if the automatic release is inoperative or if manual release is desired at any time. When the parking brake is applied, an electric ground is made energizing the brake tell tale warning light if the ignition switch is on.

BRAKE STOPLIGHT SWITCH

The brake stoplight switch is mounted on a flange on the brake pedal support bracket below the instrument panel. When the brake pedal is depressed, the spring loaded switch plunger follows the brake pedal arm downward until the switch is in the "on" position. When the brakes are released, the arm returns the switch plunger to the "off" position.

BRAKE FLUID

It is recommended that Part Number 546 4831 brake fluid or equivalent fluids meeting DOT-3 specifications be used in Cadillac brake systems.

Brake fluid should always be stored in closed containers, as it will absorb moisture from the atmosphere. Moisture contamination of brake fluid causes the boiling point of the fluid to be lowered.

Tandem Diaphragm Vacuum Power Brake Unit (Fig. 5-5)

The vacuum power brake unit consists of a tandem diaphragm vacuum power section and a dual hydraulic master cylinder.

The master cylinder is designed so that the front and rear service brakes have separate hydraulic systems. The front section of the master cylinder provides fluid for the front brakes, while the rear section provides fluid for the rear brakes except Eldorado which has the rear master cylinder section feeding the front brakes and the front master cylinder section feeding the rear brakes. Should a leak occur in the front hydraulic system, the rear brake system will still function.

Likewise, if the rear hydraulic system should develop a leak, then the front system would still function. Increased brake pedal travel and an instrument panel brake light warns the driver that such a condition may have occurred.

The tandem diaphragm vacuum power unit has a vacuum power chamber that consists of a front and rear shell, a housing divider, front and rear diaphragm and plate assemblies, a hydraulic push rod, and a diaphragm return spring, Fig. 5-5.

The unit operates so that the two diaphragm and plate assemblies utilize the differential pressure created by engine intake manifold vacuum and atmospheric pressure to assist the hydraulic push rod.

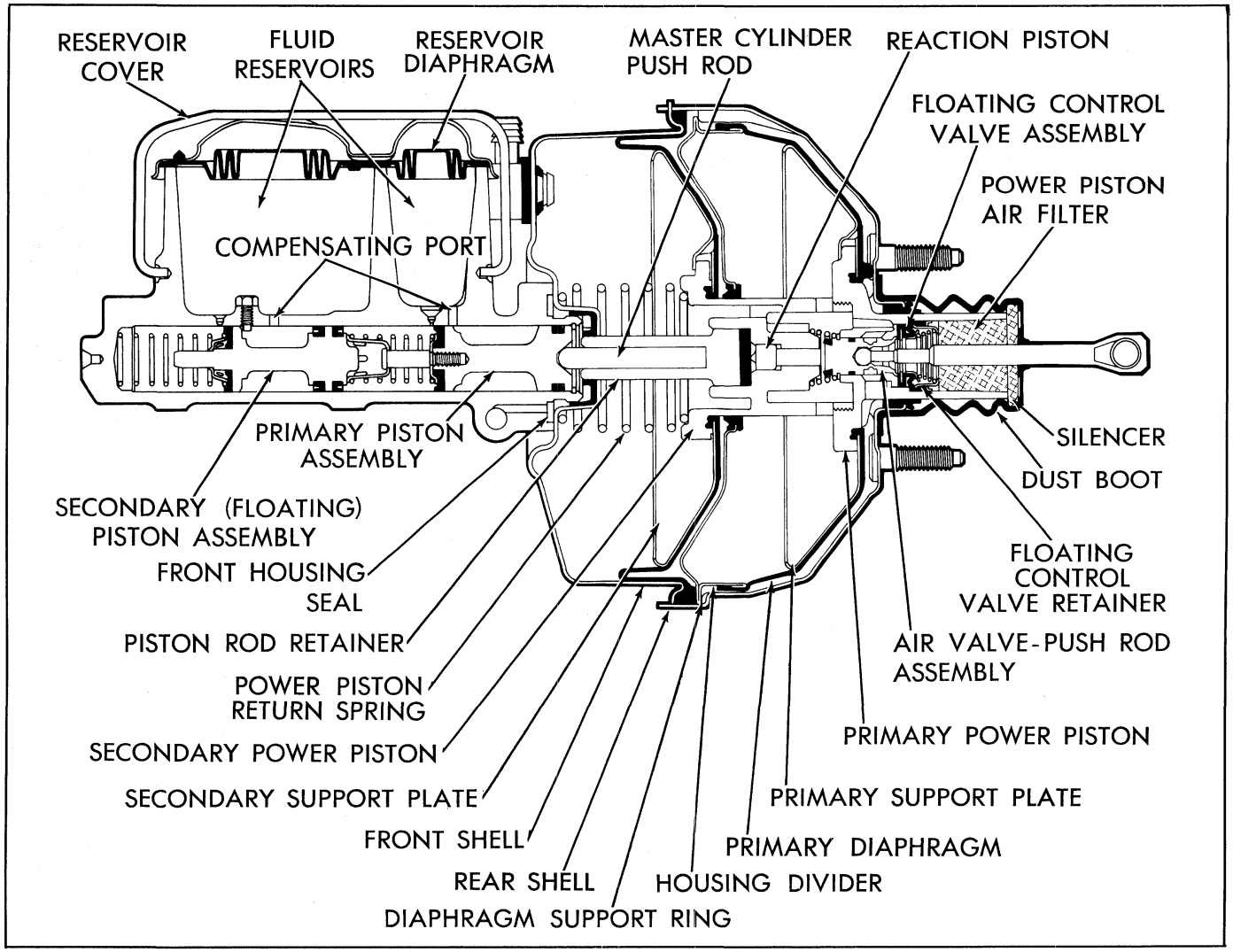


Fig. 5-5 Tandem Diaphragm Vacuum Power Brake Unit

DIAGNOSIS

TESTING BRAKE SYSTEM

a. Vacuum Power Section

1. Attach one end of spare windshield washer pump inlet hose to the port nearest the shut-off valve of Leak Testing Tool, J-23108, Fig. 5-6.

2. Disconnect power brake hose to vacuum pipe from carburetor and attach the other end of the windshield washer pump inlet hose to this fitting. A small amount of silicone lubricant will facilitate installation.

3. Connect the power brake hose to other port of the tester and secure with hose clamp, Fig. 5-6.

4. Run engine at idle for approximately 1/2 minute.

5. Turn off shut-off valve on tee.

6. Note vacuum gage reading.

7. Apply brakes with estimated 20-30 pounds force (the effort required for a moderate stop). While holding pedal force as constant as possible, note vacuum gage reading immediately after applying brake and one-half minute later.

NOTE: If pedal pressure is relaxed, vacuum reading will be incorrect.

a. Immediate reading should not be more than six inches of mercury less than initial reading taken after closing shut off valve. Any release of the brake pedal will increase the reading. Subsequent drop in vacuum reading while holding brakes applied should not exceed two inches of mercury per 1/2 minute. If vacuum leak exceeds specification, power unit must be serviced.

b. Master Cylinder Section

NOTE: These tests will not determine all master cylinder malfunctions. Use the diagnosis chart to help isolate the problem if it is not resolved by these tests.

1. Check for a cracked master cylinder casting or brake fluid around master cylinder.

Leaks are indicated only if there is at least a drop of fluid. A damp condition is not abnormal.

2. Remove fluid reservoir cover, rapidly depress brake pedal. A geyster should be seen at front reservoir as the brake pedal is repidly depressed.

a. If system fails this test, check for a binding pedal

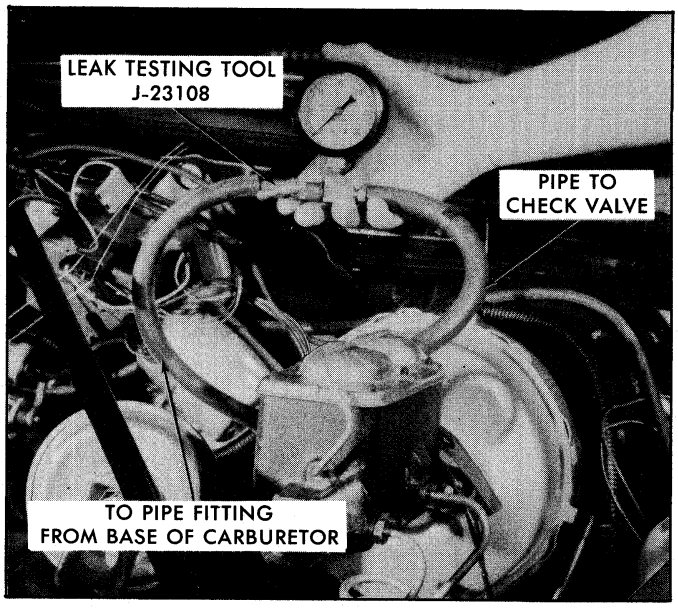


Fig. 5-6 Vacuum Leakage Test

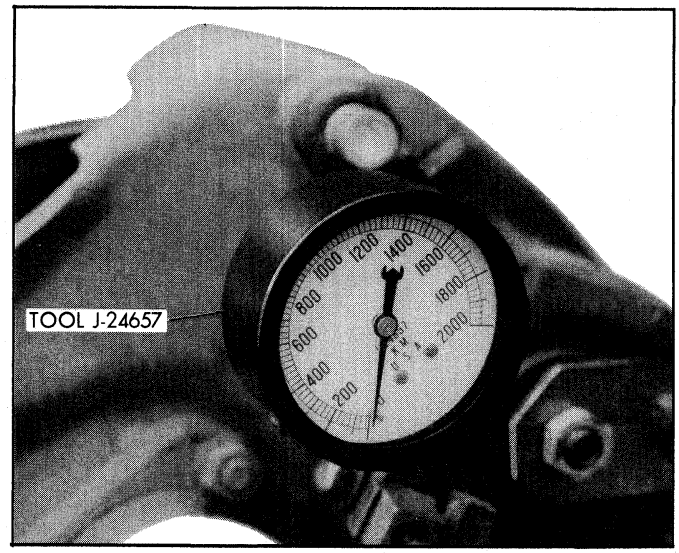


Fig. 5-7 Brake Combination Valve Pressure Gage

linkage and incorrect push rod adjustment. If both of these are satisfactory, disassemble the master cylinder and check for swollen or elongated primary piston seal(s). Also see page 5-7.

c. Brake Combination Valve

NOTE: The metering section of the valve is not used on the Eldorado, Seville and Brougham.

1. Metering Valve (on drums only see page 5-3). Proper operation of the metering valve can be checked by installing pressure brake bleeder using adapter J-25818-01 and cable J-25818-01.

a. With pressure bleeder energized, open bleeder screw on either front caliper. No fluid should come out.

2. Distributor Switch–For operational check.

a. Light should be energized during engine cranking.

b. With engine running, apply moderate pedal force, (approximately 20-30 lbs.). When an assistant opens any bleeder screw, light should go ON indicating an open or problem condition.

c. Close bleeder screw before releasing brake.

d. Upon reapplying pedal force, light should go out.

e. Check master cylinder and bring fluid up to proper level, as described on page 5-9.

3. Proportioner Operation (Exc. Commercial).

NOTE: The Eldorado Brougham and Seville rear caliper has a larger bleeder screw than the bleeder screw used on drum brake wheel cylinders. To adapt the present pressure gage to the rear caliper, use a weatherhead 46 x 3 female coupling or equivalent, and a weatherhead 90° elbow 3400 x 4 x 2 or equivalent. Always use a new copper brake hose washer between the coupling and caliper for each test.

a. Raise car.

b. Remove one of the rear brake bleeder screws and install Pressure Gage Tool J-24657, Fig. 5-7 and 5-8.

c. With engine running at idle and brake pedal applied with 100 lbs. force (approximately the force on each foot when standing) pressure reading should be less than 1,000 psi.

If any of the above specifications are not met, brake combination valve should be replaced.

d. Brake Leaks

1. With engine running at idle and transmission in Neutral, depress brake pedal and hold a constant foot pressure on pedal. If pedal gradually falls away with the constant under foot pressure, hydraulic system is leaking.

NOTE: Hydraulic system may be leaking internally as well as externally. See part b, Steps 1 and 2. Also system may appear to pass this test but still have slight leakage.

e. Excessive Pedal Travel

1. On cars equipped with Tilt and Telescope steering column, place wheel in third position from top.

2. Hook end of tape over top edge of brake pedal pad, at approximately the center of the pad.

3. Unreel tape to rim of steering wheel, Fig. 5-9.

4. Place thumbnail at edge of wheel and take a reading of the extended length.

5. While holding tape measure and with engine idling, press pedal with estimated 20-30 pounds force (the effort required for a moderate stop), and note reading on tape

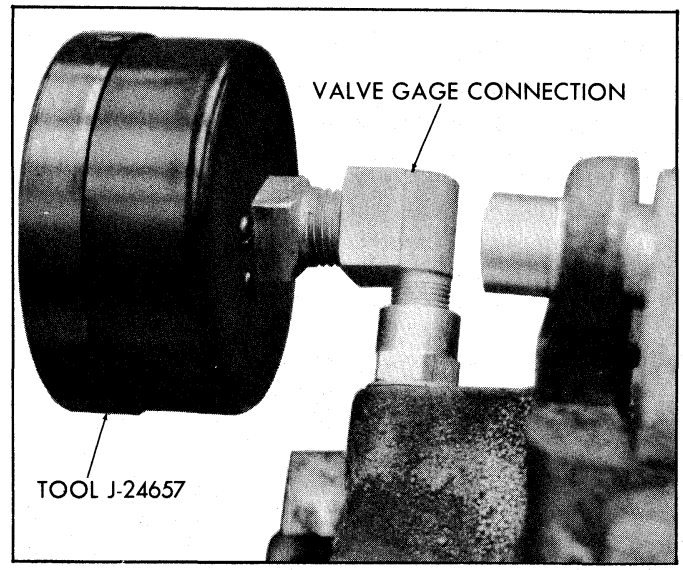


Fig. 5-8 Valve Pressure Gage Assembly

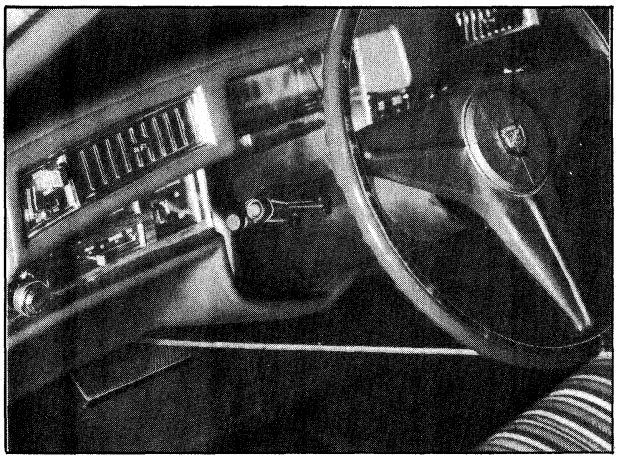


Fig. 5-9 Checking Brake Pedal Height

measure. The difference between the two readings is the amount of pedal travel.

Pedal travel should not exceed 2-1/16 inch, 2-3/4 inches on Brougham and Seville, 4 to 5-1/2 inches on Eldorado.

6. If pedal travel is greater than specification, on rear drum brake cars, first drive the car backward and forward to see if the brake pedal height will return to normal. In rare cases, excessive pedal travel develops if the car is not driven in reverse because the self-adjusting mechanism will actuate only in reverse when the brakes are applied.

Most low pedal problems are caused by air in lines, necessitating bleeding of the system. It may be necessary to bleed the system several times at each fitting. See page 5-9.

If pedal travel exceeds specification, there may still be some air in the system.

Other less frequent causes of excessive pedal travel are rear brake shoe adjusters not functioning, shoes require relining, front or rear hydraulic system has lost its fluid, and tapered linings.

f. Road Testing Brakes

Brakes should be tested on dry, clean, smooth and reasonably level roadway which is not crowned. Road test brakes by making brake applications with both light and heavy pedal forces at various speeds to determine if car stops evenly and effectively.

Also drive car to see if it leads to one side or the other without brake application. If it does, check tire pressure, front end alignment and front suspension attachments for looseness. See diagnosis chart for other causes:

Testing Brake Tell-Tale Light Operation

1. Make sure wire is connected to brake combination valve and parking brake is released.

2. Start engine, while ignition switch is in start position, brake tell-tale light should glow and go off when ignition switch returns to ignition position.

3. If system performs as described in step 2, and pedal height is satisfactory Part D page 5-6, the system is all right.

4. If light fails to glow in start position, perform electrical tests outlined in Section 8 page 8-93.

5. If light does not go out with ignition switch in ignition position, disconnect wire from assembly. If light still does not go out, proceed as follows:

a. Check to make sure park brake is released.

b. If light goes out, this indicates that the terminal is shorted or there is a leak in the brake system. Check pedal height (part d of page 5-6). If brake light glows and pedal height is low, check for all conditions listed in diagnosis chart on page 5-8. If it is determined the terminal is shorted, replace the assembly.

NOTE: The design of the brake combination valve is such that once a brake leak is sensed by the unit, a ground is made within the switch that will not be broken until the leak is corrected. Refer to page 5-9.

SUBSTANDARD OR CONTAMINATED BRAKE FLUID

Improper brake fluid, mineral oil, or water in the fluid may cause the brake fluid to boil or the rubber components in the hydraulic system to deteriorate.

When checking the fluid reservoir level, the level in the rear reservoir may be as low as one inch from the top if the front linings are worn. This is not abnormal.

To check for deterioration of rubber parts, perform step 2 of page 5-5. If primary piston cups are swollen, then rubber parts have deteriorated. This deterioration may also be evidenced by swollen wheel cylinder piston cups on the drum brake wheels.

If deterioration of rubber is evident, disassemble all hydraulic parts and wash with alcohol. Dry these parts with compressed air before assembly to keep alcohol out of system. Replace all rubber parts in system including hoses. Also when working on the brake mechanisms, check for fluid on linings. If excessive fluid is found, replace linings.

If master cylinder piston seals are all right, check for a leakage or excessive heat conditions. If condition is not found and still in doubt, drain fluid, flush with brake fluid, refill and bleed system, page 5-9.

PARKING BRAKE PRELIMINARY CHECKS

It is not always necessary to replace the parking brake assembly or vacuum diaphragm assembly in cases of an inoperative parking brake automatic release. The following checks should be performed as part of your diagnosis to determine the cause and correction of parking brake trouble and to eliminate unnecessary replacement of parking brake components.

1. Check vacuum cylinder piston travel by running engine and moving transmission selector lever from Drive to Neutral. The manual release lever should move up and down as vacuum is applied and released. If no movement is observed, check vacuum system per steps 2 and 3. If movement is slow, (more than one or two seconds to complete the full stroke) diaphragm is leaking or hoses are partially pinched or kinked. Vacuum diaphragm may be replaced as outlined on page 5-20.

2. Check for damaged or kinked vacuum hoses and for loose hose connections at parking brake vacuum cylinder, vacuum release valve at back-up light switch, and at engine manifold connection.

3. Check operation of vacuum release valve. Correct as necessary and recheck parking brake operation.

4. Check brake release with vacuum applied. If vacuum cylinder piston completes full stroke but does not release brake, a malfunction of the pedal assembly is indicated. Replace complete parking brake assembly as described on page 5-19.

BRAKE DIAGNOSIS CHART — DISC, DRUM SYSTEMS

NOTE: Operation of Tell-Tale Brake Light may be checked as outlined on Page 8-93.

CAUSE / SYMPTOM	Excessive Brake Pedal Travel	Brake Pedal Travel Gradually Increases	Excessive Brake Pedal Effort	Excessive Braking Action	Brakes Slow to Respond	Brakes Slow to Release	Brakes Drag	Uneven Braking Action (Side to Side)	Uneven Braking Action (Front to Rear)	Scraping Noise from Brakes	Brakes Squeak During Application	Brakes Squeak During Stop	Brakes Chatter (Roughness)	Brakes Groan at End of Stop	Brakes Tell-Tale Glows
Leaking Brake Line or Connection	X	XX	X						X						XX
Leaking Wheel Cylinder or Piston Seal	X	XX	X	X				X	X						X
Leaking Master Cylinder	X	XX	X						X						X
Air in Brake System	XX		X						X						XX
Contaminated or Improper Brake Fluid	X				X	X	X	X	X						X
Leaking Vacuum System			XX		X										
Restricted Air Passage in Power Head		X	X		XX	X	X								
Damaged Power Head		x	x	x	x	xx	X								
Worn Out Brake Lining			X	X				X	X	X		XX	X	X	
Uneven Brake Lining Wear-Replace	X			X				X	X	X		XX		X	
Glazed Brake Lining-Sand			XX		X			X	X			X		X	
Incorrect Lining Material-Replace			X	X				X	X	X	X	X	X	X	
Contaminated Brake Lining-Replace			X	XX	X			XX	XX	X		X	X	X	
Linings Damaged by Abusive Use-Replace			X	XX				X	X	X		X	X	X	
Excessive Brake Lining Dust-Remove with Air			X	XX				XX	XX		X	XX		X	
Heat Spotted or Scored Brake Drums or Rotors				X				X	X			X	XX	X	
Out-of-Round or Vibrating Brake Drums													XX		
Out-of-Parallel Brake Rotors	X												XX		
Excessive Rotor Run-Out	X												X		
Faulty Automatic Adjusters	X			X			X	X	X						X
Incorrect Wheel Cylinder Sizes			X	X				X	X						
Weak or Incorrect Brake Shoe Retention Springs				X	X	X	X	X	X	X	XX				
Brake Assembly Attachments-Missing or Loose	X						X	X	X	X			X	X	
Insufficient Brake Shoe Guide Lubricant							X	X	X	XX	XX				
Restricted Brake Fluid Passage or Sticking Wheel Cylinder Piston		X	X		X	X	X	X	X						X
Improperly adjusted Stoplight Switch or Cruise Control Vacuum Dump							X								
Faulty Metering Valve	X		X	X	X	X	X		X						X
Faulty Proportioning Valve			X	X	X	X			X						X
Brake Pedal Linkage Interference or Binding			X		X	XX	XX								
Improperly Adjusted Parking Brake							X		X						XX
Incorrect Front End Alignment								XX							
Incorrect Tire Pressure								X	X						
Incorrect Wheel Bearing Adjustment	X						X	X		X			X		
Loose Front Suspension Attachments							X	X		XX			X	X	
Out-of-Balance Wheel Assemblies													XX		
Operator Riding Brake Pedal			X				X		X				X	X	
Sticking Caliper or Wheel Cylinder Pistons			X				XX	X	X						

XX — Indicates more probable causes(s)
X — Indicates other causes

5. Check operation of parking brake with engine off. Parking brake should remain engaged regardless of transmission selector lever position. If not, replace parking brake assembly.

ON-CAR SERVICE

BLEEDING BRAKES

Bleeding brakes may be made considerably easier through use of one of the pressure brake bleeder tools available. This equipment consists of a tank partially filled with brake fluid and a rubber hose that connects to the hydraulic cylinder reservoir Brake Bleeder Adapter, J-23518-01. Air pressure is applied to the tank to force fluid into the brake system.

Pressure bleeding equipment must be of the diaphragm type. That is, kit must have a rubber diaphragm between the air supply and the brake fluid to prevent air, moisture, oil and other contaminates from entering the hydraulic system.

The Brake Bleeder Adapter, J-23518-01, seals the brake system from atmosphere during the bleeding operation and enables the brakes to be bled with only one hook-up.

a. Pressure Bleeder Method

1. Remove master cylinder reservoir cover and seal assembly and fill both reservoirs with fluid.
2. Install Bleeder Adapter, J-23518-01 and cables J-22489-12, on master cylinder and connect bleeder hose to Bleeder Adapter Cover.
3. Install Tool J-23770 so the metering plunger on the front of the brake combination valve is fully depressed on all cars except Eldorados.
4. Build up pressure in bleeder to 30 psi or maximum recommended by manufacturer.
5. Raise car being careful not to damage pressure bleeder equipment.
6. Perform Steps 8 through 11 in the following sequence as required.
   A. Right rear brake.
   B. Left rear brake.
   C. Right front brake.
   D. Left front brake.
7. Install a box-end wrench on bleeder screw and attach drain hose. Hose discharge end must be submerged in clean brake fluid. Use a clean bottle partially filled with brake fluid.
8. Back off fitting three-quarters turn and bleed brake until there are no more bubbles, then close bleeder screw.
9. Be sure bleeder screw is sealed.
10. Go to the next bleed position in Step 6 and repeat Steps 7, 8, 9 until all positions listed in Step 6 are completed.

NOTE: Induced pulsation while the bleeder valves are open tends to purge the system and reduce the time necessary to complete the job. This pulsation can be created by pumping the pedal. (1/2" max. travel).

11. Lower car.
12. Remove Combination Valve Bleeder Retainer, J-23770.
13. Remove pressure bleeding equipment and check reservoir level. Level should be 1/8 inch to 3/8 inch from top.
14. Install master cylinder cover and seal assembly.
15. After bleeding brakes, check pedal travel as described on page 5-6, Part e. Rebleed brakes if necessary.
16. Before driving car, be sure a firm pedal is obtained.

b. Manual Bleed Method

If a pressure bleeder is not available the following procedure may be used.

1. Fill both master cylinder reservoirs with brake fluid and install Tool J-23770 on brake combination valve on all cars except Eldorados, Seville and Brougham.

NOTE: Keep reservoirs at least partially filled at all times during bleeding operation.

2. Raise car.
3. Perform Steps 4 through 10 in the following sequence as required.
   A. Right rear brake.
   B. Left rear brake.
   C. Right front brake.
   D. Left front brake.
4. Install a box-end wrench on bleeder screw and attach drain hose. Hose discharge end must be submerged in clean brake fluid. Use a clean bottle partially filled with brake fluid.
5. Open bleeder screw.
6. Fully depress brake pedal and hold.
7. Close bleeder screw.
8. Release brake pedal.
9. Repeat Steps 4 through 8 above until brake fluid, containing no air bubbles, emerges from drain hose. Check and refill the master cylinder reservoir as required to prevent air from being drawn in through the master cylinder.
10. Go to the next bleed position in Step 4 and repeat Steps 5 thru 9 until all positions listed in Step 7 are completed.
11. Lower car.
12. Remove Tool J-23770 from the brake combination valve.
13. Check reservoir level. Level should be 1/8 inch to 3/8 inches from top.
14. Install master cylinder cover and seal assembly.
15. After bleeding brakes, check pedal travel as described on page 5-6.
16. Before driving car, be sure a firm pedal is obtained.

REAR DRUM BRAKE SHOE ADJUSTMENT

Although the hydraulic service brakes are self-adjusting, a preliminary star wheel adjustment is necessary after the rear brake shoes have been relined or replaced, or when the length of the star wheel adjuster has been changed during some other service operation. Final adjustment is made automatically by

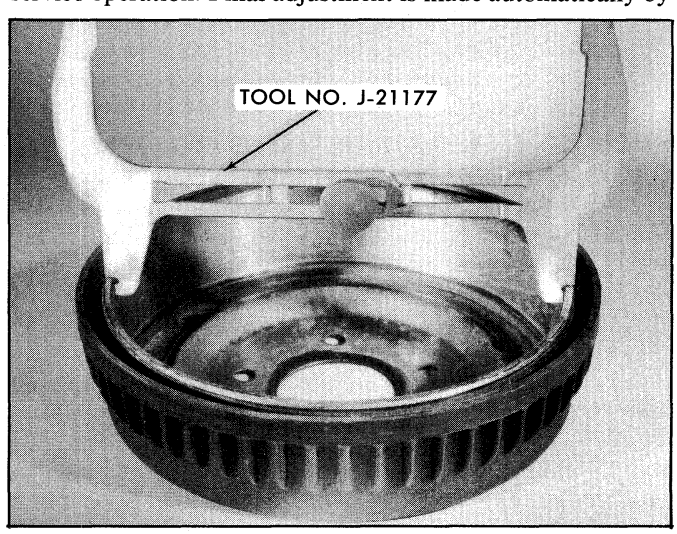


Fig. 5-10 Inside Drum Measurement

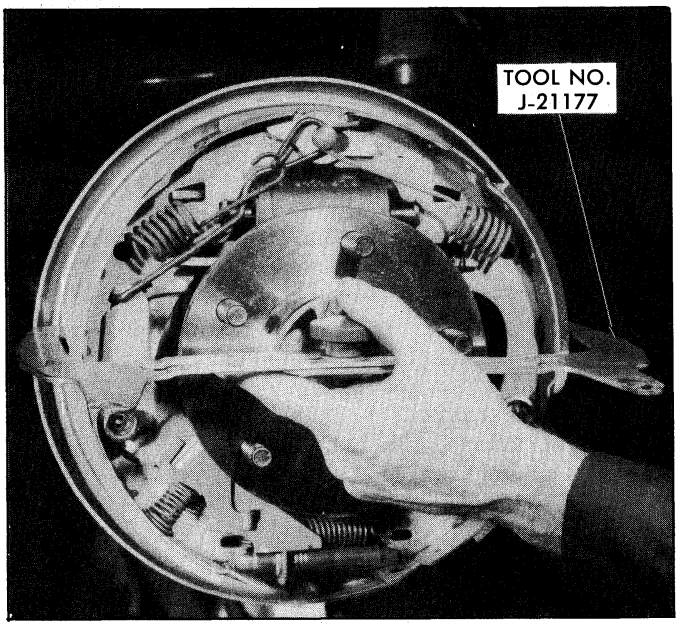


Fig. 5-11 Adjusting Brake Shoes

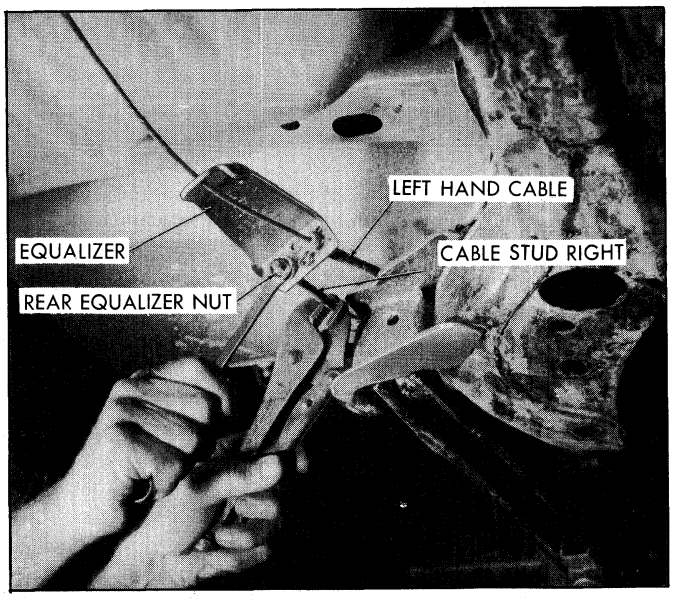


Fig. 5-12 Parking Brake Adjustment

adjusters that function when the car is moving backward. No mechanical adjustment is required when replacing front disc-brake shoe and lining assemblies.

1. Raise car and remove rear wheels and drums if not already removed.
2. Check to make certain that parking brake cable and linkage, including levers on rear secondary shoes, are free.
3. Measure brake drum I.D. using inside caliper portion of tool J-21177, Fig. 5-10.
4. Adjust brake shoes to dimension obtained on outside caliper portion of tool J-21177, Fig. 5-11.
5. Check brake fluid level in both master cylinder reservoirs. Fluid level should be approximately 1/8 to 3/8 inches below top of reservoir. Add fluid if necessary.
6. Adjust parking brake as described on page 5-10.
7. Install drums and wheels. Tighten wheel mounting nuts to 100 foot-pounds. Lower car.
8. Drive car alternately forward and backward, applying brakes moderately in each direction until pedal travel does not exceed specifications listed on part d, page 5-6.

CAUTION: *When rear drum brakes are serviced, the parking brake linkage cable at equalizer must always be readjusted to prevent possible burn out of rear brakes.*

PARKING BRAKE ADJUSTMENT–(Fig. 5-12)

DRUM BRAKES

Need for parking brake adjustment is indicated if the hydraulic system operates with good reserve, but parking brake pedal travel is less than 2 inches or more than 7 inches at 125 pound pedal force (heavy foot pressure).

NOTE: Make sure that rear drum brakes are properly adjusted before adjusting parking brake.

1. Depress parking brake pedal approximately 1.5 inch from fully released position, measuring with a ruler.
2. Raise rear wheels off floor.
3. Hold brake cable stud from turning, and tighten equalizer nut, Fig. 5-12, until light drag is felt on either wheel (going forward). After each turn of equalizer nut, check to see if either wheel begins to drag.
4. Release parking brake. No brake shoe drag should be felt at either rear wheel. Operate several times to check adjustment.

NOTE: After adjustment is performed, parking brake pedal should travel 5-1/4 inches to 6-3/4 inches with approximately 125 pounds force on pedal.

5. Lower rear wheels.

STOPLIGHT SWITCH ADJUSTMENT

The brake stoplight switch and Cruise Control switch are adjusted in an identical manner. Push the switch well into the retaining clip. Pulling the brake pedal up just enough to reach the normal released position will automatically adjust the switch, Fig. 5-13.

Rotate each switch 1/2 turn counterclockwise to be sure that Stoplight Cruise Control and Cruise Control vacuum switches do not hold brake pedal on after adjustment. There should be free play between brake pedal and switch bodies when pedal is pulled toward released direction from unapplied position.

DISC BRAKE RELINING (FRONT)

Lining Inspection

Inspect the brake linings any time that the wheels are removed (tire rotation, etc.). Check both ends of the outboard shoe by looking in at each end of the caliper. These are the points at which the highest rate of wear normally occurs. However, at the same time, check the lining thickness on the inboard shoe to make sure that it has not worn prematurely. Look down through the inspection hole in the top of the caliper to view the inboard shoe. Whenever the thickness of any lining is worn to the approximate thickness of the metal shoe, all shoe and lining assemblies should be replaced.

Front disc brakes have a wear indicator that makes a noise when the linings wear to a degree where replacement is required, Fig. 5-14. The reed is in an integral part of the inboard shoe and lining assemblies. When the lining is worn the reed contacts the rotor and produces a warning noise.

Check flatness of brake linings. Place inboard and

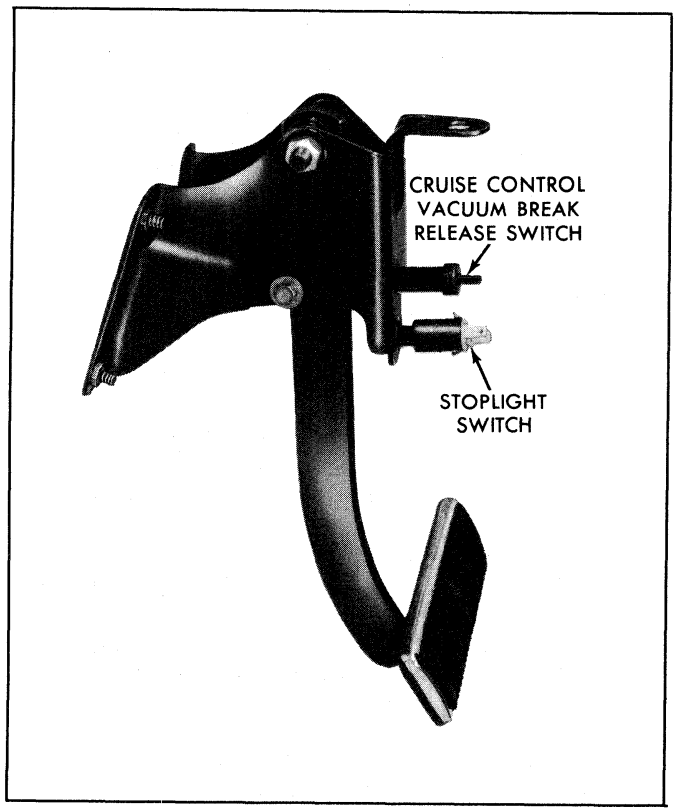


Fig. 5-13 Stoplight Switch Location

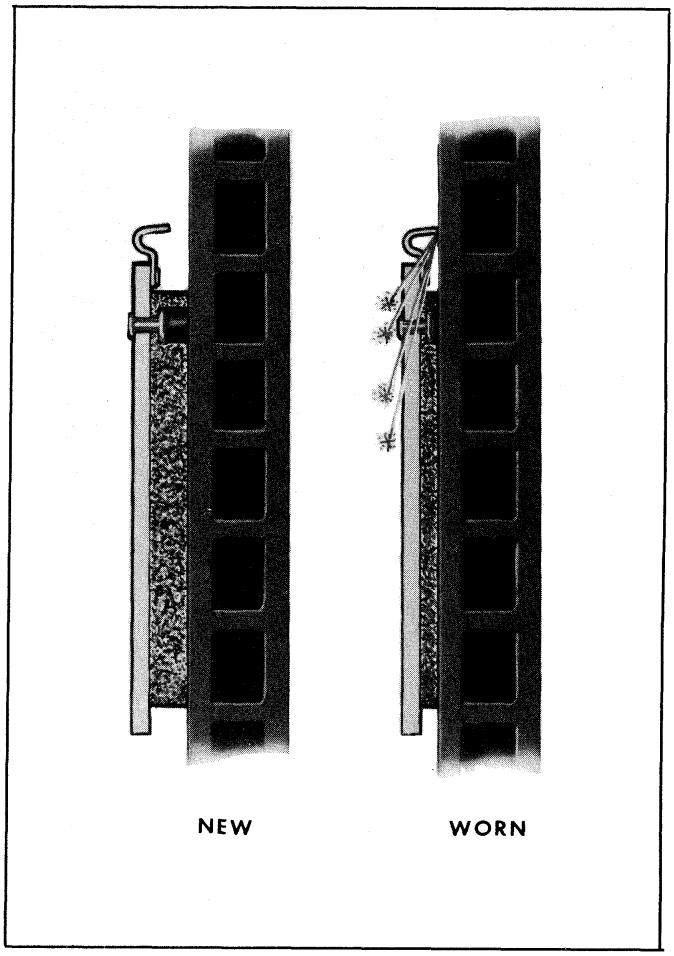


Fig. 5-14 Wear Indicator

outboard lining surfaces together and check for gap between pad surfaces. If more than .012" gap is measured at middle of linings, linings must not be used. This applies to new or used brake linings.

Inspect disc brake noise insulator on outboard shoes for damage. If damaged or distorted, replace using noise insulator kit.

Relining Procedure

1. Remove two thirds of the total fluid capacity in the front exc. Eldorado master cylinder reservoir. Discard fluid.

NOTE: Removing the fluid prevents reservoir overflow when the piston is pushed back in its bore to make room for the new lining.

2. Raise car and remove front wheels.

3. Position 7 inch "C" clamp on the caliper so that solid side rests against back of caliper assembly. The screw end rests against back of outboard shoe, Fig. 5-15.

4. Tighten "C" clamp until caliper moves out far enough to push piston to bottom of piston bore. This will release the pressure on shoe and lining assemblies.

5. Remove "C" clamp.

6. Remove brake hose from ball joint on Eldorado.

7. Remove two bolts, using a 3/8 head Allen Socket Assembly, that hold caliper to steering knuckle, Fig. 5-16.

NOTE: It is not necessary to remove brake hose when relining disc brakes.

8. Slide caliper off rotor and support with a hook-shaped wire fastened to upper suspension arm.

CAUTION: *Do not allow caliper to hang from brake hose, as damage may occur.*

9. Remove inboard shoe and spring from piston.

10. Remove outboard shoe from caliper.

11. Push out two sleeves from inboard ears of the caliper.

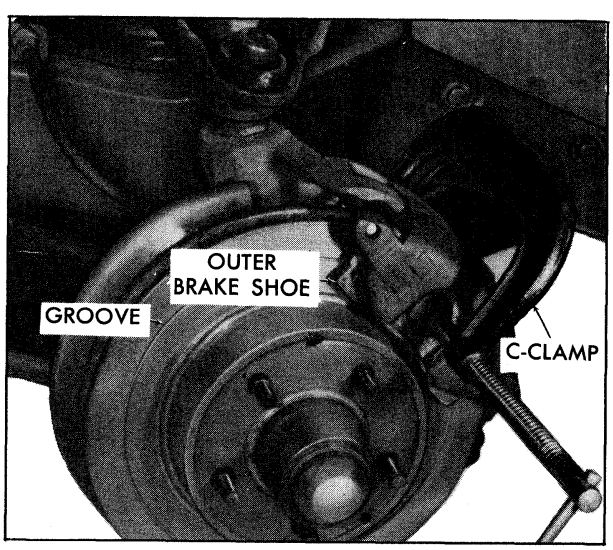


Fig. 5-15 Pushing Piston Into Bore

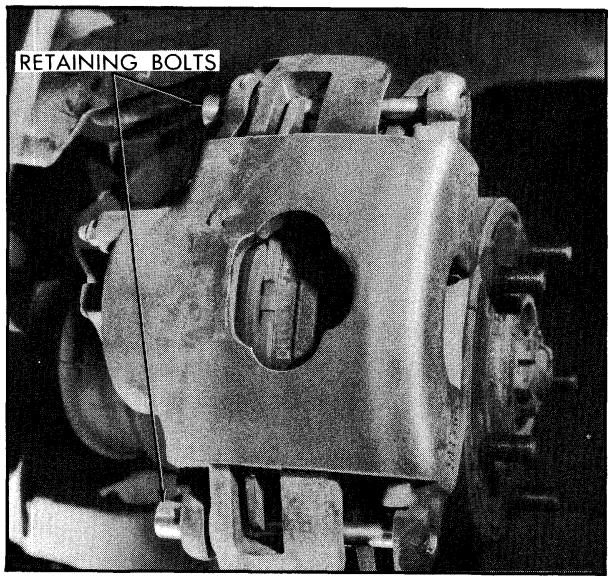


Fig. 5-16 Sliding Caliper Disc Brake

12. Remove four rubber bushings, two on inboard ears and two on outboard ears.

13. Examine piston area for fluid leaks by looking for excessive moisture around boot area. Check dust boot for cuts, cracks or other damage which would affect its ability to seal piston bore. If leaks are present or boot shows damage, caliper should be overhauled as described on page 5-13. If no problems are found, wipe clean the inside of the caliper including four ears where bushings are installed. Wipe the outside surface of the dust boot clear of all dirt so that when piston is pressed to bottom of bore, boot will fold back without coming out of groove in piston.

CAUTION: *Do not use air for cleaning caliper because of the possibility of unseating dust boot.*

14. Examine both sides of rotor for scoring or rough finish. Refer To page 5-14 to determine condition of rotor. In normal use, a slight ridge or rust may form on the edge of the rotor. This ridge may be removed with sandpaper.

15. Make sure the piston is bottomed in the piston bore. Make sure the dust boot has folded back correctly as the piston moved back.

16. Add new bushings and sleeves prelubed. Install the sleeves and position the sleeve so that end toward the shoe and lining assembly is flush with the machined surface or the ear.

17. Secure clip-on spring to inner shoe inside cut-out section of piston. Install inboard shoe and lining assembly with wear indicator to rear of car, on the lower end of caliper as installed in the car.

NOTE: With wear indicator there is a specific left hand and right hand inboard shoe.

18. Place the outboard shoe and lining in the caliper. The two ears at the ends of the shoe fit over the ears on the caliper. The flange on the bottom of the shoe fits into the cut-out section of the caliper.

19. Position caliper on rotor and line up holes in caliper ears with holes in steering knuckle. Make sure the brake hose is not twisted as its natural curvature is essential to maintain proper hose-to-suspension clearance through full movement of suspension and steering parts.

20. Wipe all dirt and corrosion from the caliper mounting bolts. **Do not use abrasives,** as they will remove protective plating. Lubricate both ends of bolts with silicone lubricant.

21. Install the caliper mounting, making sure bolt passes under ears of inboard shoes, Fig. 5-16.

22. Repeat steps 22 and 23 in placing remaining bolt into caliper assembly.

23. Tighten caliper mounting bolts, using a 3/8 Allen Head Socket Assembly to 30 foot-pounds.

(For steps 23, 27, 29.) See Caution page 5-1.

24. Pump brake pedal to seat lining against rotor.

25. Clinch upper ear of outboard shoe by positioning 12" pliers with one jaw on top of upper ear and one jaw in notch on bottom of shoe, opposite upper ear, see Fig. 5-17.

NOTE: After clinching, there should be no radial clearance between the shoe ears and caliper housing.

26. If radial clearance exists, repeat clinching procedure.

27. If working on an Eldorado, center brake hose collar in clip and tighten upper spherical jount nut to 60 foot-pounds. Install cotter pin.

28. Repeat steps 3 through 28 on other brake assembly.

29. Install wheels, tighten wheel mounting nuts to 130 foot-pounds on Eldorados, 100 foot-pounds for all other cars and lower car.

See Caution on page 5-1.

30. Before moving the vehicle, pump the brake pedal two or three times to insure firm pedal.

31. Allow car weight to be supported on front wheels and inspect front brake hoses for twisted condition. If necessary, correct as described on page 5-21.

32. Check the master cylinder reservoirs and fill 1/8 to 3/8 inch from top.

33. Any time the front brakes are relined, the rear brakes should be checked.

34. Break in new linings as described on page 5-12.

BREAK-IN OF NEW LININGS

New or replacement brake linings, if subjected to normal usage at speeds under 50 MPH need no special break-in. However, the first few brake applications may be somewhat erratic, and it may be necessary to stabilize the brakes before delivering the car to the owner. If brake action is erratic, one acceptable way to seat the brakes is to make five or ten moderate brake stops at speeds of 30 or 40 MPH, at approximately one-half mile intervals.

DISC BRAKE CALIPER ASSEMBLY FRONT

a. Removal

1. Remove two thirds of the total fluid capacity in the front on all exc. Eldorado master cylinder reservoir. Discard fluid.

NOTE: Removing fluid prevents reservoir overflow when the piston is pushed back in its bore to remove the caliper.

2. Raise car and remove front wheels.

3. Position a "C" Clamp on the caliper so that solid side rests against back of caliper assembly. The screw end rests against back of outboard shoe, Fig. 5-15.

4. Tighten "C" clamp until caliper moves out far enough to push piston to bottom of piston bore. This will release the

pressure on shoe and lining assemblies.

5. Remove "C" clamp.

6. Remove flexible hose attaching bolt from hose fitting and remove hose from caliper.

7. Using a 3/8 Allen Head Socket assembly, remove two screws that hold caliper to steering knuckle.

8. Slide caliper from rotor.

9. Place caliper on clean workbench and overhaul caliper as described on page 5-13.

10. Inspect flexible hose for worn spots, cracks of deterioration. Replace if necessary.

c. Installation

1. Make certain that piston is bottomed in piston bore. Make certain that the dust boot folds back correctly as piston is moved back.

2. Secure slip-on spring to inner shoe cut-out section of inner shoes. Install inboard shoe and lining assembly with wear indicator on lower end of caliper as installed on car.

NOTE: There are left and right inboard shoes. They must be installed properly for wear indicator to operate. Outboard shoes have insulators attached. See Figs. 5-2 and 5-3.

3. Place outboard shoe and lining in caliper. The two ears at ends of shoe fit over ears of caliper. Flange on bottom of shoe fits into cut-out section of caliper.

4. Position caliper onto rotor and line up holes in caliper ears with holes in steering knuckle. Clean dirt and corrosion from Allen Head caliper mounting screws. **Do not use abrasives** since they will remove the protective plating. Lubricate both ends of caliper screws with silicone lubricant.

5. Install the caliper mounting, making sure bolt passes under ears of inboard shoes, Fig. 5-16.

6. Pass screw through outboard ear on caliper until threads on screw can be started into steering knuckle.

7. Repeat steps 8 and 9 in placing remaining screw into caliper assembly.

8. Tighten caliper mounting screws to 30 foot pounds.

9. Using new washers, install screw which secures flexible hose. Tighten screw to 30 foot-pounds maximum torque.

CAUTION: *Do not twist hose any more than necessary during this operation. Its natural curvature is essential to maintain proper hose-to-suspension clearance through full movement of suspension and steering parts.*

10. Inspect by turning steering from stop-to-stop while observing hose position. Be sure that hose does not touch other parts at any time during steering travel.

11. Pump brake pedal to seat lining against rotor.

12. Clinch upper ears of outboard shoe by positioning 12" pliers with one jaw on top of upper ear and one jaw in notch on bottom of shoe, opposite upper ear. Fig. 5-17.

NOTE: After clinching, there should be no radial clearance between the shoe ears and caliper housing.

13. If radial clearance exists, repeat clinching procedure.

14. Install wheel and tighten mounting nuts to 100 foot-pounds torque. For steps 11 and 17 See "CAUTION", page 5-1.

15. Bleed all brakes as outlined on page 5-9.

16. Before moving car, pump brake pedal two or three times to be sure that pedal is firm.

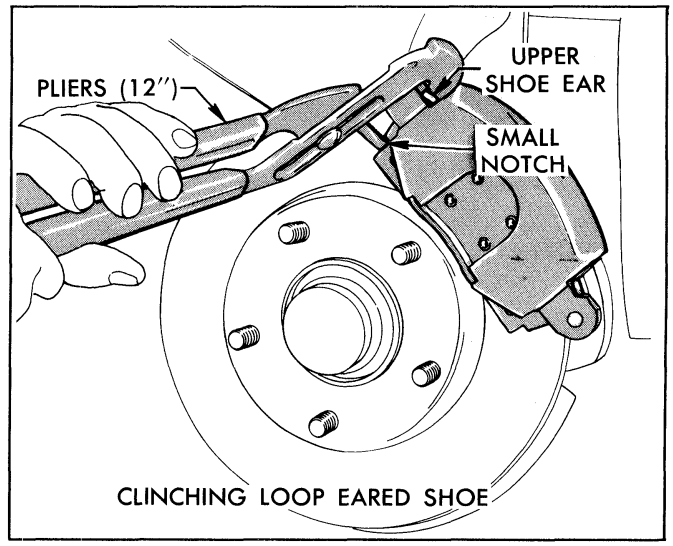


Fig. 5-17 Clinching Outboard Shoe

DISC BRAKE CALIPER DISASSEMBLY, CLEANING, INSPECTION AND ASSEMBLY (Front)

a. Disassembly

1. Clean the caliper exterior with denatured alcohol.

2. Remove shoe and lining and inspect. Refer To page 5-10.

3. Push out two sleeves from inboard ears of the caliper.

4. Remove four rubber bushings, two on inboard ears and two on outboard ears.

5. Place a pad of clean shop towels or wood block on caliper, Fig. 5-18.

NOTE: The towels or wood block will prevent damaging the piston when it is pushed out by air pressure.

6. Use service air hose to apply moderate air pressure to brake fluid inlet hole to force piston out of caliper. Keep fingers clear of piston.

CAUTION: *Use clean air only. Air supplies that are*

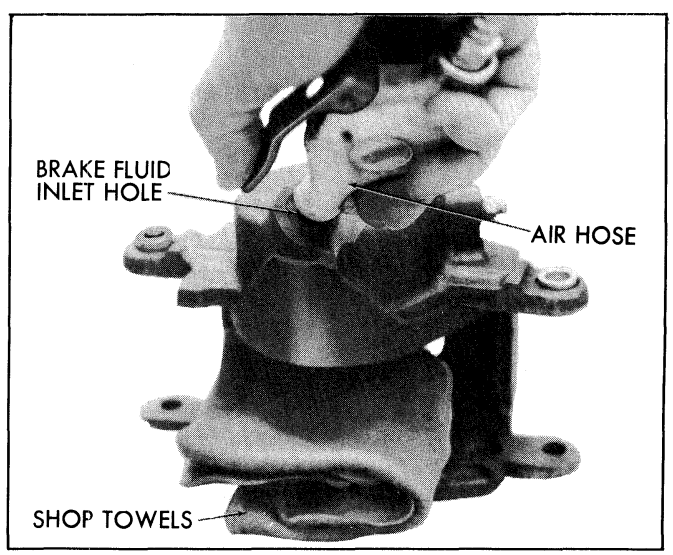


Fig. 5-18 Removing Piston

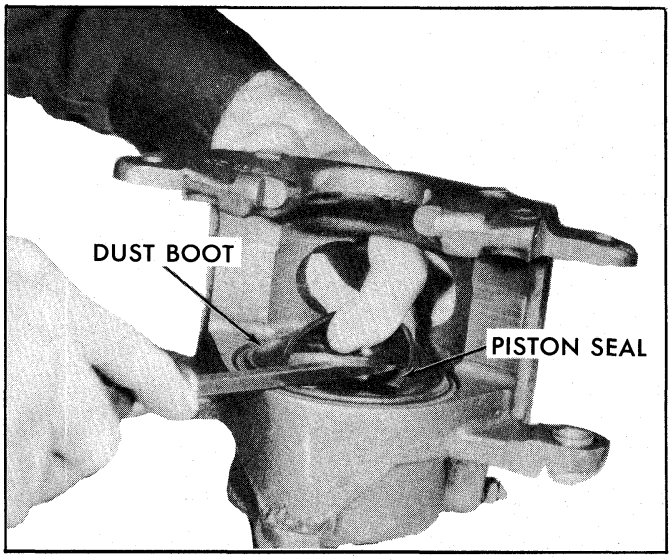


Fig. 5-19 Removing Dust Boot

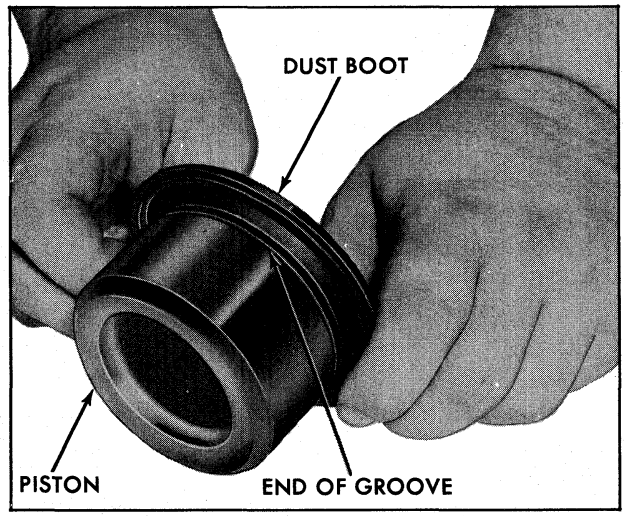


Fig. 5-20 Assembling Dust Boot on Piston

lubed or oiled contain mineral oil that will damage rubber parts.

7. Using a screwdriver, pry boot out of housing, being careful not to scratch bore, Fig. 5-19. Discard boot.

8. Using a toothpick, remove piston seal from groove in bore and discard seal.

CAUTION: *Do not use any metallic device to remove the seal, as it may scratch or damage the bore or groove.*

9. Remove bleeder fitting from caliper assembly.

b. Cleaning and Inspection

1. Inspect the piston for scoring, pitting, nicks, corrosion and worn or damaged chrome plating. If any of these faults appear, it will be necessary to replace the piston.

2. The bore should be inspected for the same faults as the piston with the exception of chrome plate. Stains or corrosion can be polished with fine crocus cloth. Wash caliper bore with clean denatured alcohol. If the faults cannot be cleaned up in this manner, it will be necessary to replace the caliper.

3. All passageways should be blown out with clean air.

c. Assembly

1. Install bleeder fitting in caliper.

2. Lubricate piston bore and new piston seal with brake fluid.

3. Position the new seal in the groove in the piston bore.

4. Assemble new dust boot on piston, so that inner diameter of boot is secured in groove and boot fold faces away from closed end of piston, Fig. 5-20.

NOTE: Do not use previously removed boot.

5. Lubricate sealing surface of piston with brake fluid. Position piston in bore and press it down to bottom of bore. Make certain dust boot does not disengage from groove in piston.

6. With dust boot evenly positioned in caliper counterbore, position Boot Installer, J-22904, on boot and tap with a plastic hammer to seat boot, Fig. 5-21.

7. Lubricate four new bushings with silicone lubricant and install bushings in caliper ears.

8. Lubricate new sleeves with silicone lubricant and install in inboard caliper ear. Position the sleeve so that end toward the shoe and lining assembly is flush with the machined surface of the ear.

HUB AND ROTOR ASSEMBLY (Front)

a. Removal

1. Remove wheel disc and loosen wheel mounting nuts on side from which hub and rotor is to be removed.

2. Raise front end of car and place jack stands under front frame side rails.

3. Remove wheel mounting nuts and remove wheel and tire.

4. Remove two bolts securing brake caliper to steering knuckle. Slide caliper off rotor and use a piece of wire to attach caliper to upper suspension arm.

CAUTION: *Never allow caliper to hang from brake hose, as damage may occur.*

5. Remove dust cap, cotter pin, spindle nut, and washer.

6. Remove outer cone and bearing assembly.

7. Remove hub and rotor assembly from steering knuckle spindle.

b. Installation

1. Install hub and rotor assembly on spindle.

2. Install bearing assembly, washer and spindle nut, tightening nut with fingers.

3. Adjust wheel bearings as in Section 3 page 3-C-6.

4. Install caliper following Steps 3 through 10 of page 5-13. Pump brake pedal two or three times to insure a firm pedal.

5. Install wheel and tire and install wheel mounting nuts finger tight.

6. Raise car, remove jack and jack stands, and lower car.

7. Tighten wheel mounting nuts to 130 foot-pounds on Eldorados, 100 foot-pounds on all others.

8. Install wheel disc.

SERVICING FRONT ROTORS

When performing any service on front disc brakes, inspect the rotor ventilation passages for obstructions, such as salt or mud build-up. Any build-up must be removed because it decreases brake cooling, which might lead to increased lining wear rate and brake shudder.

When new linings are installed, the rotor should be

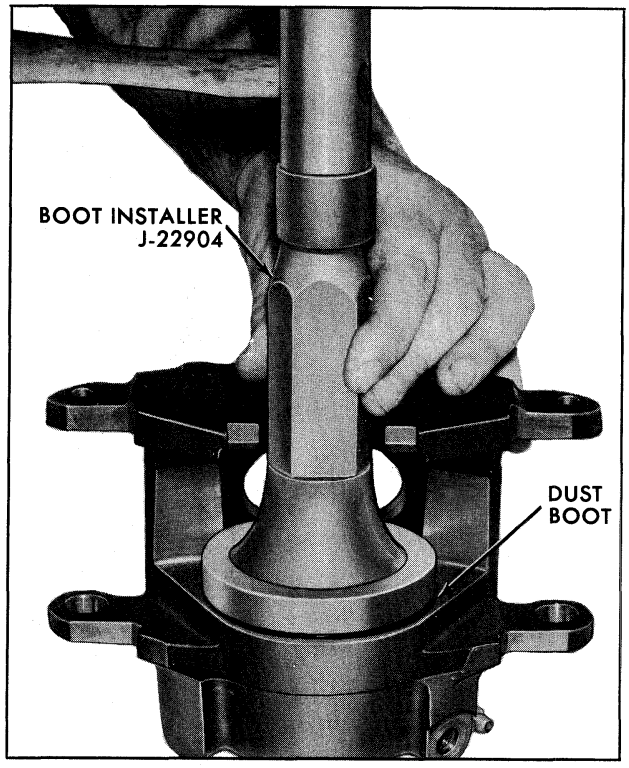


Fig. 5-21 Installing Dust Boot in Caliper

lightly sanded using a circular non-directional motion. A slight ridge of rust may form on the edge of the rotor during normal use. This ridge should be removed during the sanding operation.

Scoring of the rotor, due to advanced wear of linings, does not always necessitate replacement of the rotor. Rotors with scoring of the surface up to approximately .020 inch in depth are not detrimental to brake operation and may be used with new linings.

Once a wear pattern has been established, front disc brake cars are not as susceptible to problems occurring because of scored rotors as front drum brake cars are due to scored drums.

In normal servicing of worn lining or on caliper removal, lateral runout of the rotor need not be checked, except when brake shudder is evident.

If brake shudder develops after long periods of use, it may be caused by light surface deposits (such as lining oxides) on the braking surface of the rotor. These deposits, which appear as a dark blotch about the size of half-dollars, may be removed by sanding.

Brake shudder may be caused by excessive rotor lateral runout or out-of-parallelism.

Before checking runout and parellelism, check rotor thickness.

NOTE: Each rotor has its minimum thickness cast into the castings.

Before checking runout and parellelism, check rotor thickness. If total rotor thickness is less than (24.5mm) on Brougham and Seville cars, the rotor must be replaced. On Limousine and Commercial Chassis if total rotor thickness is less than 1.215 inch the rotor must be replaced. On Eldorado, if total thickness is less than 1.170 inch the rotor must be replaced. Some rotors may already be at minimum thickness, so the rotors must be checked before attempting a refinishing operation.

When checking runout exc. Eldorado first tighten front wheel bearing to take up end play. If lateral runout is in excess of .005 inch, or parallelism is in excess of .0005 inch, the rotor should be refinished or replaced.

On the Eldorado, lateral runout of the hub and rotor assembly must not exceed .008 inch or parallelism .0005 inch. If these specifications are exceeded, the rotor should be refinished or replaced. When checking runout on this car, the wheel nuts must be installed with the flat portion of the hex against the rotor to retain the rotor against the hub.

The hub and rotor assembly (exc. Eldorado) is a cast integral unit but the assemblies for the DeVille, Seville and Brougham are 12″ x 1″ and are not interchangeable with the 12″ x 1/4″ used on the limousine and commercial chassis.

The Eldorado rotor is not integral with its hub and it is not necessary to replace both parts. Only replace the faulty part.

NOTE: This section, page 5-15 pertains to drum brakes that are used on the DeVille, limousine and commercial chassis. The rear disc brakes used on the Eldorado, Seville and Brougham are covered on pages 5-32 to 5-56.

RELINING REAR DRUM BRAKES (Figs. 5-22 Thru 5-25)

CAUTION: *Make certain that hands are clean when handling brake parts and avoid handling friction surfaces of drums and linings as possible contamination may occur.*

1. Release parking brake, raise car, and remove rear wheels.

2. Remove rear brake drum assemblies.

3. Loosen parking brake cable locknut on equalizer.

4. Remove primary brake shoe retracting spring using Brake Spring Remover and Installer J-8049.

5. Disconnect link at anchor and remove link, secondary brake shoe retracting spring, and anchor plate.

6. Remove primary brake shoe hold-down cup, spring and pin and secondary brake shoe hold-down pin, cup and spring.

7. Remove pawl return spring, actuating lever and pawl.

8. Disengage brake shoes from wheel cylinder connecting links and parking brake strut rod. Remove strut rod and spring.

9. Disconnect parking brake cable from operating lever on left rear secondary shoe and right rear primary shoe and remove complete shoe and lining assembly from brake backing plate.

10. Remove star wheel adjuster and primary to secondary connecting spring from shoe assembly.

11. Remove parking brake operating lever from shoe

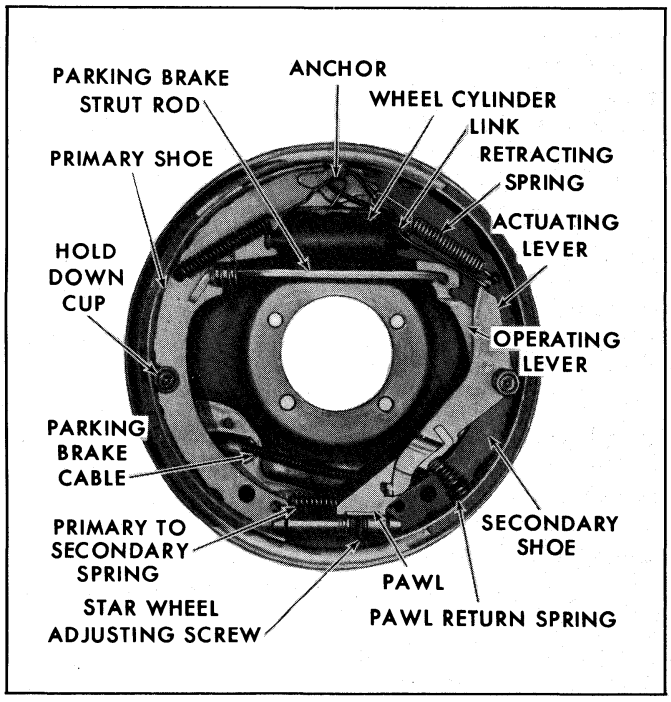


Fig. 5-22 Rear Wheel Drum Brake Mechanism LH-Limousine and Commercial Chassis

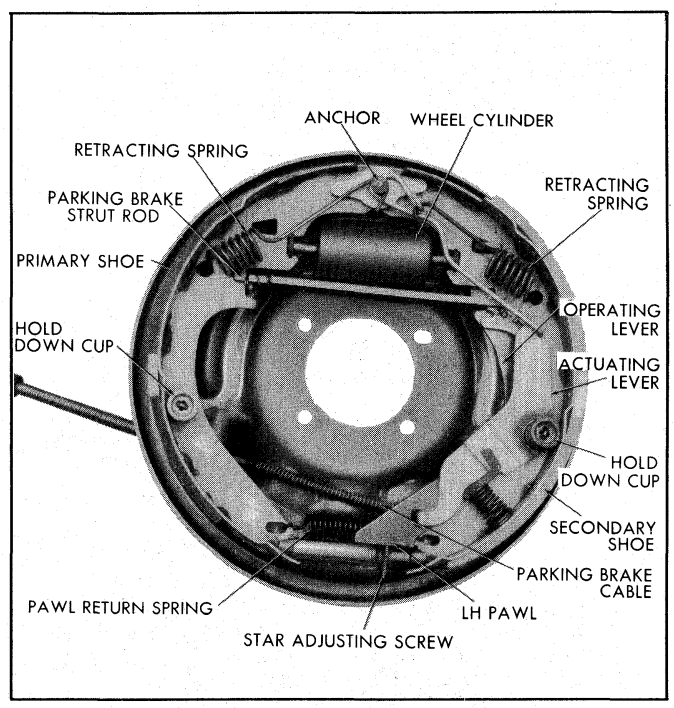


Fig. 5-24 Rear Wheel Drum Brake Mechanism LH "C" Car

assembly.

12. Clean brake backing plate and all brake parts.

13. Tighten nuts that hold backing plate to rear axle housing to 30 foot-pounds on Brougham and Seville, 60 foot-pounds on limousine and commercial chassis. See "CAUTION" on page 5-1 of this section.

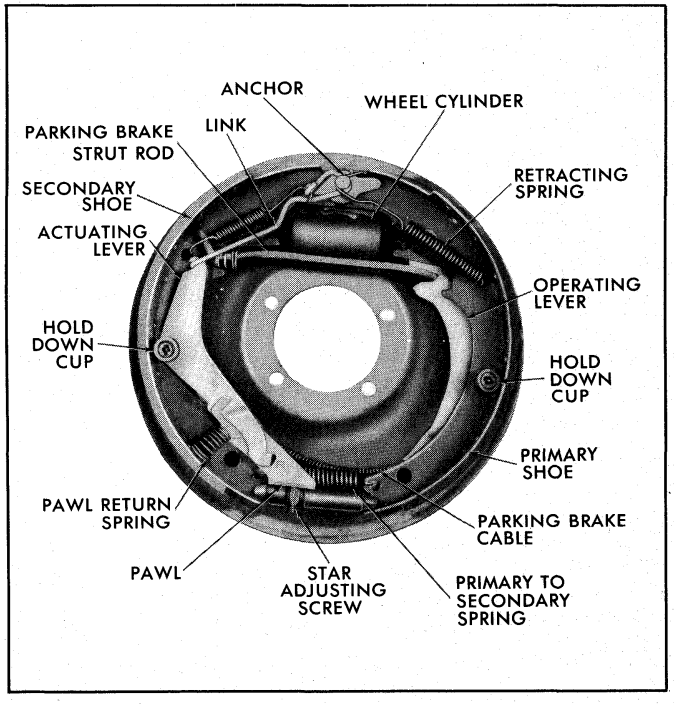


Fig. 5-23 Rear Wheel Drum Brake Mechanism RH-Limousine and Commercial Chassis

WARNING: WHEN SERVICING WHEEL BRAKE PARTS DO NOT CREATE DUST BY GRINDING OR SANDING BRAKE LININGS OR BY CLEANING WHEEL BRAKE PARTS WITH A DRY BRUSH OR WITH COMPRESSED AIR. (A WATER DAMPENED CLOTH SHOULD BE USED.) MANY WHEEL BRAKE PARTS CONTAIN ASBESTOS FIBERS WHICH CAN BECOME AIRBORNE IF DUST IS CREATED DURING SERVICING. BREATHING DUST CONTAINING ASBESTOS FIBERS MAY CAUSE SERIOUS BODILY HARM.

14. Install parking brake operating lever on replacement brake shoes.

15. Lubricate threads and socket of star wheel adjuster and points of contact between brake and other brake parts with a heat resistant lubricant, part number 1050110 or its equivalent. Use sparingly, especially on brake shoe pads.

16. Thread star wheel adjusting screw completely into pivot nut to permit installation of brake drum over replacement brake shoes.

17. Install star wheel adjuster and primary-to-secondary connecting spring on brake shoes. Make certain that star wheel rotates in proper direction. Star wheel adjusters with three wide grooves on O.D. of pivot nut (left hand threads),

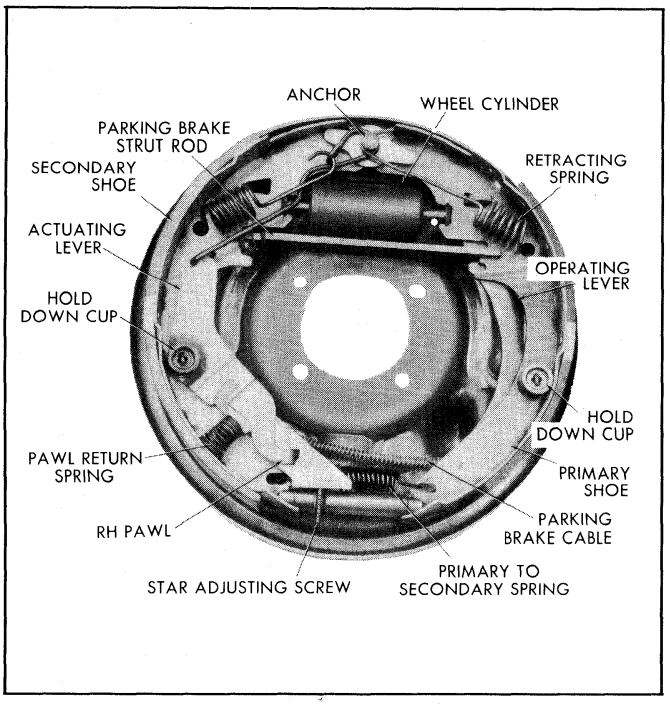


Fig. 5-25 Rear Wheel Drum Brake Mechanism RH "C" Car

Fig. 5-26 and 5-27 are installed on right side of car and those with three narrow grooves on O.D. of pivot nut (right hand threads) must be installed on left side.

18. Position shoe assemblies on brake backing plate and connect parking brake cable to operating lever.

19. Install parking brake strut rod and spring on brake shoe assembly. See chart below for proper spring identification.

20. Engage shoes with wheel cylinder connecting links and install hold-down pin, cups, and spring on primary brake shoe.

21. Position actuating lever and pawl so that actuating lever is on top of secondary brake shoe. Secure with hold-down pin sleeve, spring and cup.

22. Install shoe guide plate, link, and secondary brake shoe retracting spring. See chart below for proper spring identification. For easiest installation first connect spring to link then install link on anchor using brake Spring remover and Installer, J-8049.

23. Install pawl return spring. Make certain that star wheel engages pawl.

24. Install primary brake shoe retracting spring using Spring Installer, J-8049. See chart below for proper spring identification.

25. Perform preliminary service brake adjustment as described on page 5-9.

26. Install rear brake drums on rear axle shaft flange.

27. Install wheels on brake drums. Tighten wheel mounting nuts to 100 foot-pounds.

See "CAUTION" on page 5-1 of this section.

28. Adjust parking brake as described on page 5-10.

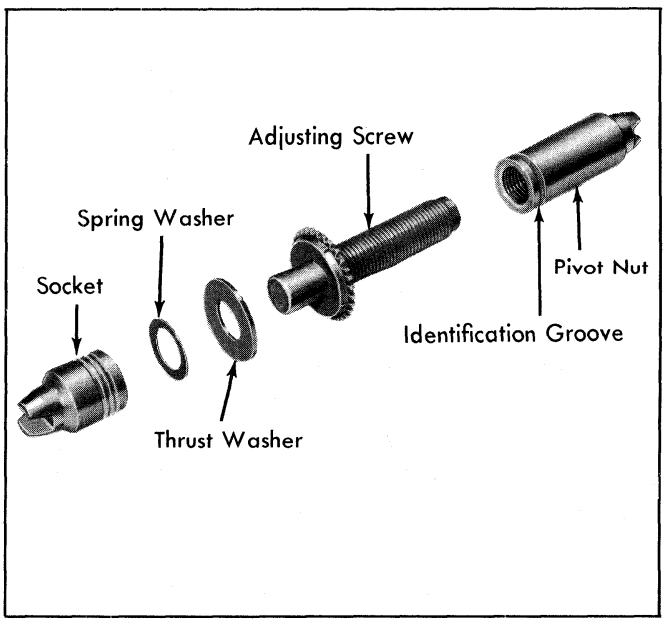


Fig. 5-26 Star Wheel Adjuster Disassembled-Limousine and Commercial Chassis

MACHINING BRAKE DRUMS (Fig. 5-28)

a. Warped or Scored

Brake drums should be carefully checked to see if they have become warped or scored excessively. If they appear salvageable and if suitable equipment is available, they can be machined.

Drum machining is a precision operation. Equipment used for this purpose must be capable of maintaining the close limits specified. Be sure to install drum in the machining equipment correctly and to check runout of lathe spindle to insure accuracy of final machining operation. Inside drum diameter must not be machined over 11.060 inches on DeVille Cars and not over 12.060 inches on all other cars. Should brake drums be machined too thin, the intense heat

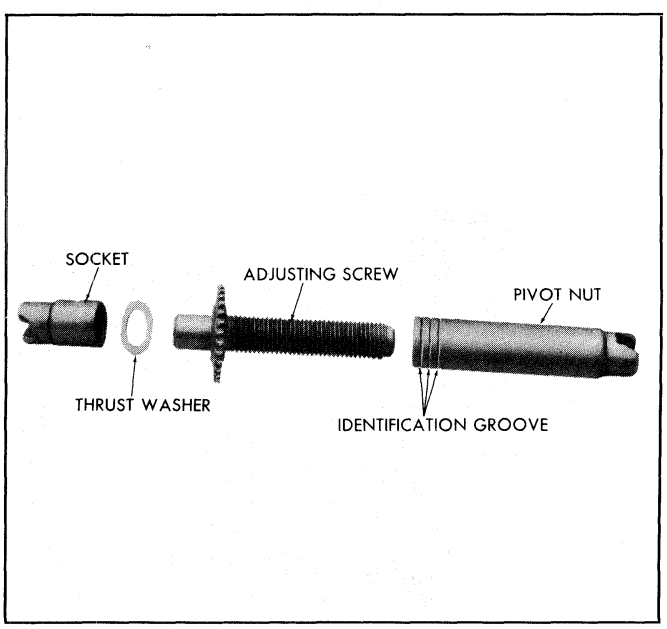


Fig. 5-27 Star Wheel Adjuster Disassembled - C-Car

BRAKE SPRING APPLICATION CHART

	DeVille		Limo and Commercial	
	LH 11" x 2"	RH 11" x 2"	LH 12"x2½"	RH 12"x2½"
Primary Return	Orange	Orange	Maroon	Maroon
Secondary Return	Unpainted	Unpainted	Yellow	Unpainted
Primary Hold Down	Unpainted	Unpainted	Gray	Gray
Secondary Hold Down	Unpainted	Unpainted	Green	Green
Park Brake Strut	Unpainted	Unpainted	Lt. Blue	Lt. Blue

that develops under severe driving conditions will cause them to distort, crack or warped.

In addition, the specification listed on page 5-43 must be held.

Replacement brake drums supplied by your servicing Parts Warehouses are machine-finished at the factory before being shipped. They do not require any further finishing before installation, but they must be thoroughly cleaned with a non-oil base solvent to remove all traces of the oil or grease used for rust-proofing during storage and transit. Do not machine drums to roughen the braking surface. Use coarse emery cloth for this purpose.

b. Brake Shudder (With Drum Brakes)

Brake shudder may be experienced during light pedal application just as the car is braked to a stop. The shudder, sometimes called "footballing", chatter, or surge, may be caused by improper fit of the rear brake drum to the rear axle shaft, resulting from the mounting face of the drum being out-of-flat.

The out-of-flatness and resultant roughness or "footballing" condition of the rear brake drums can usually

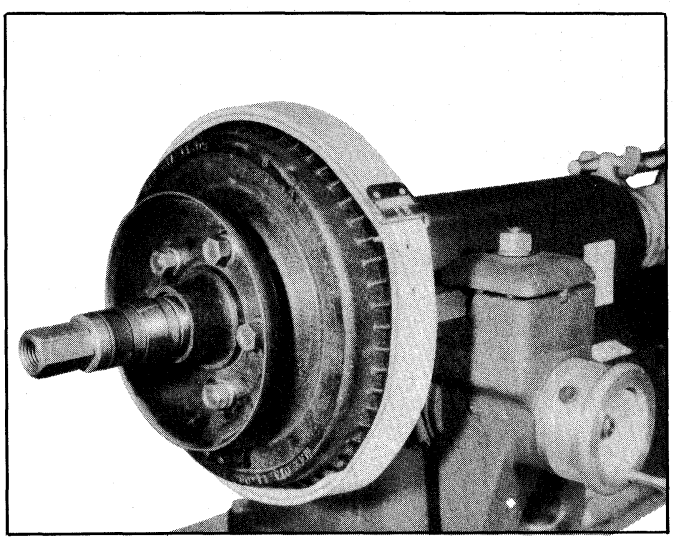


Fig. 5-28 Assembly Mounted on Lathe

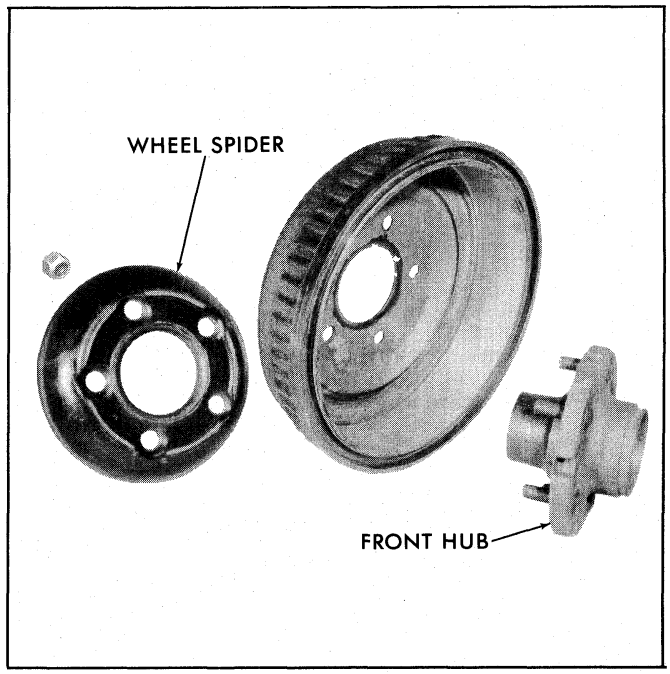


Fig. 5-29 Assembling Spider Hub to Drum

be eliminated by turning the suspected drum while it is clamped between a front wheel hub and a wheel spider assembly, Fig. 5-29.

The entire procedure for drum-turning is as follows:

1. Wipe drum inner mounting surface and front hub surface clean of all metal chips, dust or foreign matter.
2. Install drum causing roughness or shudder between front hub, and wheel spider section, Fig. 5-29 securing with five wheel attaching nuts. Torque nuts to 50 foot-pounds, using a criss-cross pattern of tightening.
3. Turn drum on a lathe in usual manner that a drum would be turned, Fig. 5-30.
4. After turning drum, unbolt assembly and remove drum. Drum is now ready for installation on car and roadtesting to confirm correction of brake roughness or shudder.

This procedure can be used for all Cadillac rear drums that exhibit brake shudder, and all past model front drums regardless of the make of drum.

NOTE: Front drums of past models have the hub assembled so only the wheel spider need be mounted on these drums before turning.

Though the front wheel, tire, hub and drum of past models can be removed from the car as an assembly and turned as an assembly on some lathes, it is recommended the tire and wheel assembly be removed from the drum and the wheel spider be installed before turning. This permits greater ease of handling and places less weight on the drum lathe spindle bearings.

WHEEL CYLINDER SERVICING

a. Removal

1. Raise car and remove wheel and brake drum. Vacuum out dust and dirt from drum and linings.
2. Disconnect hydraulic brake piping from wheel cylinder.
3. Remove brake shoe retracting springs and link.
4. Remove two screws holding wheel cylinder to backing

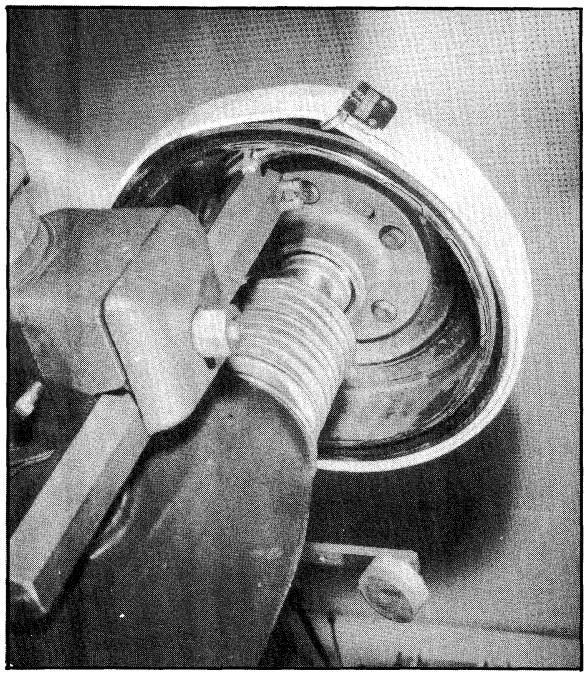


Fig. 5-30 Turning Drum

plate.

5. Disengage wheel cylinder connecting links from brake shoes and remove wheel cylinder.

CAUTION: *Be sure brake fluid does not drip on brake lining, as fluid may damage linings.*

b. Disassembly (Fig. 5-31)

1. Remove connecting links and rubber boots from ends of wheel cylinder.
2. Slide pistons and piston cups from either end of cylinder.
3. Remove piston cups, spring and expander assembly.
4. Remove bleeder screw assembly.

c. Cleaning and Parts Replacement

With clean hands, wash all parts except pistons in clean alcohol. Wipe pistons with clean dry cloth. Inspect surface of cylinder bore and hydraulic passages. Replace wheel cylinder if any obstructions are observed in holes or if there are any nicks or burrs in bore.

If it is necessary to replace any of the wheel cylinder assembly parts, refer to parts book for replacement parts.

d. Assembly (Fig. 5-31)

1. Install bleeder screw assembly.
2. Install piston cup in one end of cylinder with lip toward center, and install piston with flat side toward cup.
3. Install rubber boot into end of wheel cylinder.
4. Install spring and expander assembly.
5. Install other piston cup, lip toward center. Install piston, flat side toward cup.
6. Install remaining rubber boot into end of cylinder.

e. Installation

1. Position wheel cylinder on brake backing plate, slipping cylinder-to-shoe connecting links in place at same time.
2. Install two screws holding wheel cylinder to backing plate. Tighten to 15 foot-pounds maximum torque.

See "CAUTION" on page 5-1.

3. Install brake shoe retracting springs and link.

NOTE: Avoid handling friction surfaces of drums and linings.

4. Connect brake piping to wheel cylinders.
5. Install brake drum and wheel assembly and torque wheel mounting nuts to 100 foot-pounds.
6. Bleed all brakes as described on page 5-9.

PARKING BRAKE PEDAL ASSEMBLY

a. Removal

1. Remove steering column lower cover as explained on page 8-4.
2. Place parking brake pedal in release position. Set transmission shift lever in Park position.
3. Working underneath car, remove equalizer nut and

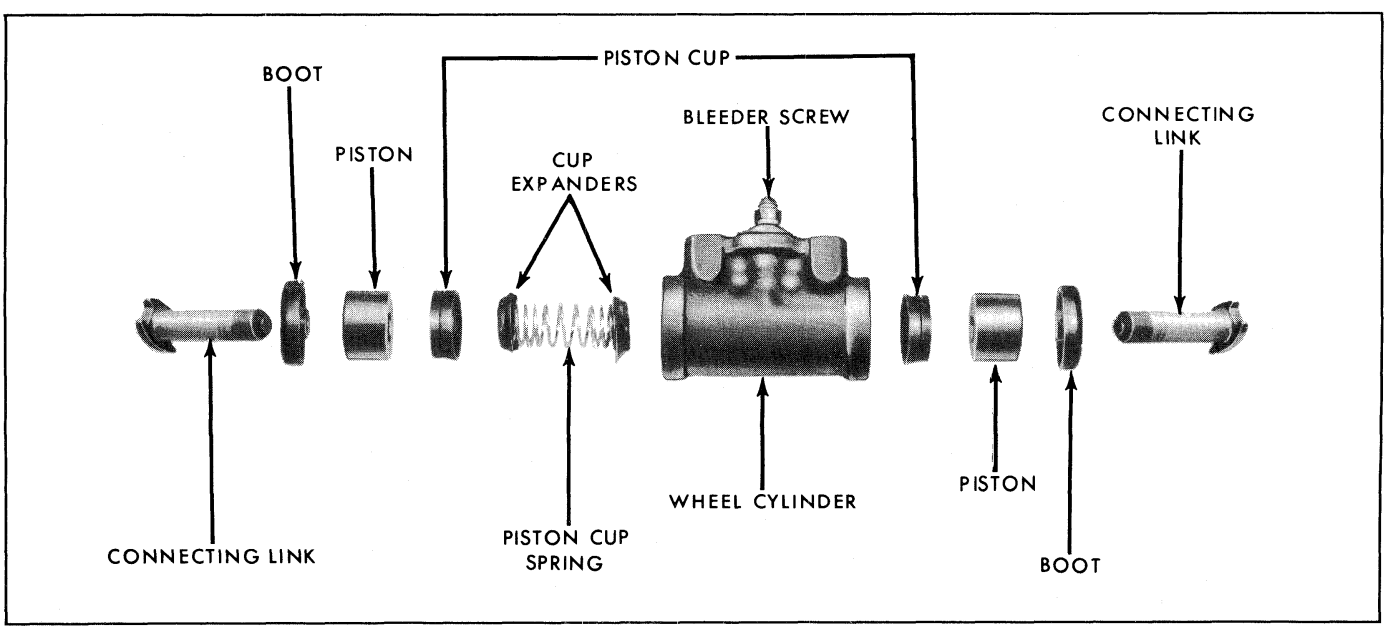


Fig. 5-31 Wheel Cylinder Disassembled

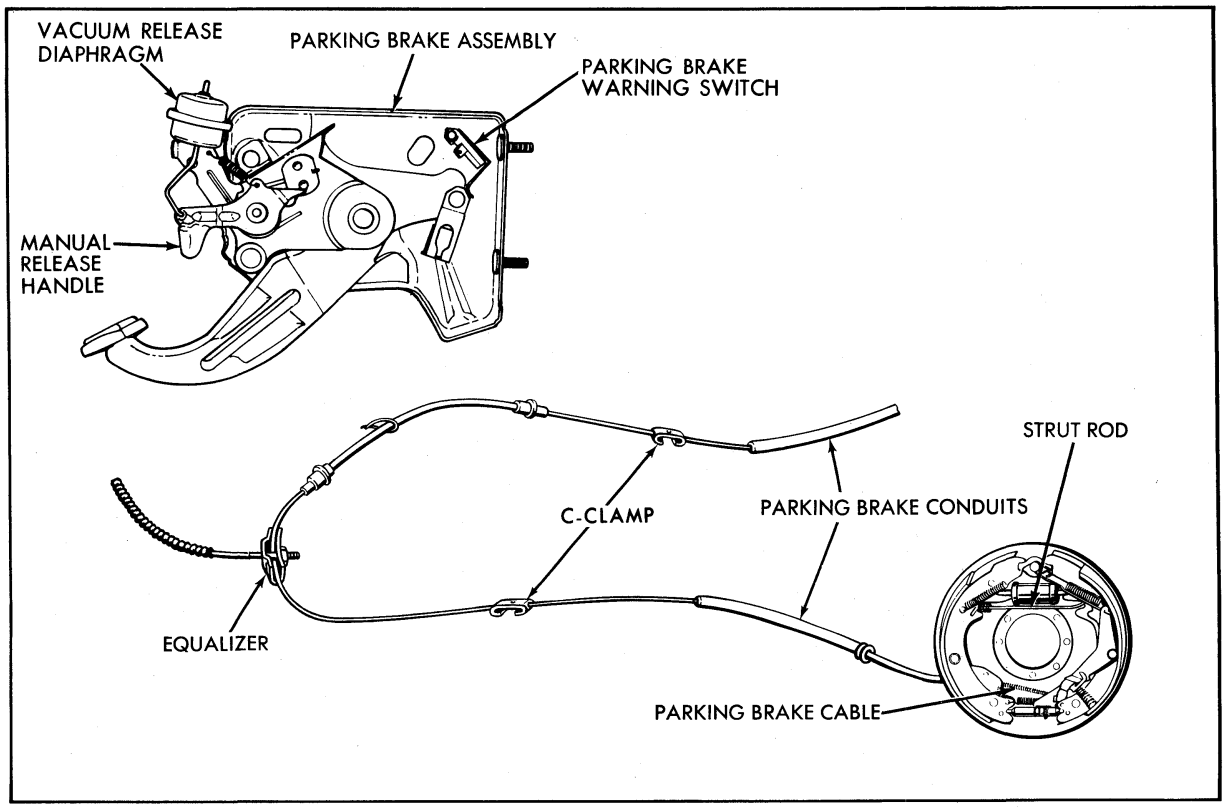


Fig. 5-32 Parking Brake Cable

washer and separate cable stud from equalizer and front cable from "C" connector.

4. Disconnect parking brake vacuum hose at cylinder and park brake light switch wire connector.

5. Working from under hood remove two parking brake assembly-to-cowl mounting nuts.

6. Remove one parking brake assembly-to-instrument panel mounting bolt and move assembly away from cowl.

7. Position brake pedal lever so that clevis on parking brake assembly is exposed, and remove brake cable end from clevis and conduit from bracket.

b. Installation

1. Position parking brake pedal so that clevis is exposed, and attach parking brake cable to clevis on parking brake assembly and conduit to bracket. Secure with retainer.

2. Install parking brake assembly and secure to cowl with two mounting nuts.

3. Install one parking brake assembly-to-instrument panel mounting bolt.

4. Connect hose to parking brake vacuum cylinder.

5. Connect parking brake switch wire.

6. Insert front cable through "C" connector and secure R.H. cable stud on equalizer Fig. 5-32.

7. Install equalizer nut.

8. Adjust parking brake as described on page 5-10.

9. Check operation of automatic release.

10. Install steering column lower cover, as explained on page 8-4.

PARKING BRAKE VACUUM DIAPHRAGM

a. Removal

1. Remove parking brake pedal assembly as described on page 5-19.

2. Remove one screw that retains cylinder and bracket to parking brake assembly.

3. Detach link that connects cylinder to manual release lever and remove cylinder.

b. Installation

1. Secure link to manual release lever.

2. Position cylinder and bracket on parking brake assembly and secure with screw.

3. Install parking brake assembly as described on page 5-20.

4. Connect park brake light switch wire, to switch.

5. Test lock and automatic release operations with engine running in Neutral and Drive ranges.

NOTE: Parking brake should release in any drive range with engine running, and should remain engaged in Neutral and Park with engine running and "brake" light should light with park brake applied and ignition in run position.

PARKING BRAKE CABLE (Fig. 5-32)

a. Removal (Front Cable)

1. Release parking brake.

2. Disconnect cable stud at equalizer by removing equalizer nut and separating cable stud from equalizer.

3. Remove front cable from "C" connector.

4. Remove retainer at frame.

5. Remove retainer at pedal assembly.

6. Remove cable end from parking brake assembly clevis.

7. Pull cable through hole in frame and remove from car.

b. Installation (Front Cable)

1. Insert cable through hole in body.
2. Install cable end into clevis in pedal assembly.
3. Install retainer at pedal assembly.
4. Install cable grommet into hole in body.
5. Insert cable through hole in frame.
6. Install retainer.
7. Connect cable to left rear cable at "C" connector.
8. Connect cable stud at equalizer by installing nut.
9. Adjust parking brake as outlined on page 5-10.

c. Removal - Rear Cables (Except Eldorado)

1. Release parking brake.
2. Raise rear of car and place on jack stands.
3. Remove rear wheel and drum on same side of car as parking brake cable being replaced.
4. Remove equalizer nut and retainer. Separate equalizer from right rear cable stud.
5. Remove end of left rear cable from "C" connector and equalizer.
6. Remove clip securing right rear cable to control arm bracket and remove cable from bracket by pulling rearward.
7. Remove cable from brake backing plate.

NOTE: Removal can be assisted by compressing multiple prong retainer with worm screw hose clamp.

8. Remove pawl spring and pawl lever from actuating lever.
9. Remove cable end from operating lever, and remove cable from backing plate.

d. Installation–Rear Cables (Except Eldorado)

1. Route cable end through rear of backing plate and install on operating lever.
2. Install pawl lever and pawl spring.
3. Position parking brake cable clamp against backing plate on limousine and Commercial Chassis only.

See "CAUTION" on page 5-1 of this section.

4. Install cable ends through back plate (DeVille).

NOTE: Pull on cable and check operation of cable and brake shoes by pulling on front end of cable to be sure cable is not bound.

5. Route left cable over top of left rear suspension lower control arms.
6. Insert cable through hole in equalizer bracket and secure with clip.
7. Install left hand cable end in "C" shaped connector.
8. Route right rear cable out rear exit hole on backing plate, along right rear axle tube, across axle cover over left axle tube to anchor hole on left lower front control arm bracket. Install right rear cable in clip on right rear spring seat and rear axle cover clip at 12 o'clock position.
9. Connect cable stud to equalizer bracket.
10. Install rear drum and wheel and torque with mounting nuts to 100 ft. lbs.
11. Adjust parking brake as described on page 5-10.

BRAKE COMBINATION VALVE (Except Eldorado)

a. Removal

1. Disconnect wiring connector from valve.
2. Disconnect three brake pipes from valve.
3. Remove two bolts securing valve to frame or bracket and remove valve.

b. Installation

1. Position valve to frame or bracket and secure with two bolts.
2. Install brake pipes to valve.
3. Connect wiring connector to valve.
4. Bleed brakes as described on page 5-9.

NOTE: The brakes should be bled in the usual manner. Then, before driving car be sure a firm pedal is obtained.

SERVICING HYDRAULIC BRAKE HOSES AND PIPING (Fig. 5-33)

The brake system should be checked visually each time the car is lubricated. When the car is raised on a lift for lubrication, brake lines, hoses, and cables should be inspected for proper attachment, leaks, cracks, chafing, deterioration, etc.

The brake hoses should be carefully inspected for cracks in the rubber cover (360° around) at either end of the hose near the fittings by flexing the hose while inspecting it. Adequate lighting and a mirror are essential tools for a good inspection. This inspection is made easier by steering the wheels to a full turn and/or removing the front wheels. If any cracks, chafing, or leaks of the brake hose are detected, the brake hose should be replaced.

a. Removal - Hydraulic Brake Hose (Front Wheels Exc. Eldorado)

1. Disconnect steel brake line from hose. Cap fitting to prevent dirt from entering brake line.
2. Remove U-shaped retainer from hose fitting and withdraw hose from frame support bracket.
3. Remove brake hose mounting bolt, discard copper gaskets. If hose is to be reinstalled, cover end fittings to prevent dirt entering hose.

b. Installation - Hydraulic Brake Hoses (Front Wheels Exc. Eldorado)

1. Install new copper gaskets on brake hose mounting bolts. Tighten bolts in caliper inlet to 30 foot-pounds maximum torque.
2. Install U-shaped retainer to secure hose in frame support bracket.
3. Place steel tube connector nut in hose fitting and tighten to 20 foot-pounds maximum torque.
4. Bleed all brakes as outlined on page 5-9.

c. Removal - Hydraulic Brake Hose (Front Wheels Eldorado)

1. Disconnect Steel brake line from hose. Cap fitting to prevent dirt from entering brake line.
2. Remove U-shaped retainer from hose fitting and withdraw hose from frame support bracket.
3. Turn hose fitting out of caliper inlet and remove copper gasket. Discard gasket. If hose is to be reinstalled, cover end fittings to prevent dirt from entering.

d. Installation - Hydraulic Brake Hoses Front Wheels - Eldorado

1. Install new copper gasket on caliper end of hose (male end). Tighten hose in caliper inlet to 30 foot-pounds maximum torque.

CAUTION: *Never tighten hose in caliper inlet with hose attached at frame ends as this will twist the hose and could cause damage.*

2. With suspension in normal position (front wheels straight ahead) pass female end of hose through frame support bracket, allowing hose to seek its own position. Insert

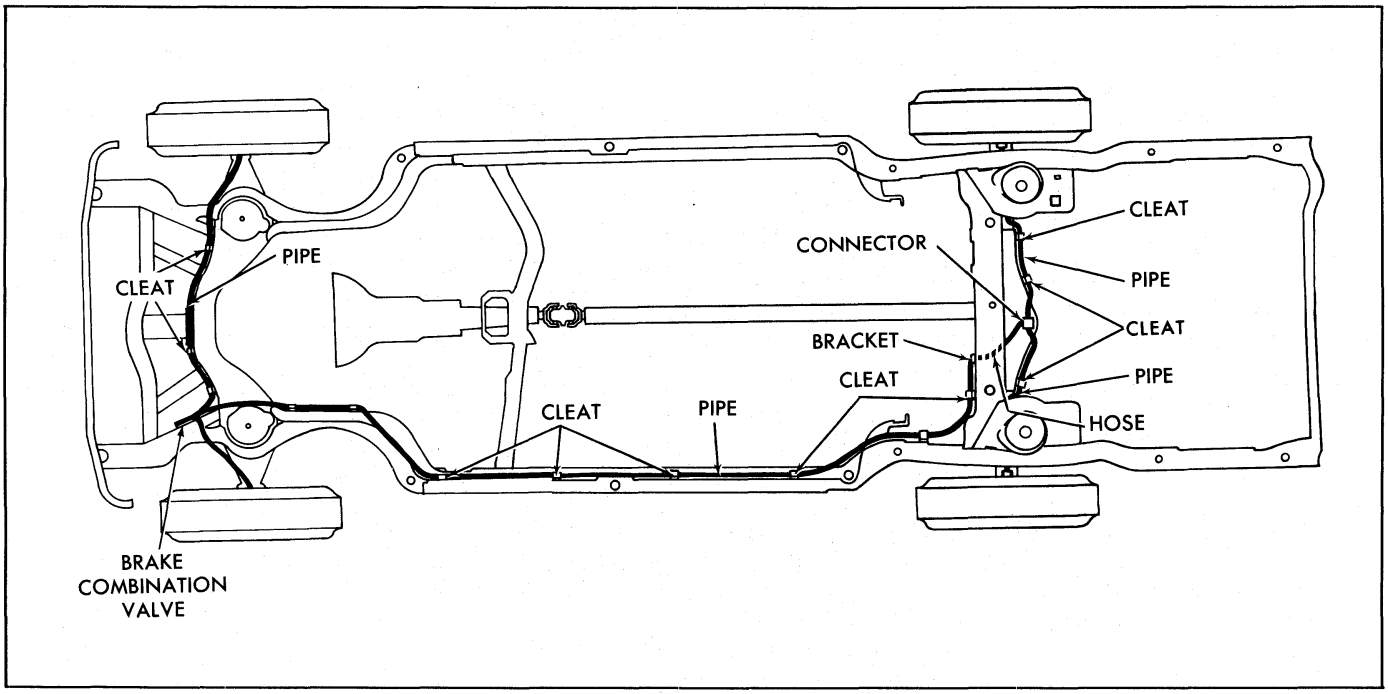


Fig. 5-33 Hydraulic Brake Lines

hex of hose fitting into the 12-point hole in support bracket in position that will require the least twist in hose.

NOTE: Do not twist hose any more than necessary during this operation as its natural curvature is essential to maintain proper hose-to-suspension clearance through full movement of suspension and steering parts.

3. Install U-shaped retainer to secure hose in frame support bracket. On Eldorado, install hose and clip on upper spherical joint stud. Install nut torque to 60 foot-pounds and insert cotter pin.

4. Inspect by turning steering from stop-to-stop while observing hose position. Be sure that hose does not touch other parts at any time during steering travel. If contact does occur, remove hose retainer and rotate female hose end in support bracket one or two points in appropriate direction, replace retainer, and reinspect.

5. Place steel tube connector nut in hose fitting and tighten to 20 foot-pounds maximum torque.

6. Bleed all brakes as outlined on page 5-9.

e. Removal - Hydraulic Brake Hose (Rear Wheels)

1. Disconnect brake pipes from hose. Cap pipes to prevent entry of dirt or foreign matter into system.

2. Remove retainer securing forward end of hose to frame or bracket.

3. Remove screw securing hose to axle or bracket.

f. Installation - Hydraulic Brake Hose (Rear Wheels)

1. Thread rear axle pipe nuts into hose.

2. Install brake hose mounting screw and torque to 12 foot-pounds.

3. Pass forward end of hose through mounting hole in frame or bracket allowing hose to seek its own position. Insert key end of hose fitting into key shape hole in frame or bracket and install retainer.

4. Remove line caps and tighten pipe nuts to 20 foot-pounds maximum torque.

5. Bleed brakes as described on page 5-9.

g. Removal - Hydraulic Brake Piping (Rear Wheels)

1. Disconnect steel brake piping at rear wheel cylinder fitting. Cap fitting to prevent dirt from entering wheel cylinder.

2. Disconnect brake piping at brake hose on axle housing.

3. Unbend the welded retainer(s) on axle housing,

h. Installation - Hydraulic Brake Piping (Rear Wheels)

1. Install steel piping on welded retainers.

2. Connect piping at brake hose and tighten to 20 foot-pounds maximum torque.

3. Connect piping at wheel cylinder fitting, tightening to 20 foot-pounds maximum torque.

4. Bend welded retainer(s) over piping enough to secure, being careful not to damage brake piping.

NOTE: Realign brake lines to original positions. Do not leave brake lines misrouted.

HYDRAULIC BRAKE TUBING

Hydraulic brake tubing is a double layer annealed steel terne plate tubing which resists corrosion and has the physical strength to stand up under the high pressures which are developed when applying the brakes. In making up hydraulic brake pipes, it is recommended that Flaring Tool No. J-23530 be used to double-lap flare the ends of the tubing. Unless the tubing is properly flared, the connections may leak and the brakes could become ineffective.

CAUTION: *When necessary to replace brake tubing, always use special steel tubing which is designed to withstand high pressure and resist corrosion. Ordinary copper tubing is not satisfactory and should not be used.*

This safety steel tubing must be double-lap flared at the ends in order to produce a strong leak-proof joint.

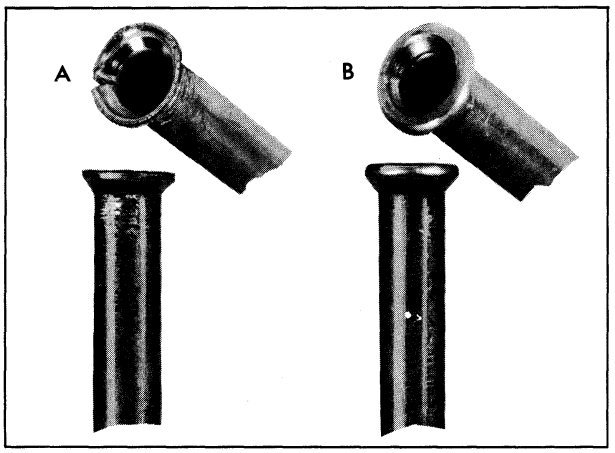


Fig. 5-34 Single and Double Lap Flare

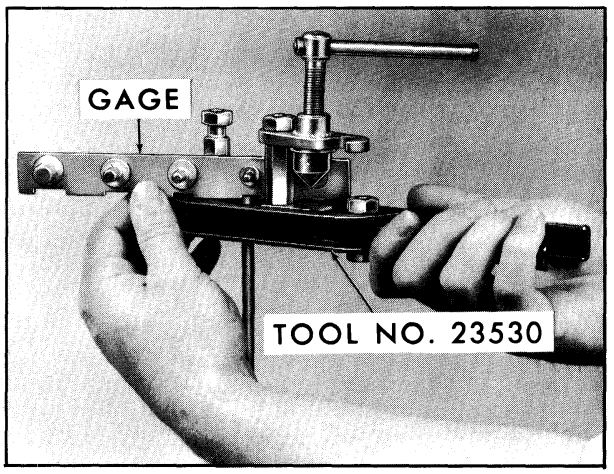


Fig. 5-35 Placing Tubing in Tool

Figure 5-34 shows two pieces of tubing, one with single-lap flare "A" and the other with double-lap flare "B". It will be noted that the single-lap flare in "A" split the tubing while the one shown in "B" is well-formed and unbroken due to the reinforcement of the double wall.

The following procedure should be followed in making up hydraulic brake pipes.

DOUBLE LAP FLARING

1. Cut the tubing to the desired length.
2. Cut end square and clean burrs from inside and outside of tubing to be flared.
3. Using Tool No. J-23530, unscrew compression screw until swivel cone is at its highest point; swing strap to one side.
4. Open lever handle so it is at right angle to rest of tool, and revolve hexagonal tube clamps to accommodate tubing. (Selection of six sizes).
5. Be sure tubing nut is properly placed on tubing. Insert end of tube between two blocks until level with top of gage, Fig. 5-35.
6. Insert proper pin of gage into tubing and swing strap back in closed position. Tighten compression screw until gage bottoms on tool, Fig. 5-36 then unscrew compression screw and swing strap to one side. Remove gage.
7. Swing strap back in closed position, then tighten compression screw to flare cone downward to complete double-lap flare, Fig. 5-37.
8. Unscrew compression screw and open smaller lever handle to remove tubing.
9. Inspect flared ends for splits, cracks, pits or excessive out of round which may cause leaks.
10. Blow tubing out with dry compressed air to remove any foreign objects.

POWER BRAKE UNIT

a. Removal

1. Disconnect master cylinder, Fig. 5-38. Plug master cylinder to prevent fluid loss.
2. Disconnect vacuum hose from vacuum check valve on power head.
3. Remove steering column lower cover as described on page 8-4.
4. Remove retainer and washer that attach power unit push rod to brake pedal arm.
5. Remove any three of four nuts securing power unit to cowl and loosen fourth nut.
6. Working in engine compartment, free power unit from cowl.
7. Disconnect brake unit push rod from brake pedal arm. Remove spring spacer from brake pedal arm.
8. Remove remaining nut retaining power unit to cowl, and remove power unit gasket from engine compartment.

b. Installation

1. Position power unit and gasket.
2. Working inside passenger compartment, loosely install four nuts retaining power unit to cowl.
3. Install spring spacer, push rod and washer on brake pedal arm and secure with retainer.
4. Tighten four nuts that hold the power unit to 16 foot-pounds.
5. Position master cylinder to power unit, install two

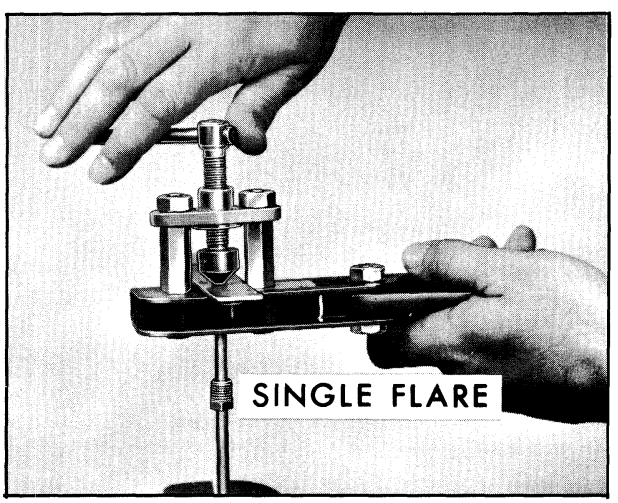


Fig. 5-36 Preparing for Double Lap

nuts and tighten to 20 foot-pounds.

6. Install steering column lower cover as described on page 8-4.

7. Connect vacuum hose and check valve to power unit.

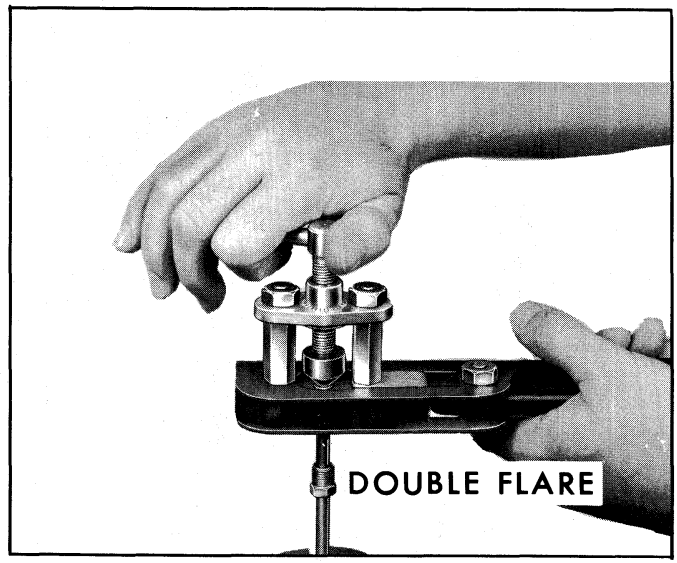


Fig. 5-37 Completing Double Lap Flare

UNIT OVERHAUL

MASTER CYLINDER DISASSEMBLY, CLEANING, INSPECTION AND ASSEMBLY (Fig. 5-39)

a. Disassembly

NOTE: If trouble has been traced to hydraulic system, master cylinder may be removed from power head without removing power head from car. Area surrounding master cylinder mounting surface must be kept clean.

1. Disconnect and cap front and rear brake lines if not done previously. Plug master cylinder outlets to prevent fluid loss.

2. Remove two self-locking nuts that hold master cylinder to power head and remove master cylinder.

3. Pry bale type retainers off of reservoir cover, and remove reservoir cover and seal. Drain brake fluid from reservoirs.

4. Remove seal from reservoir cover.

5. Remove lock ring from open end of master cylinder and remove rear piston assembly, Fig. 5-39.

6. Firmly rap master cylinder on a block of wood until floating piston drops in bore and remove front (floating) piston assembly, retainer and spring.

CAUTION: *Check progress of floating piston dropping in bore to avoid striking piston on wood. If floating piston sticks in bore, blow dry compressed air through front brake outlet hole to force piston out.*

7. Place master cylinder in vise with outlet holes up being careful not to damage reservoir seal surface of casting.

8. Remove the primary seal, and secondary seals from the front (floating) piston.

9. Remove piston extension screw from center of floating piston stop and remove floating piston stop and spring from rear piston.

NOTE: If necessary, grasp the unfinished piston body immediately under flange containing holes with a pair of pliers to remove piston extension screw.

10. Remove spring retainer, primary seal, and secondary seal from the rear piston.

b. Cleaning and Inspection

1. Inspect master cylinder bore for scoring, pitting or etching. Any of these will require replacement of master cylinder casting.

2. Examine fluid reservoir for foreign matter, and check all passages for restrictions. If there is any suspicion of contamination or evidence of corrosion, completely flush hydraulic system, using clean brake fluid.

NOTE: A grease like silicone substance may be found

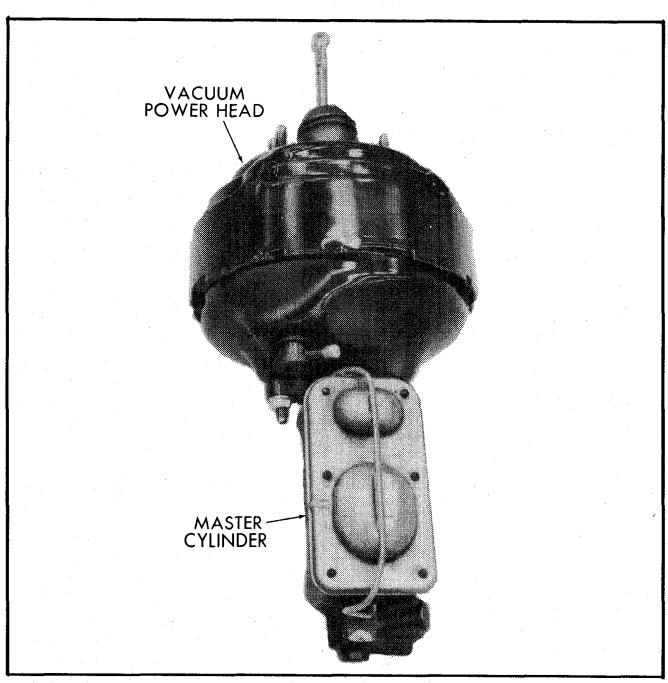


Fig. 5-38 Vacuum Power Brake Unit

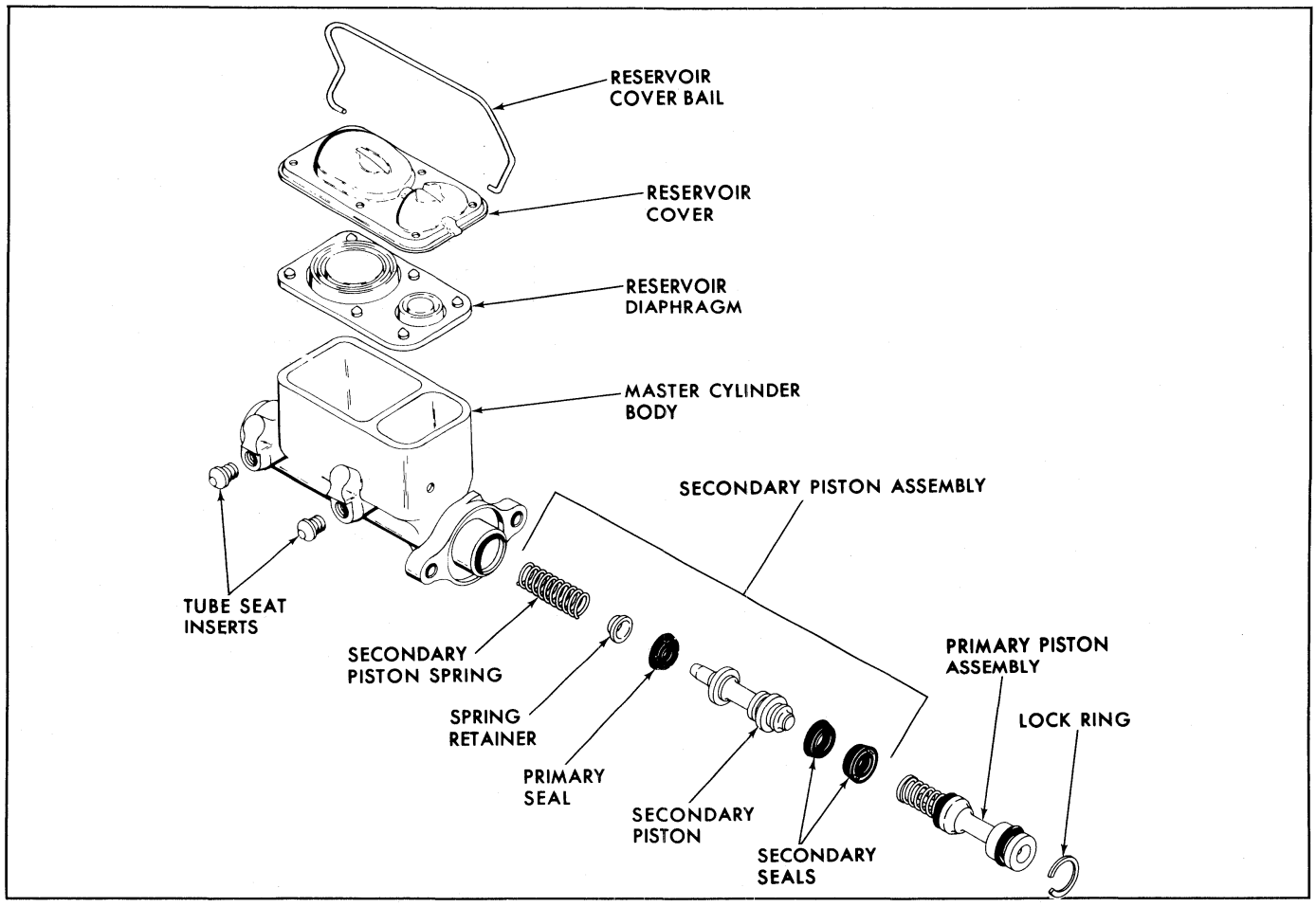


Fig. 5-39 Master Cylinder Disassembled

inside the brake master cylinder when it is being overhauled. This substance is used by the manufacturer as a lubricant to provide smooth brake actuation. It is a normal condition and need not be cleaned out of the master cylinder before reassembly.

3. Inspect floating piston for severe scoring, pitting, or distortion. Any of these will require replacement of master cylinder assembly.

4. Thoroughly wash all parts (except the inside of master cylinder) in clean alcohol, including new parts to be used in assembly of master cylinder but do not wash silicone out of master cylinder.

CAUTION: *Use of gasoline, kerosene, or any cleaner with even a trace of mineral oil can damage rubber parts.*

5. Use air hose to blow out all passages, orifices, and valve holes. Air dry and place cleaned parts on clean paper or lint-free cloth.

6. When overhauling a master cylinder, use all parts furnished in master cylinder repair kit.

c. Assembly

Be sure all parts are clean before assembling master cylinder. Do not let grease or mineral oil come in contact with any rubber parts.

1. Lubricate rubber parts with clean brake fluid.

2. Install new secondary seal in center groove of floating piston. Lip of seal should face toward the end of the piston where the primary seal is to be installed.

3. Install new secondary seal in groove at end of floating piston, back-to-back with secondary seal in center groove, Fig. 5-39 so that lip faces toward that end.

4. Install primary seal over end of floating piston opposite secondary seals.

5. Install "O" Ring Seal in groove on push rod end of rear piston.

6. Install primary seal on opposite end of rear piston.

7. Position spring retainer on one end of rear piston spring and floating piston stop on other end.

8. Position spring assembly on rear piston with spring retainer seated inside lips of primary seal.

9. Insert piston extension screw in center of floating piston stop.

10. Compress primary piston spring and start piston extension screw in hole in end of piston, release spring and turn down screw. Torque to 7-8 foot-pounds to bottom shoulder on screw against retainer.

11. Position retainer in floating piston spring and position spring assembly on floating piston with retainer seat inside lip of primary seal.

12. Coat master cylinder bore, primary seal and secondary seals on floating piston with clean brake fluid.

13. Position master cylinder casting in vise so that open end of bore is down slightly and install floating piston assembly in bore, spring end first, until assembly bottoms in bore.

14. Reposition master cylinder in vise so that open end of bore is up.

15. Coat primary and secondary seals on rear piston assembly with clean brake fluid and insert assembly into master cylinder bore, spring end first.

16. Pressing downward on rear piston, install lock ring in groove in master cylinder piston.

17. Install new reservoir seal on reservoir cover, place cover on master cylinder, retaining with bale-type retainers.

18. Install master cylinder on power head, torquing nuts to 20 foot-pounds maximum torque.

19. Install front and rear brake lines, if power head is on car, tightening lines to 15 foot-pounds and bleed brakes as described on page 5-9.

C-CAR, BROUGHAM AND SEVILLE SERIES

VACUUM POWER HEAD DISASSEMBLY, CLEANING, INSPECTION AND ASSEMBLY

NOTE: Vacuum power heads for limousine and commercial chassis are not serviceable. Complete replacement of the head is required.

a. Disassembly

NOTE: Scribe mark on top center of front and rear housings in line with master cylinder reservoir cover to facilitate reassembly.

1. Remove master cylinder reservoir cover retainer from reservoir cover assembly and empty brake fluid from reservoirs.

2. Remove two locknuts which hold master cylinder to front housing, and remove master cylinder from its mounting studs. Remove front housing seal from front shell.

NOTE: If Separating Fixture, J-23456, is not available, use Separator J-9504. Do not remove master cylinder at this time if J-9504 is to be used.

3. Secure Power Unit Shell Holding and Separating Fixture, J-23456, and power head, Fig. 5-40. Studs on rear shell engage base of fixture and studs on front shell engage bar of tool with bar bearing against front shell. Secure front shell to bar with two master cylinder lock nuts.

4. Rotate bar counterclockwise and unlock shells.

NOTE: Use screw driver to disengage lugs.

5. Back off on hold down clamp sufficiently to remove front shell, return spring, retaining plate and piston rod retainer, Fig. 5-41 and 5-42.

WARNING: BE CAREFUL WHEN SEPARATING DIAPHRAGMS THAT RETURN SPRING DOES NOT FLY OUT AS INJURY MAY OCCUR.

6. Remove vacuum check valve and grommet from front shell.

7. Remove assembly from holding fixture and remove J-22884 from vise.

8. Remove boot from rear housing and push rod. Remove felt silencer from inside the boot.

9. Remove power piston assembly from rear shell and remove primary power piston seal from center opening of rear shell.

10. Lift bead on outside diameter of secondary diaphragm, Fig. 5-42.

11. Mount Holding Fixture, J-23101, in a vise with wide jaw up. Position secondary power piston so that two radial slots in piston fit over jaws of tool,, Fig. 5-43.

12. Fold back primary diaphragm from outside diameter of primary support plate. Grip edge of support plate and rotate counterclockwise to unscrew primary piston from secondary power piston, Fig. 5-43.

NOTE: It is possible that primary support plate will unlock from primary piston before primary piston unscrews from secondary piston. If this happens, continue to turn primary support plate counterclockwise. Tabs ("stops") on primary support plate will temporarily lock primary support plate to primary power piston and permit continued counterclockwise rotation to unscrew primary power piston from secondary power piston.

13. Remove air valve spring from secondary power piston or end of air valve.

14. Remove housing divider from secondary power piston. Remove secondary power piston seal from housing divider.

15. Secondary power piston should still be positioned on Tool J-23101. Fold back secondary diaphragm from O.D. of secondary support plate. Grip edges of support plate and rotate clockwise to unlock secondary support plate from secondary power piston, Fig. 5-44.

16. Remove secondary diaphragm and support plate and separate, Fig. 5-45.

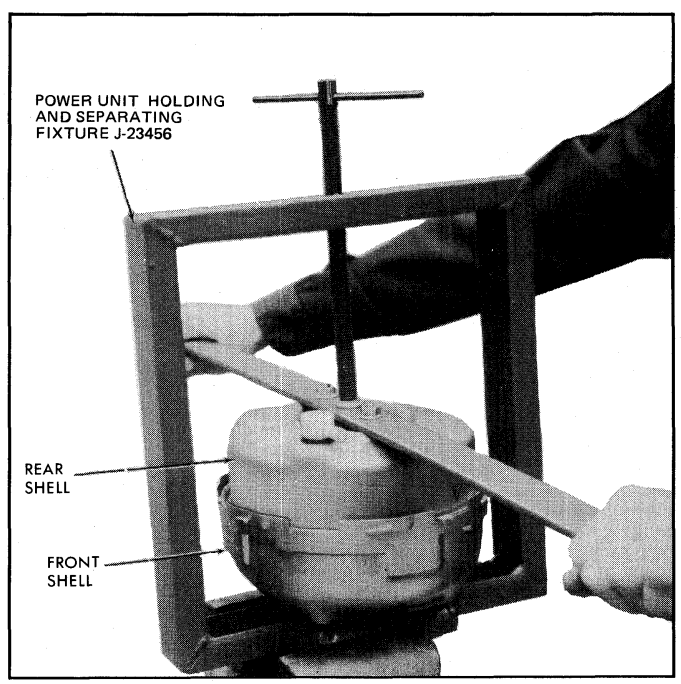


Fig. 5-40 Removing Rear Shell

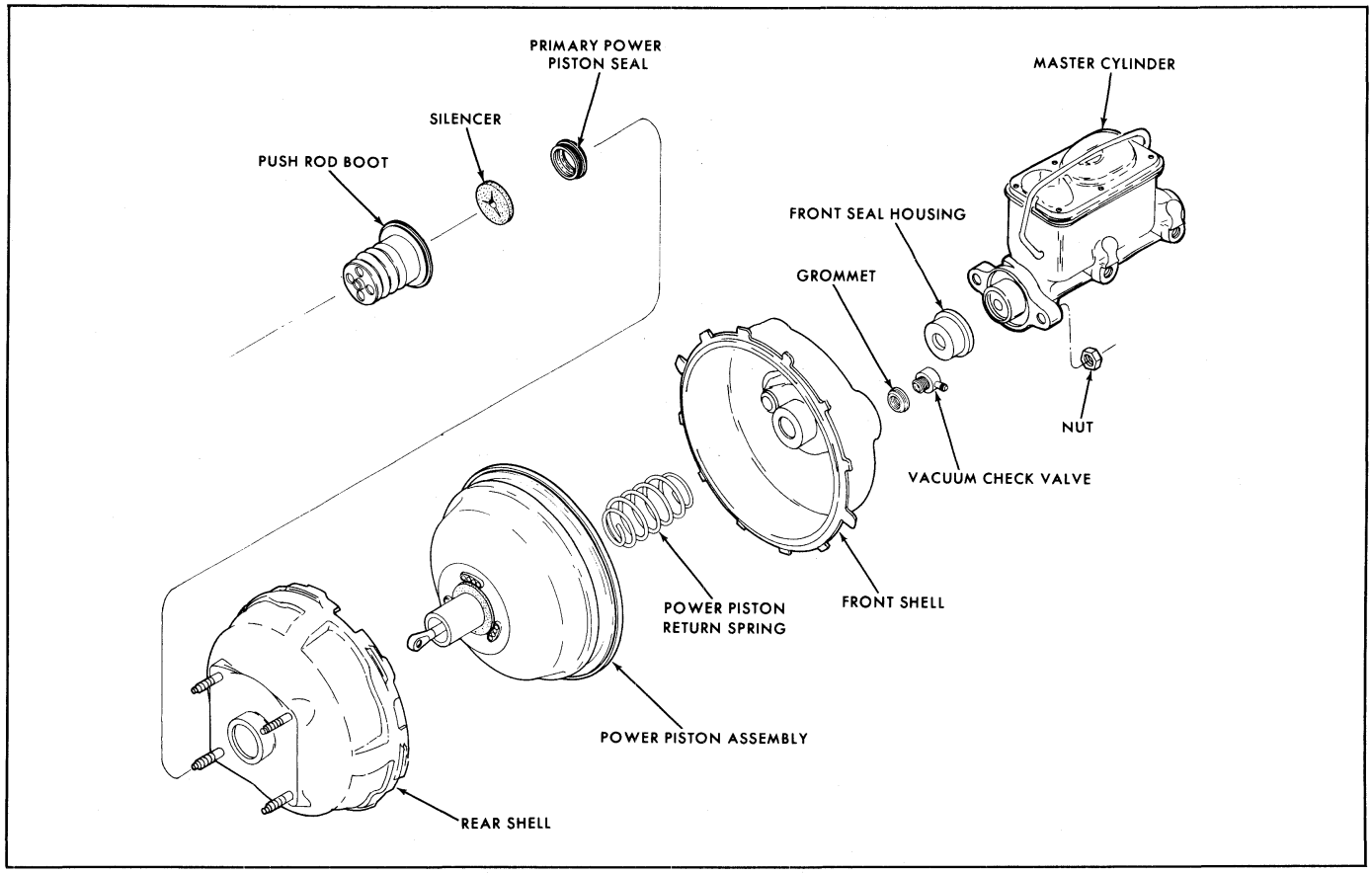


Fig. 5-41 Vacuum Power Head Disassembled

17. Remove reaction piston and reaction disc from center of secondary power piston by holding it in hand and pushing down on end of reaction piston with a small object, such as a pencil, wooden dowel or metal rod, Fig. 5-46.

18. Mount Tool J-23101 in vise with small jaws up. Position primary power piston so two radial slots in piston fit over jaws of tool, Fig. 5-47.

19. Fold back primary diaphragm from support plate. Grip edge of support plate and rotate in a counterclockwise direction to unlock primary support plate from primary power piston. Fig. 5-48.

20. Remove primary diaphragm from primary support plate.

21. Remove air filter from tubular section of primary power piston, Fig. 5-42.

22. Remove power head silencer from neck of power piston tube.

23. Remove rubber reaction bumper from end of air valve.

24. Clamp eyelet end of air valve push rod in side of vise and using Snap Ring Pliers, J-4880 remove snap ring from air valve, Fig. 5-49.

25. Remove air valve-push rod assembly from tube end of primary power piston by pulling on primary power piston. A considerable force will be required.

Removal of air valve push-rod assembly will disassemble control valve retainer.

26. Remove "O" ring seal from air valve. Air valve push rod assembly is serviced as a complete assembly, since floating control valve cannot be removed over end of push rod.

b. Cleaning and Inspection

1. Thoroughly wash all parts in clean alcohol.

CAUTION: *Use of gasoline, kerosene, or any cleaner with even a trace of mineral oil can damage rubber parts.*

2. Use air hose to blow out all passages, orifices, and valve holes. Air dry and place cleaned parts on clean paper or lint-free cloth.

3. If any rust is found inside front or rear shell, polish clean with crocus cloth or fine emery paper, washing clean afterwards.

4. Inspect front and rear shells for scratches, scores, pits, dents or other damage affecting rolling or sealing of diaphragm or other seals. Small imperfections may be smoothed out with fine crocus cloth.

5. Inspect all original parts, not being replaced by repair kit, for damage, distortion or excessive wear and chips, and replace as necessary.

6. Use all parts furnished in power head repair kit.

c. Assembly

1. Lubricate "O" ring seal, Fig. 5-42 with silicone lubricant and place on air valve.

2. Wipe a thin film of silicone lubricant on large and small O.D. of floating control valve.

3. If floating control valve needs replacement, it will be necessary to replace complete air valve push rod assembly, since floating control valve is a component part of this assembly and cannot be disassembled from push rod, Fig. 5-50.

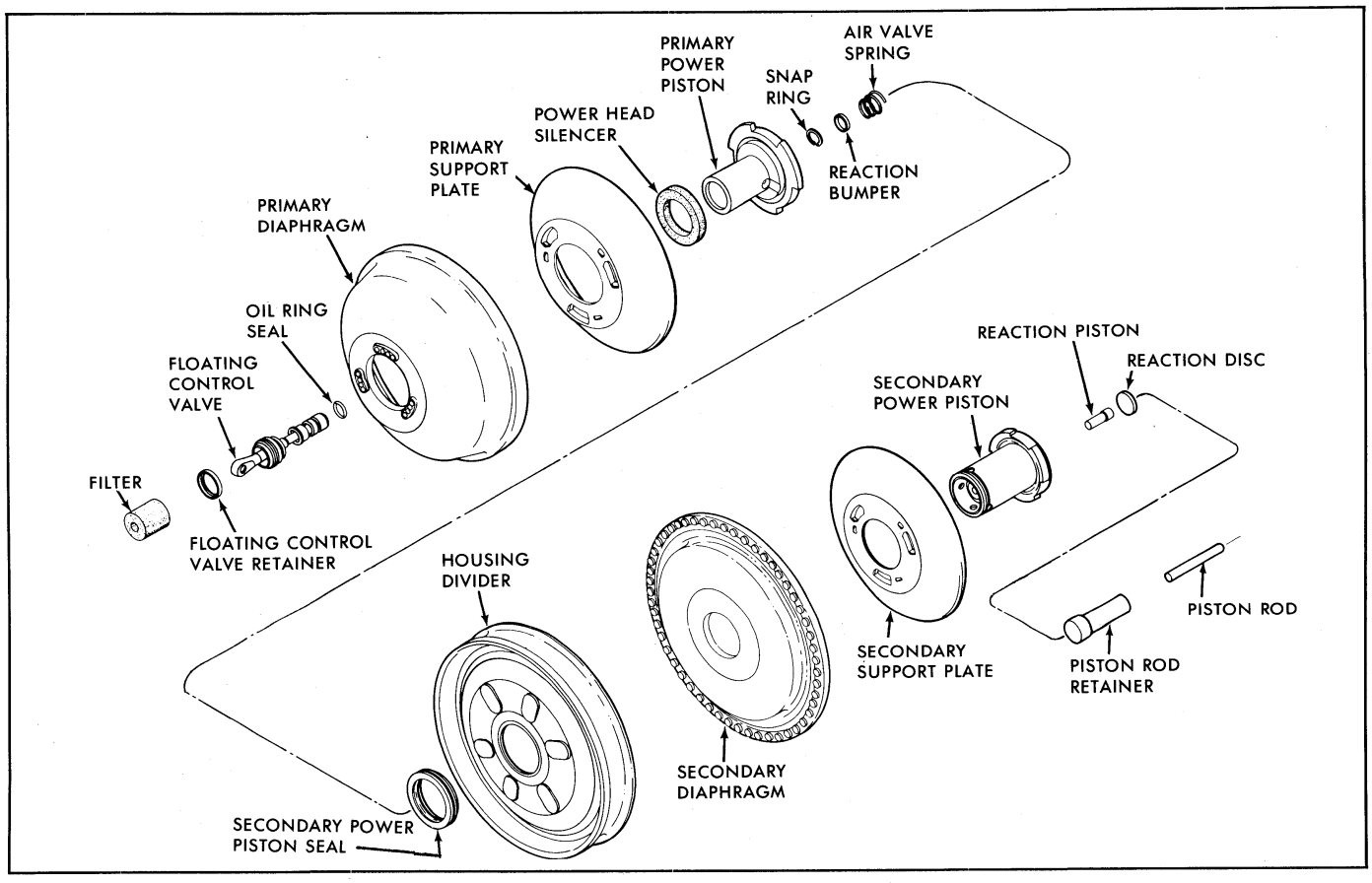


Fig. 5-42 Power Piston Disassembled

4. Place air valve end of air valve push rod assembly into tube of primary power piston. Manually press air valve push rod assembly so that floating control valve bottoms on tube section of primary power piston.

5. Place floating control valve retainer, Fig. 5-51, on Control Valve Retainer Installer, J-23175. Place over push rod so that closed side of retainer seats on floating control valve. With Installer, J-23175, manually press retainer and floating control valve assembly to seat in primary power piston tube, Fig. 5-51.

6. The filter element can now be stretched over push rod eye and pressed into primary power piston tube, Fig. 5-42.

7. Using Snap Ring Pliers, J-4880, place snap ring in its air valve groove, Fig. 5-49.

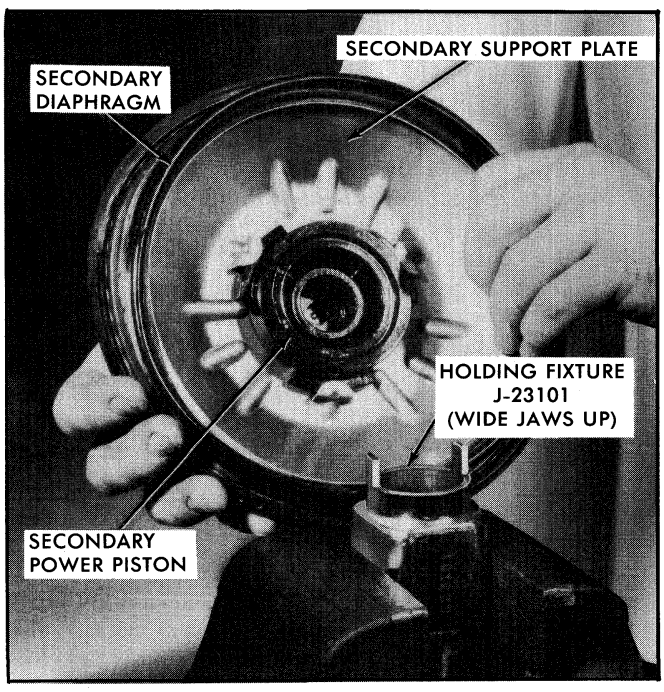


Fig. 5-43 Positioning Secondary Power Piston

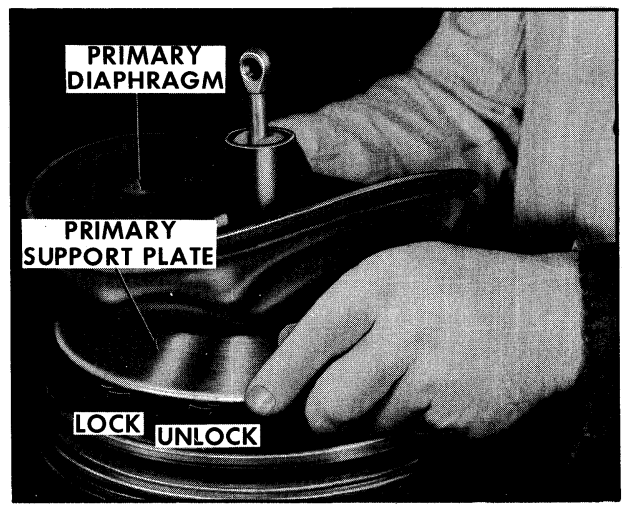


Fig. 5-44 Loosening Power Piston

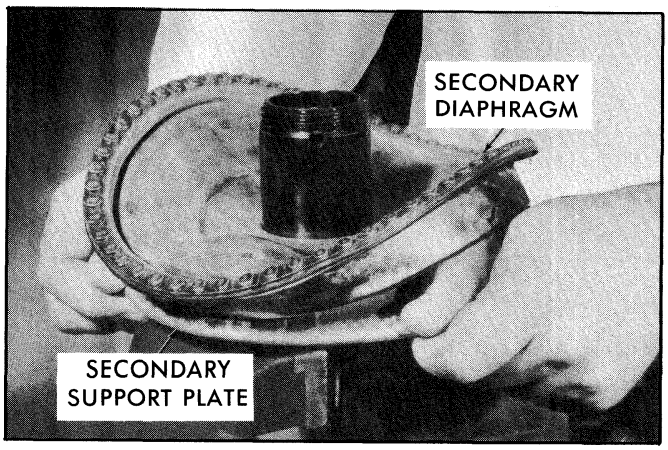


Fig. 5-45 Removing Secondary Diaphragm

NOTE: If snap ring is installed in O-ring groove, power pistons will not thread together all the way and threads may be damaged.

8. Position rubber reaction bumper on end of air valve.

9. Apply a light film of silicone lubricant to O.D. rubber reaction disc. Place disc in small cavity of the secondary power piston and push disc down to seat on reaction piston.

10. Assemble primary diaphragm to primary support plate from side of plate opposite locking tangs, Fig. 5-42. Press raised flange on I.D. of diaphragm through center hole of support plate. Be sure edge of support place center hole fits groove in raised flange of diaphragm. Lubricate diaphragm I.D. and raised surface of flange that fits into a groove in the primary power piston with light coat of silicone lubricant.

11. Mount Holding Fixture, J-23101, in vise, small jaws up. Position primary power piston so two radial slots in piston fit over jaws of tool, Fig. 5-47.

12. Fold primary diaphragm away from O.D. of the primary support plate.

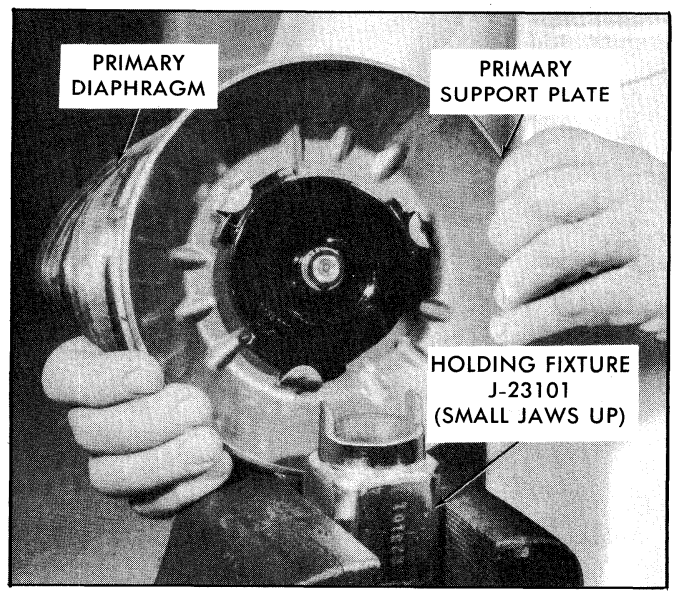


Fig. 5-47 Positioning Primary Power Piston

13. Holding edges of the support plate, with the locking tangs down, place primary support plate and diaphragm assembly over tube of primary power piston. Flange on the I.D. of primary diaphragm will fit groove in the primary power piston.

14. Grip edges of primary support plate, press down, and rotate clockwise until tabs on primary power piston contact stops on support plate, Fig. 5-48.

15. Place power head silencer on tube of primary power piston so holes at the base of tube are covered.

16. Apply a very light film of silicone lubricant to O.D. of primary power piston tube.

17. Remove primary piston assembly from Tool J-23101 and lay it aside.

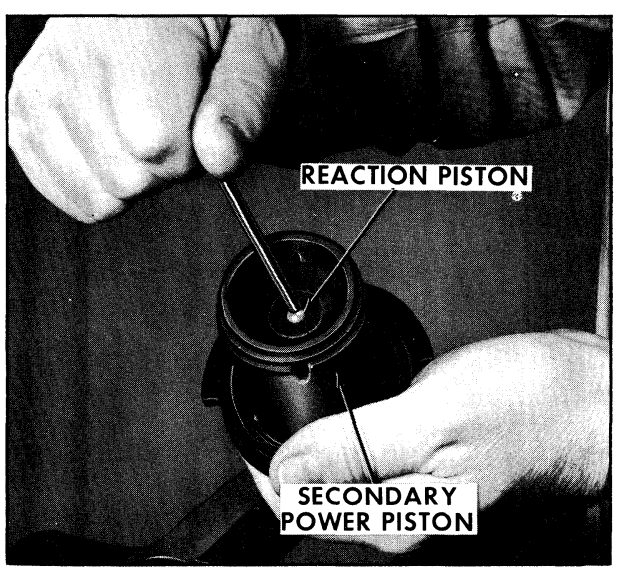


Fig. 5-46 Removing Reaction Piston

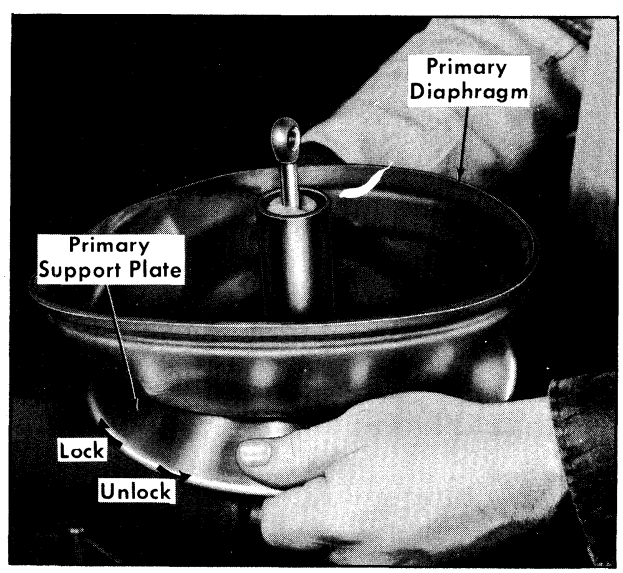


Fig. 5-48 Removing Primary Diaphragm

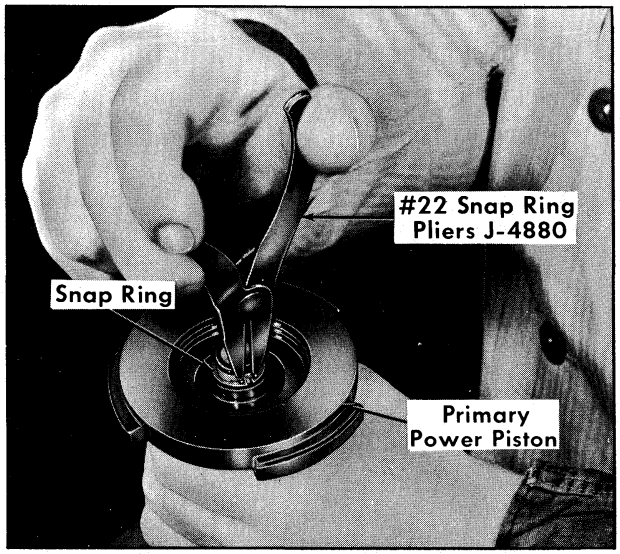


Fig. 5-49 Removing Snap Ring From Air Valve

18. Assemble secondary diaphragm to secondary support plate from side of support plate opposite locking tangs, Fig. 5-42. Press raised flange on I.D. of diaphragm through center hole of support plate. Be sure edge of support plate center hole fits groove in the raised flange of diaphragm. Apply thin coat of silicone lubricant to I.D. of secondary diaphragm and raised surface of flange (that fits into a groove in the secondary power piston).

19. Mount Tool J-23101 in vise with large jaws up. Position secondary power piston so curved slots in piston fit over jaws of Tool, Fig. 5-43. Apply light coat of silicone lubricant to tube of secondary power piston.

20. Fold secondary diaphragm away from O.D. of secondary support plate.

21. Holding edges of the support plate, with locking tangs down, place secondary diaphragm and support plate assembly over tube of secondary power piston. Flange on I.D. of secondary diaphragm will fit secondary piston groove.

22. Grip edges of secondary support plate, press down, and rotate counterclockwise until tabs on secondary power piston contact stops on support plate, Fig. 5-45. Fold secondary diaphragm back into position on secondary support plate. Leave secondary power piston assembly on Tool J-23101 in vise.

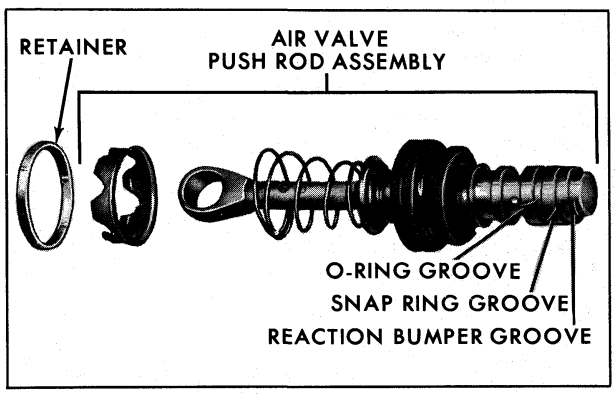


Fig. 5-50 Floating Control Valve

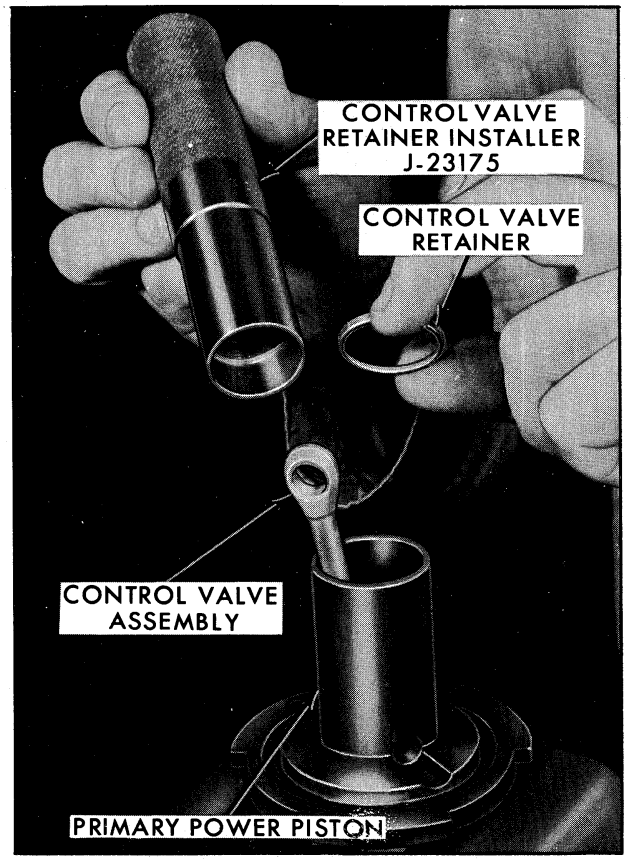


Fig. 5-51 Installing Retainer Ring

23. Apply light coat of talcum power or silicone lubricant to bead on O.D. of secondary diaphragm. This will facilitate assembly of front and rear housings.

24. With conical surface facing up, Install seal so part number can be read from this side.

25. Lubricate I.D. of secondary seal with silicone lubricant.

26. Position Secondary Seal Protector Tool, J-23188 on threaded end of secondary power piston, Fig. 5-52.

27. Hold the housing divider so the six impressions on middle of divider sticks up. Press divider down over tool and onto secondary power piston tube where it will rest against the diaphragm support ring. Remove Seal Protector, J-23188, from secondary power piston; however, do not remove secondary power piston subassembly from Holding Fixture, J-23101.

28. Pick up primary power piston assembly and position small end of air valve return spring on air valve so it contacts air valve retaining ring.

29. Fold primary diaphragm away from O.D. of primary support plate.

30. Position primary power piston on tabular portion of secondary power piston, making sure small end of air valve return spring seals on air valve snap ring.

31. Grip edge of primary support plate, press down, and start threads on secondary power piston into threaded portion of primary power piston by rotating clockwise, Fig. 5-44.

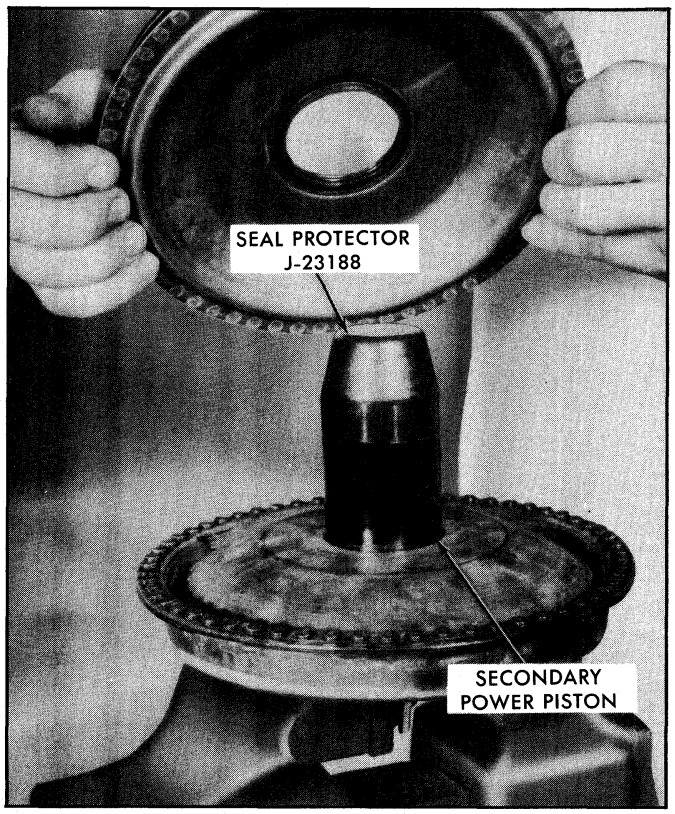


Fig. 5-52 Installing Housing Divider

32. Continue to tighten primary power piston until it is securely attached to secondary power piston.

33. Fold primary diaphragm back into position on primary support plate and pull diaphragm O.D. over formed lip of housing divider. Check to be sure bead on diaphragm is seated evenly around complete circumference.

34. Remove assembly from tool J-23101. Wipe a thin film of silicone lubricant on O.D. of piston rod retainer. Insert master cylinder piston rod retainer into secondary power piston cavity so flat end bottoms against rubber reaction disc in bottom of cavity.

35. Place primary power piston seal in rear housing center hole so formed flange of housing center hole fits groove of primary power piston seal. The part number of seals should show on inside of shell.

36. Coat I.D. of primary power piston seal with thin film of silicone lubricant.

37. Mount Power Unit Holding and Separating Fixture, J-22884, in vise and position rear shell on tool so studs fit holes provided in tool.

38. Assemble power piston to rear shell by pressing primary power piston tube through rear housing seal. Press down until housing divider seats in the rear shell and primary power piston bottoms against shell.

39. Install vacuum check valve grommet in front shell with large diameter outside.

40. Install vacuum check valve.

41. Position power piston return spring over front shell.

42. Hold front shell assembly (with mounting studs up) over rear shell. Position front shell so that when tangs on edge of front shell are locked in slots on edge of rear shell, scribe marks on top of shells will be in line.

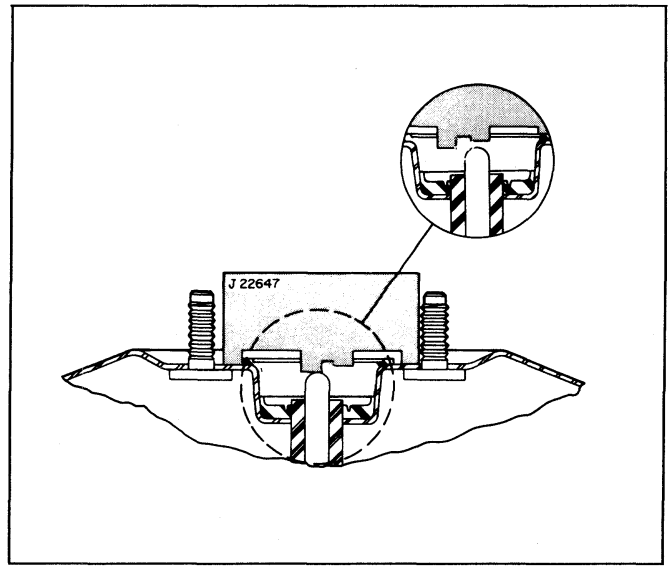


Fig. 5-53 Gaging Push Rod

43. Lower front shell assembly onto rear shell by tightening hold down clamp. Power piston spring must seat in depression in face of secondary power piston. Check to be sure bead on O.D. of secondary diaphragm is positioned between edges of shells.

44. Continue to tighten clamp on front shell and fit tangs, in appropriate slots, on rear shell.

45. Rotate bar clockwise into locked position and remove power head from Holding Fixture, J-22884.

46. Place silencer in closed end of power head boot. Stretch boot over push rod and over flange in center of housing.

47. Place power head assembly in vise with front shell facing up. Insert master cylinder piston rod, flat end first, into piston rod retainer.

48. Press down on master cylinder piston rod to be sure it is properly seated.

NOTE: Remove front housing seal to assure that no vacuum is in power head while gaging.

49. Place Gage, J-22647, over piston rod in a position which will allow gage to be slipped to left or right without contacting studs, Fig. 5-53.

The center section of gage has two levels. The piston rod should always contact the long section (low level) of gage. The piston rod should never contact the short section (high level) of gage, Fig. 5-53. Move gage from side to side to check piston rod height.

Any variation beyond these two limits must be compensated for by obtaining an adjustable piston and from your servicing Parts Distribution Center and adjusting self-locking screw to meet gaging specifications.

50. Wipe a thin film of silicone lubricant on the I.D. of front housing seal and position seal in housing depression.

51. Install master cylinder assembly on front housing positioning cylinder on mounting studs so top of master cylinder reservoir is toward scribe marks on housing. Assemble locknuts on studs and torque to 20 foot-pounds.

TORQUE SPECIFICATIONS

Material Number	Application	Size	Foot-Pounds
Special	Pipe Nut to Master Cylinder	1/2 –20 or 9/16–18	25 Max.
Special	All Other Brake Pipe Nuts	3/8 –24, 7/16–24, 1/2 –20	20 Max.
260M	Parking Brake Cable Clamps (at Backing Plate)	5/16–24	11
Special	**Brake Hose to Caliper	7/16–20	30 Max.
300M	**Brake Backing Plate to Rear Axle Housing	7/16–20	40 Max.
284M	**Brake Unit to Cowl	3/8 –16	13
286M	Brake Pedal Pivot Bolt	7/16–20	13
286M	Master Cylinder to Vacuum Power Head	3/8 –24	20
Special	**Caliper to Steering Knuckle Bolt	Special	30
Special	Piston Extension Screw	Special	90*
286M	Wheel Mounting Nuts	1/2 –20	100
Special	Bleeder Screw	Special	*Inch-Pounds 90
(NOTE: Refer to back of Manual, Page 10-1, for bolt and nut markings and steel classifications.)			

***CAUTION: This fastener is is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.*

FOUR WHEEL DISC SYSTEMS
GENERAL DESCRIPTION

The caution on page 5-32 applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations.

Brougham and Seville are equipped with a power assisted hydraulic 4 wheel disc brake system and a mechanically operated parking brake. Separate hydraulic systems from the dual master cylinder operate the single piston sliding caliper front and rear disc brakes, Fig. 5-54, 5-55.

The rear disc brake calipers include an integral parking brake with automatic adjusting provisions. The parking brake mechanically applies the rear calipers through foot operated linkage.

Parking brake control is provided by a foot operated silent operating pedal. It is released automaticaly by a vacuum controlled diaphragm when the engine is running and the shift selector is placed in any position other than neutral of park. A manual release lever is located on the inboard side of the parking brake assembly. When park brake is applied a *brake* warning lamp illumination in the instrument panel housing is lighted.

COMBINATION VALVE (Fig. 5-56)

The non-serviceable combination valve is located directly below the master cylinder. The combination valve incorporates the following two functions into one part:

1. PRESSURE DIFFERENTIAL SWITCH–The pressure differential section monitors the front and rear brake systems to measure any difference in hydraulic pressure between the two systems. If a sufficient pressure differential exists between the systems an electrical ground is made energizing the *brakes* tell tale light on the right side of the instrument cluster if the ignition switch is on. The valve and switch are so designed that the switch will latch in the "warning" position once a malfunction has occurred. The light will turn off after the malfunction is repaired and a pedal force sufficient to develop approximately 450 psi hydraulic brake line pressure is applied.

2. PROPORTIONING VALVE–The rear brake proportioning valve improves front-to-rear brake balance under severe brake application. Severe brake application transfers part of the vehicle rear weight to the front wheels. The resulting decrease in weight at the rear wheels can permit the rear wheel brakes to "lock up" causing rear wheel skid.

NOTE: The combination valve used on 4 wheel disc brakes system is specific.

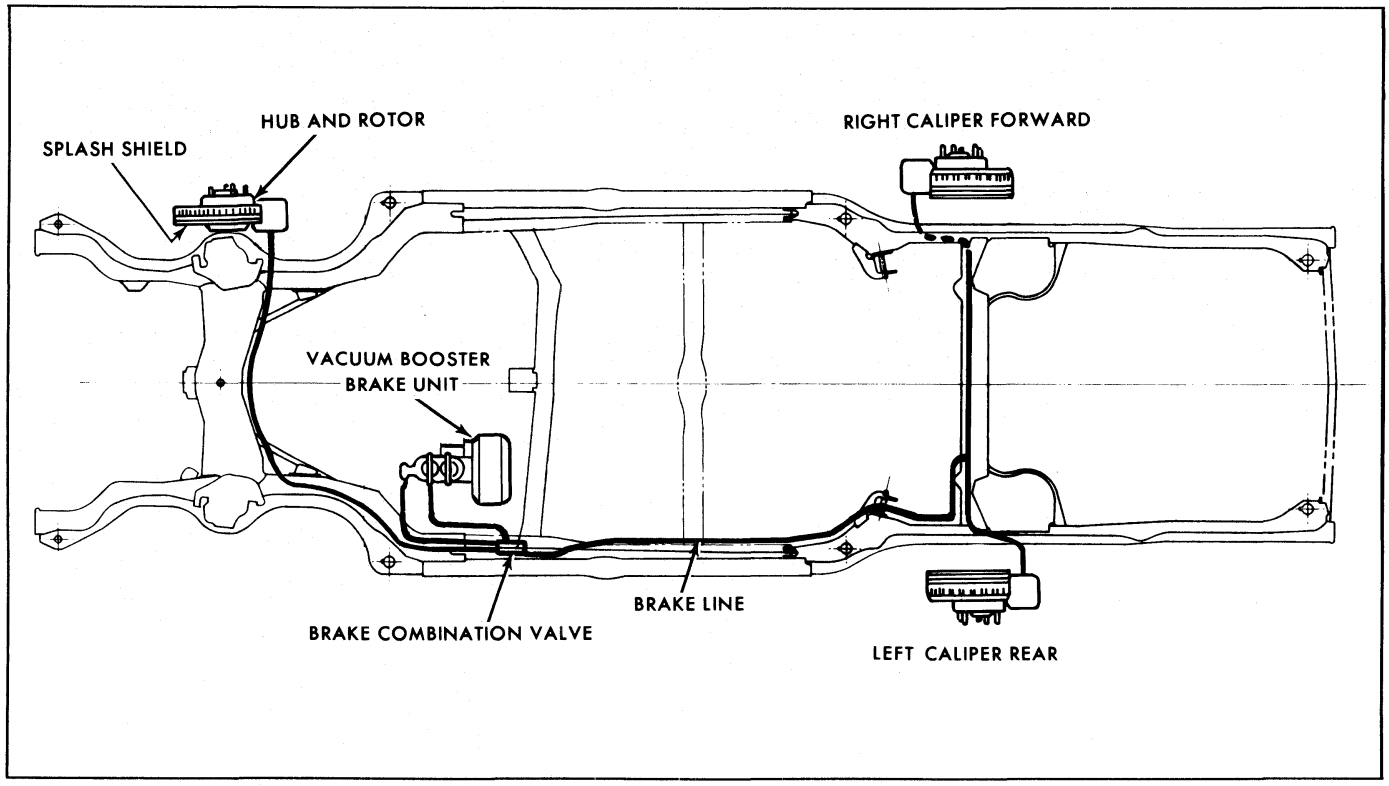


Fig. 5-54 Location of Components-Brougham

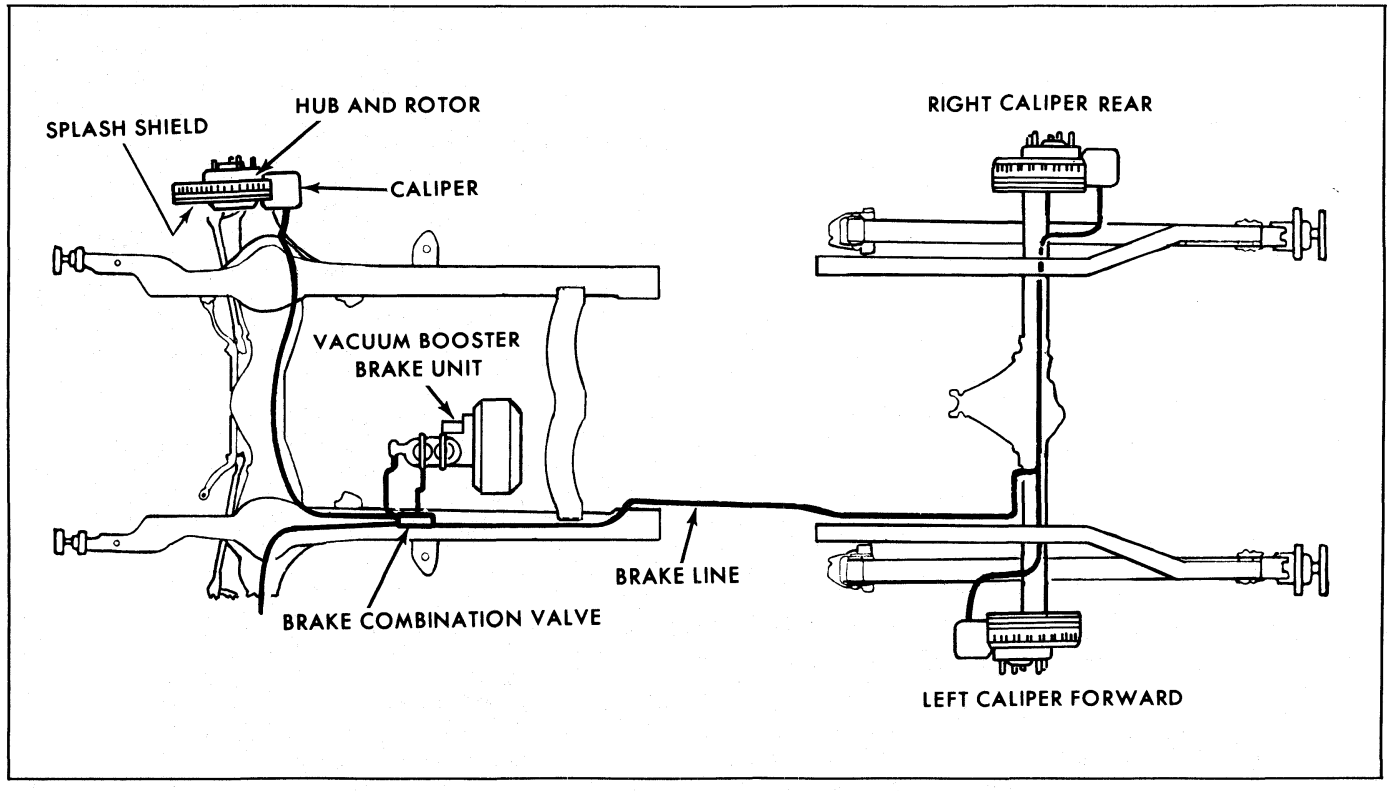


Fig. 5-55 Location of Components-Seville

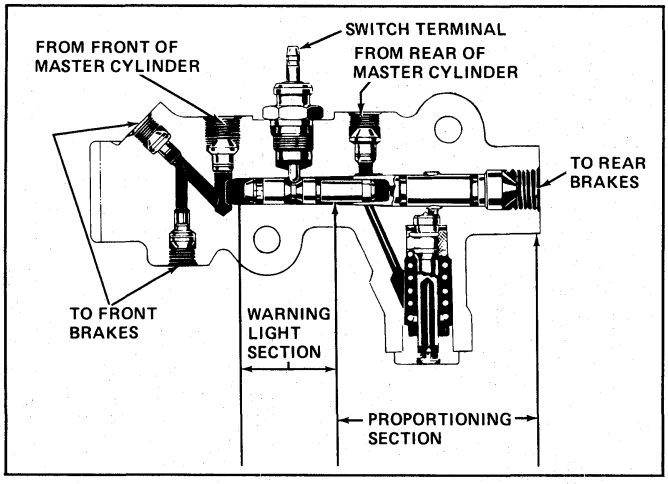


Fig. 5-56 Combination Valve (Typical)

DIAGNOSIS

BRAKE COMBINATION VALVE

1. Distributor Switch–For operational check.

a. Light should be energized during engine cranking.

b. With engine running, apply moderate pedal force, (approximately 20-30 lbs). When an assistant opens any bleeder screw, light should go ON indicating an open or malfunctioning condition.

c. Close bleeder screw before releasing brake.

d. Upon reapplying pedal force, light should go out.

e. Check master cylinder and bring fluid up to 1/4 inch from top of reservoir.

2. Proportioner Operation.

a. Raise car.

b. Remove one of the rear wheel caliper bleeder screws and install Pressure Gage Tool J-24657, Figs. 5-57 and 5-58.

c. With engine running at idle and brake pedal applied with 50 lbs. force (slightly beyond the point where the pedal gets hard) pressure reading should not exceed 700 psi.

If any of the above specifications are not met, brake combination valve should be replaced.

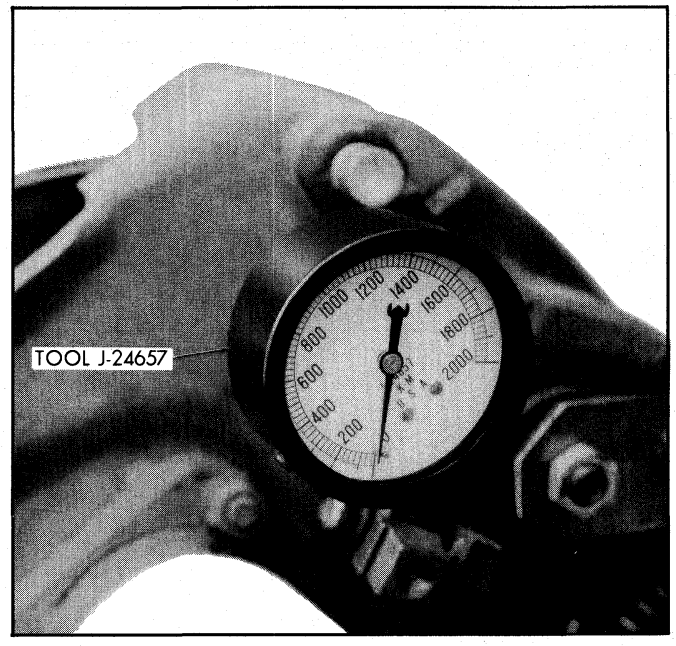


Fig. 5-57 Proportioning Valve Test-Rear Line Pressure

BRAKE DIAGNOSIS CHART — 4 WHEEL DISC SYSTEMS

NOTE: Operation of Tell-Tale Brake Light may be checked as outlined on Page 8-102

CAUSE / SYMPTOM	Excessive Brake Pedal Travel	Brake Pedal Travel Gradually Increases	Excessive Brake Pedal Effort	Excessive Braking Action	Brakes Slow to Respond	Brakes Slow to Release	Brakes Drag	Uneven Braking Action (Side to Side)	Uneven Braking Action (Front to Rear)	Scraping Noise from Brakes	Brakes Squeak During Application	Brakes Squeak During Stop	Brakes Chatter (Roughness)	Brakes Groan at End of Stop	Brakes Tell-Tale Glows
Leaking Brake Line or Connection	X	XX	X						X						XX
Leaking Piston Seal	X	XX	X	X				X	X						X
Leaking Master Cylinder	X	XX	X						X						X
Air in Brake System	XX		X						X						XX
Contaminated or Improper Brake Fluid	X				X	X	X	X	X						X
Leaking Vacuum System			XX		X										
Restricted Air Passage in Power Head		X	X		XX	X									
Damaged Power Head		X	X	X	X	XX									
Worn Out Brake Lining			X	X				X	X	X	X	X		X	
Uneven Brake Lining Wear-Replace	X			X				X	X	X	X	XX		X	X
Glazed Brake Lining-Sand			XX		X			X	X		X	X			
Incorrect Lining Material-Replace			X	X		X		X	X			X		X	
Contaminated Brake Lining-Replace				XX		X		XX	XX	X	X	X		X	
Linings Damaged by Abusive Use-Replace			X	XX				X	X	X	X	X		X	
Heat Spotted or Scored Discs				X				X	X		X	X	XX	X	
Out-of-Parallel Brake Discs	X												XX		
Excessive Run-Out Disc	X												X		
Automatic Adjuster Problem	X						X	X	X						X
Brake Assembly Attachments-Missing or Loose	X						X	X	X	X		X	X	X	
Restricted Brake Fluid Passage		X	X		X	X	X	X	X						X
Improperly adjusted Stoplight Switch or Cruise Control Vacuum Dump							X								
Metering Valve Problem		X	X	X	X	X	X		X						X
Proportioning Valve Problem		X	X	X	X	X	X		X						X
Brake Pedal Linkage Interference or Binding			X		X	XX	XX								
Improperly Adjusted Parking Brake							X		X						
Improper Length Master Cylinder Push Rod	X			X		X	XX		X						
Incorrect Front End Alignment								XX							
Incorrect Tire Pressure								X	X						
Incorrect Wheel Bearing Adjustment	X									X			X		
Loose Front Suspension Attachments							X	X		XX			X	X	
Out-of-Balance Wheel Assemblies													XX		
Operator Riding Brake Pedal			X				X		X					X	
Sticking Caliper or Wheel Cylinder Pistons					X	X	XX	X	X						
Park Brake Switch Circuit Grounded															XX
Park Brake Not Releasing						X		X							XX

XX — Indicates more probable causes(s)
X — Indicates other causes

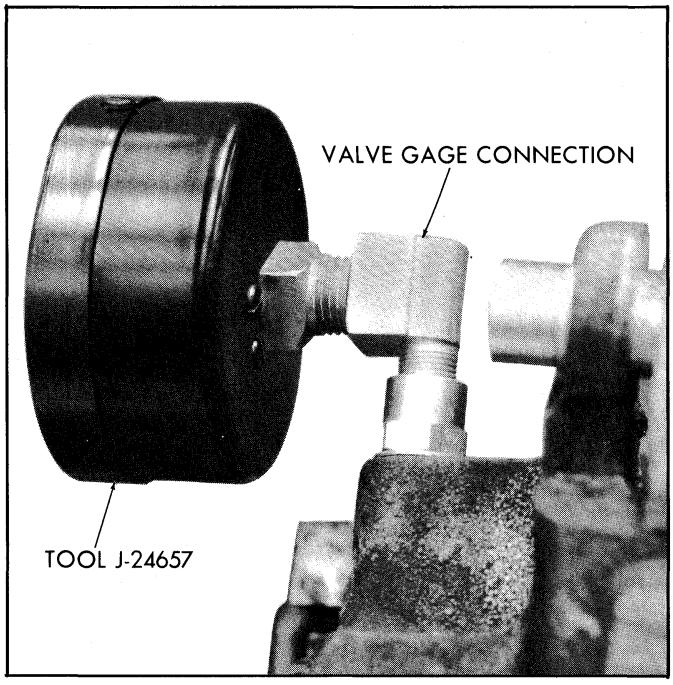


Fig. 5-58 Valve Pressure Gage Assembly

ON-CAR SERVICE

PARKING BRAKE ADJUSTMENT (Figs. 5-59 and 5-60)

1. Lubricate parking brake cables at underbody rub points, and at equalizer hooks on Seville. Check for free movement of all cables.
2. Make sure parking brake pedal is in fully released position.
3. Raise rear wheels off floor.
4. Hold brake cable stud from turning and tighten equalizer nut until cable slack is removed.
5. Make sure caliper levers are against stops on caliper housing after tightening equalizer nut.
6. If levers are off stops, loosen cable until levers do return to stops.
7. Operate parking brake pedal several times to check adjustment.

NOTE: After cable adjustment is performed, parking brake pedal should travel 5 1/4" to 6 3/4" (6 1/4" to 7 1/4" on Seville) with approximately 125 pounds force on pedal–heavy foot pressure.

8. Lower rear wheels.

NOTE: Levers must be on caliper stops after completion of adjustment. Back off park brake adjuster if necessary to keep levers on stops.

PARKING BRAKE CABLES (Brougham)

a. Front Cable

The procedure for removing and installing the front parking brake cable is described on page 5-36.

b. Removal–Rear Cable–Brougham

1. Release parking brake.
2. Raise rear of car and position on jack stands.
3. Loosen equalizer nut and remove equalizer.
4. Remove cable from equalizer.
5. Remove clips retaining right hand parking brake cable to lower control arm bracket on left side and compress tangs of retainers securing parking brake cables to caliper support plates.
6. Remove cable ends from parking brake actuator.
7. Remove right hand cable from rear axle cover clip and from right hand spring seat clip.

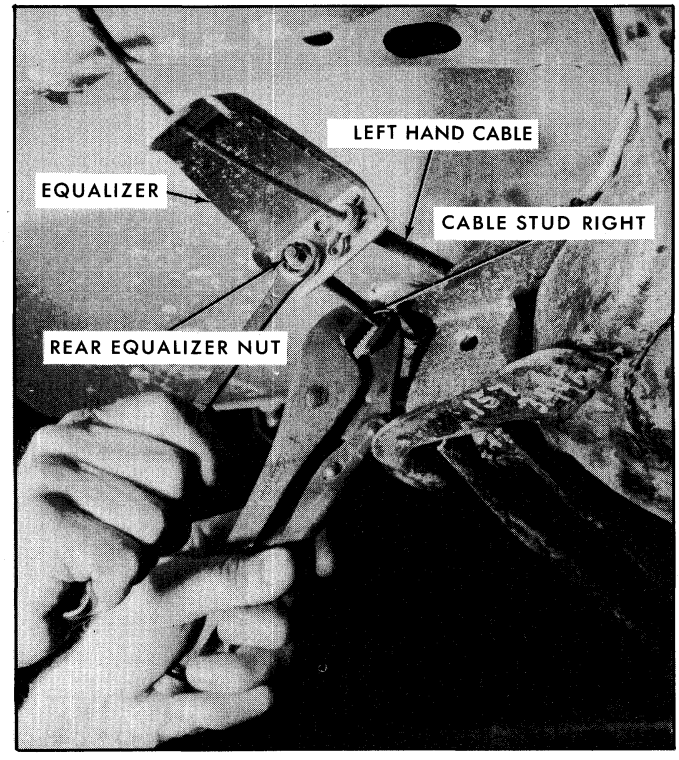


Fig. 5-59 Adjusting Parking Brake-Brougham

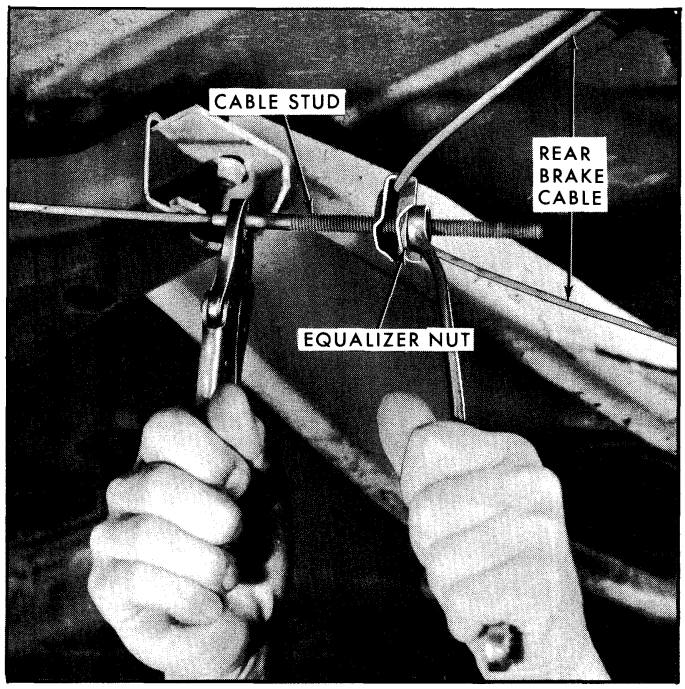


Fig. 5-60 Adjusting Parking Brake-Seville

c. Installation–Rear Cable (Fig. 5-61) Brougham

1. Reinstall caliper lever return spring.
2. Route cable end through caliper spring and through caliper lever.
3. Route left conduit over left lower control arm and attach conduit to equalizer with retainer guide cable through forward hole in equalizer and connect to front cable with U-shaped connector.
4. Route right conduit along rear of right axle tube beneath spring seat clip and axle rear clip conduit and axle rear clip conduit is then retained at top bolt of axle housing inspection cover. Conduit is then routed over left axle tube and anchored by retainer at control arm bracket. Stud end of cable is then attached to equalizer with equalizer nut.
5. Adjust parking brake as described on page 5-53.

d. Removal–Center Cable–Seville

1. Release parking brake.
2. Remove equalizer nut from cable stud and remove equalizer.
3. Remove wire hook guide from underbody bracket, Fig. 5-62.
4. Remove cable from right and left "C" connectors and remove cable.

e. Installation–Center Cable–Seville

1. Make certain protective sheath is under exhaust pipe and install cable in right and left "C" connectors.
2. Install wire hood guide securing cable to right side of underbody.
3. Install cable in equalizer and secure to front cable stud with nut.
4. Adjust parking brake as described on page 5-53.

f. Removal–Rear Cables–Seville

1. Release parking brake.
2. Raise rear of car and place on jack stands.
3. Remove rear wheel and drum on same side of car as parking brake cable being replaced.
4. Remove equalizer nut and separate equalizer from front cable stud.
5. Remove end of cable being replaced from "C" connector.
6. Disengage caliper lever return spring.
7. Compress tangs of retainer securing parking brake cable to bracket on caliper.
8. Remove cable end from caliper lever.

g. Installation–Rear Cables–Seville (Fig. 5-62)

1. Reinstall caliper lever return spring.
2. Route cable end through spring and through caliper lever.
3. Route cable under rear leaf spring and secure with clamp.
4. Seat retainer tangs to caliper bracket.
5. Insert cable through hole in bracket and secure to bracket with wire retainer.

NOTE: Pull on cable and check operation of cable by pulling on front end of cable to be sure it is not binding.

6. Install cable end in C-shaped connector.
7. Insert front cable stud through equalizer hole and install equalizer nut.
8. Install rear drum and wheel and tighten wheel lug nuts to 80 foot-pounds torque.
9. Adjust parking brake as described on page 5-53.

REAR BRAKE CALIPER (Figs. 5-63 thru 5-65)

a. Removal

1. Raise car on hoist.
2. Remove wheel disc and wheel and tire assembly.
3. Loosen tension on parking brake cable at equalizer.
4. Remove cable from parking brake lever.
5. Remove spring and remove conduit from bracket, Figs. 5-66 and 5-67.
6. Remove brake line from caliper and plug openings to retain fluid and prevent entrance of dirt.

NOTE: On all calipers except the right hand Brougham remove the bolt from the brass flock.

7. Remove caliper mounting bolts and remove caliper.

b. Inspection

1. Clean dirt and corrosion from face of piston.
2. Examine piston and check valve area for fluid leaks by looking for moisture around boot area. Check dust boot for cuts, cracks or other damage which would affect its ability to seal piston bore. If leaks are present overhaul as described on page 5-41.

CAUTION: *Do not use air for cleaning caliper because of the possibility of unseating dust boot.*

3. Check for leaks at threaded end of actuator screw. If leaking, overhaul caliper as described on page 5-41.

c. Lining Replacement

NOTE: Remove shoe and lining assemblies.

1. Remove and discard two caliper mounting sleeves and four bushings.
2. Using silicone lube, install new bushings and sleeves.

NOTE: Sleeves are installed in inner bushings.

3. Remove and discard piston check valve and install new piston check valve. Fig. 5-68.

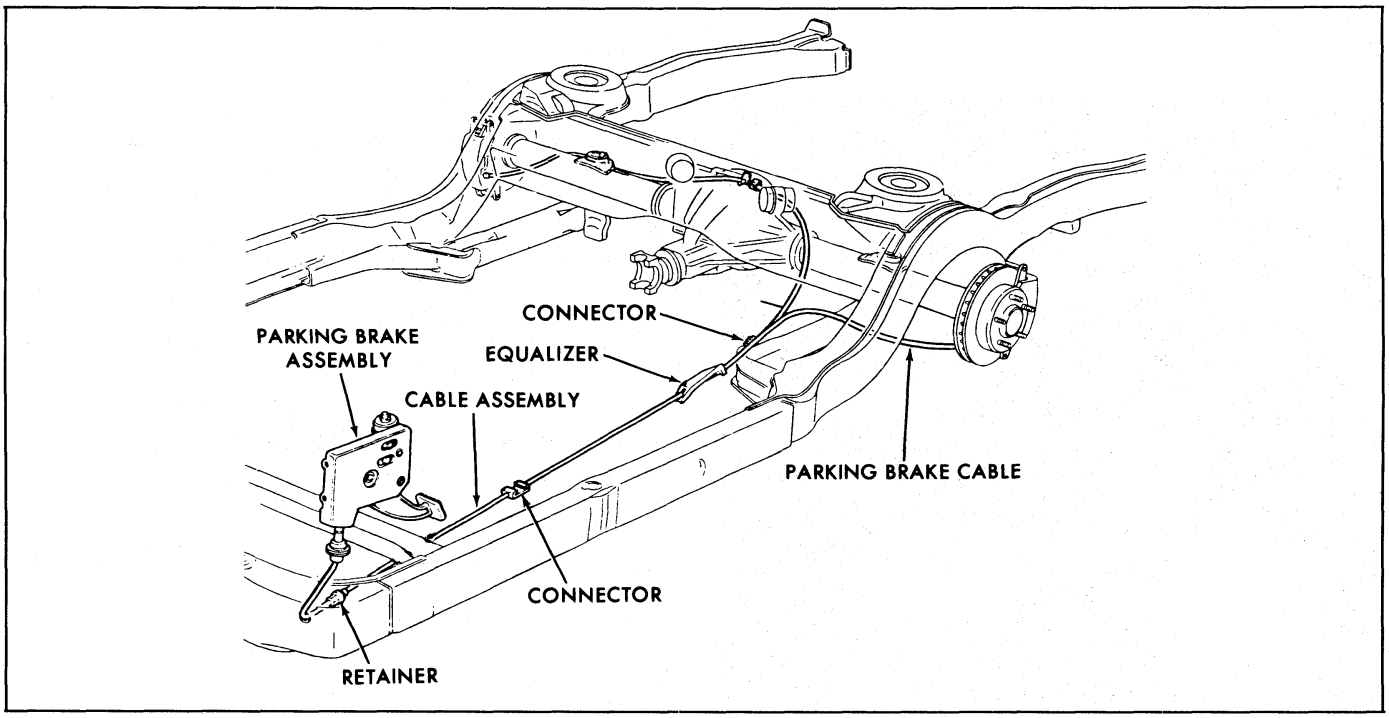


Fig. 5-61 Parking Brake Cable-Brougham

WARNING: FRONT BRAKE SHOES MUST NOT BE USED ON REAR CALIPERS.

4. Remove return spring, lock nut, lever, lever seal, and nylon anti-friction washer. On Eldorado, no return spring.

NOTE: Lever must be held in place while removing nut.

5. Clean any contamination from caliper surface in the area of the lever seal.

6. Using a 7 inch (or larger) "C" clamp with the solid end on the lever stop, Fig. 5-69 and screw end on the back of the outboard lining assembly, turn clamp until piston bottoms in the caliper.

NOTE: Do not position "C" clamp on actuator screw, optional use Tool J-23072, Fig. 5-74.

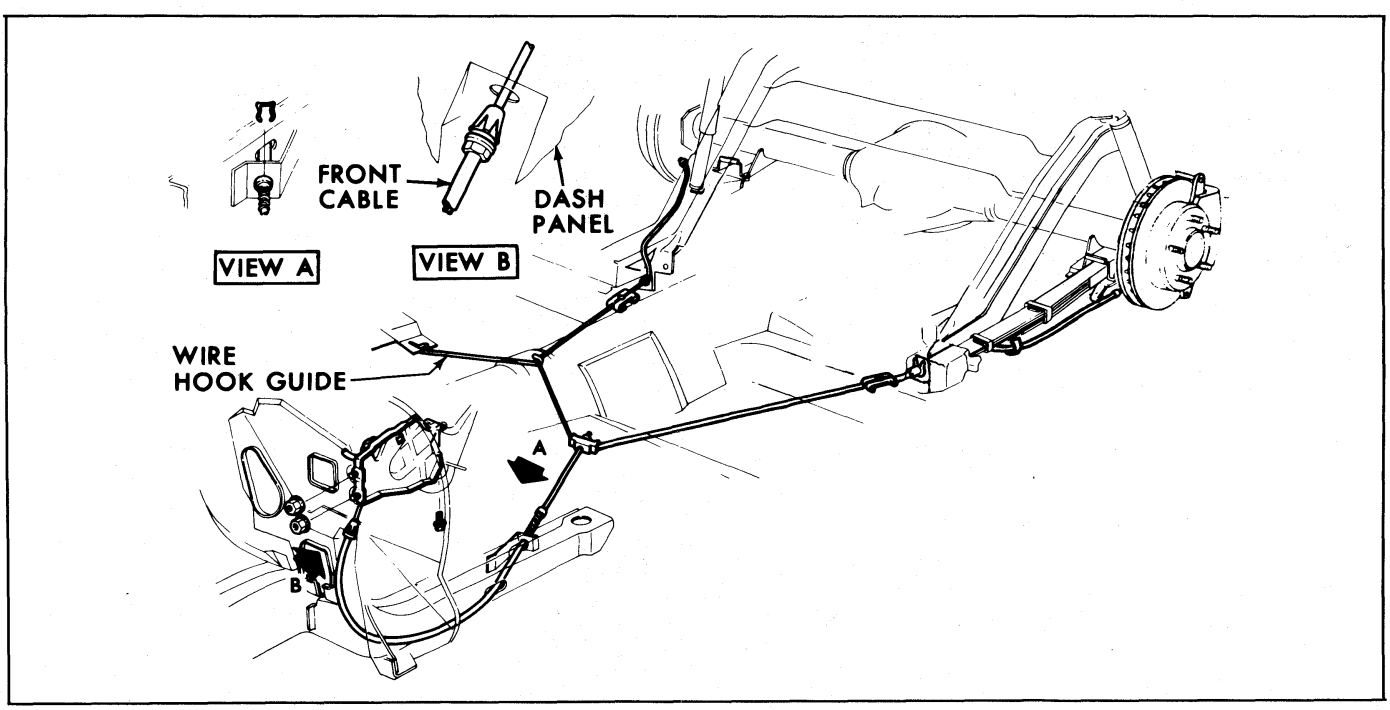


Fig. 5-62 Parking Brake Cable Seville

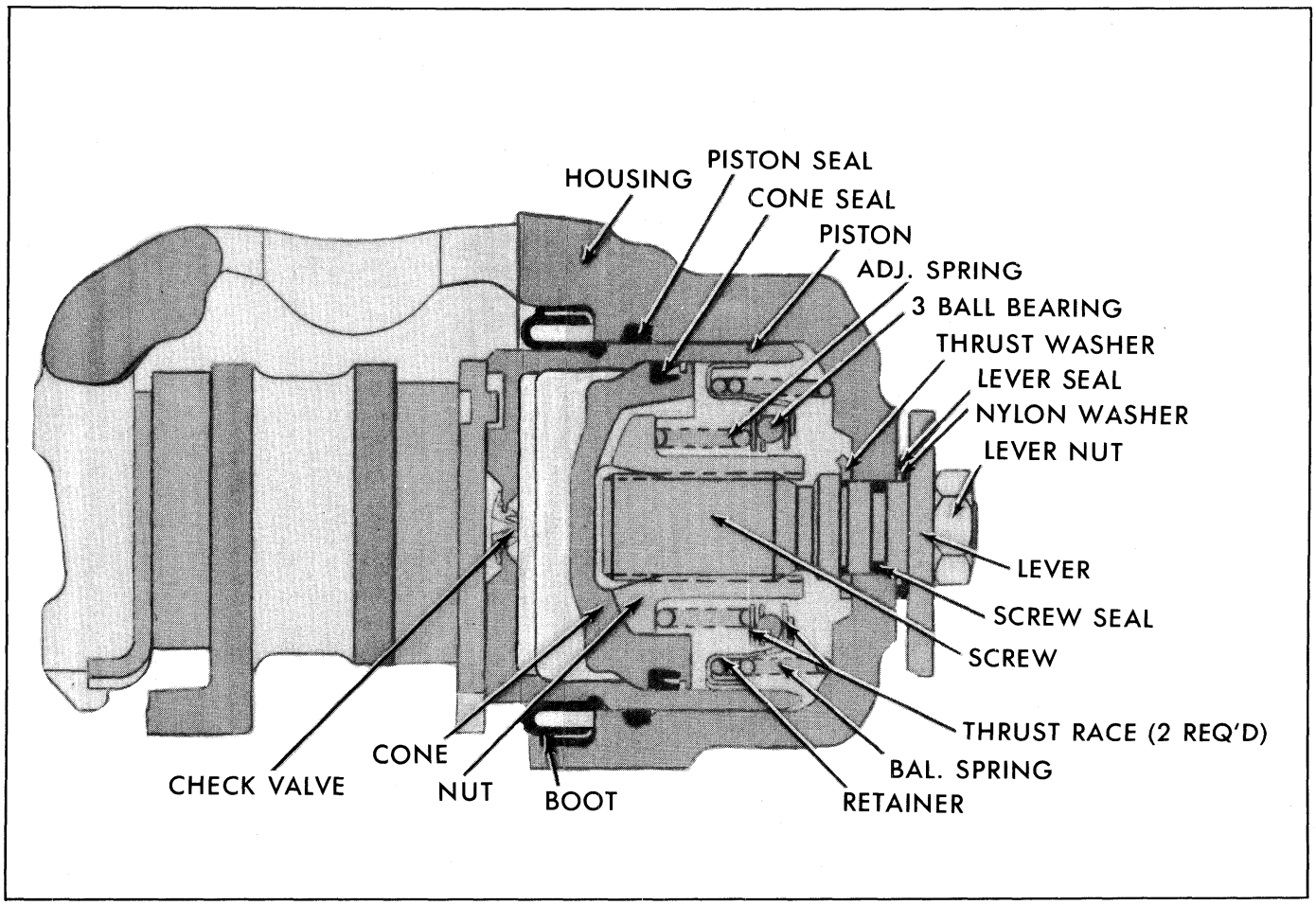


Fig. 5-63 Rear Brake Caliper Cross Section View

7. Before removing the clamp, lube the caliper housing surface (under the lever seal), with silicone.

8. Install new anti-friction washer, new lever seal.

8a. Install lever.

NOTE: Install lever on hex with arm pointing downward.

9. Rotate lever toward front of car exc. Brougham on right hand and while holding in this position, install nut and torque to 25 foot-pounds. Then rotate lever back to stop.

10. Install lever return spring and remove "C" clamp, Fig. 5-69.

11. Position new inboard shoe assembly on piston. The D-shaped tab must fit in the D-shaped indentation provided in the piston. If piston requires rotation, use Spanner Wrench J-7624 to turn it, Fig. 5-83.

12. Install new spring retainer on all exc. Eldorado outboard shoe assembly.

13. Wipe all dirt from caliper mounting bolts. Do not use sand paper or wire brush as this will damage the plating. If bolts are corroded or damaged they should be replaced.

d. Installation

1. Slide caliper over rotor and install mounting bolts. Insure that all sleeves, bushings and pins are well lubricated with silicone.

NOTE: Mounting bolt should go under inboard shoe ears.

2. Torque caliper mounting bolts to 30 foot-pounds.

See "CAUTION" on page 5-32.

3. Unplug fittings and reconnect brake line to caliper assembly.

NOTE: If brass bolt and block was removed with brake pipe, unplug fittings and install bolt and block using two new copper gaskets. Torque bolt or connector to 30 foot-pounds maximum. Realign brake lines to original positions so that they will not contact any other part during suspension travel. Do not leave brake lines misrouted.

4. Seat the outboard shoe against caliper by pumping service brake pedal or stroking the parking brake lever. Clinch upper ear of outboard shoe by positioning 12" pliers with one jaw on top of upper ear and one jaw in notch on bottom of shoe, opposite upper ear.

NOTE: After clinching, there should be no radial clearance between the shoe ears and caliper housing.

5. If radial clearance exists, repeat clinching procedure.

6. Install lever return and connect parking brake conduits and cables adjust as outlined on page 5-53.

7. Bleed rear brake system as outlined on page 5-9.

8. After bleeding, apply brake several times hydraulically (service brake) to insure adjustment.

9. Torque wheel mounting nuts to 100 foot-pounds.

10. Install wheel disc.

11. Lower car.

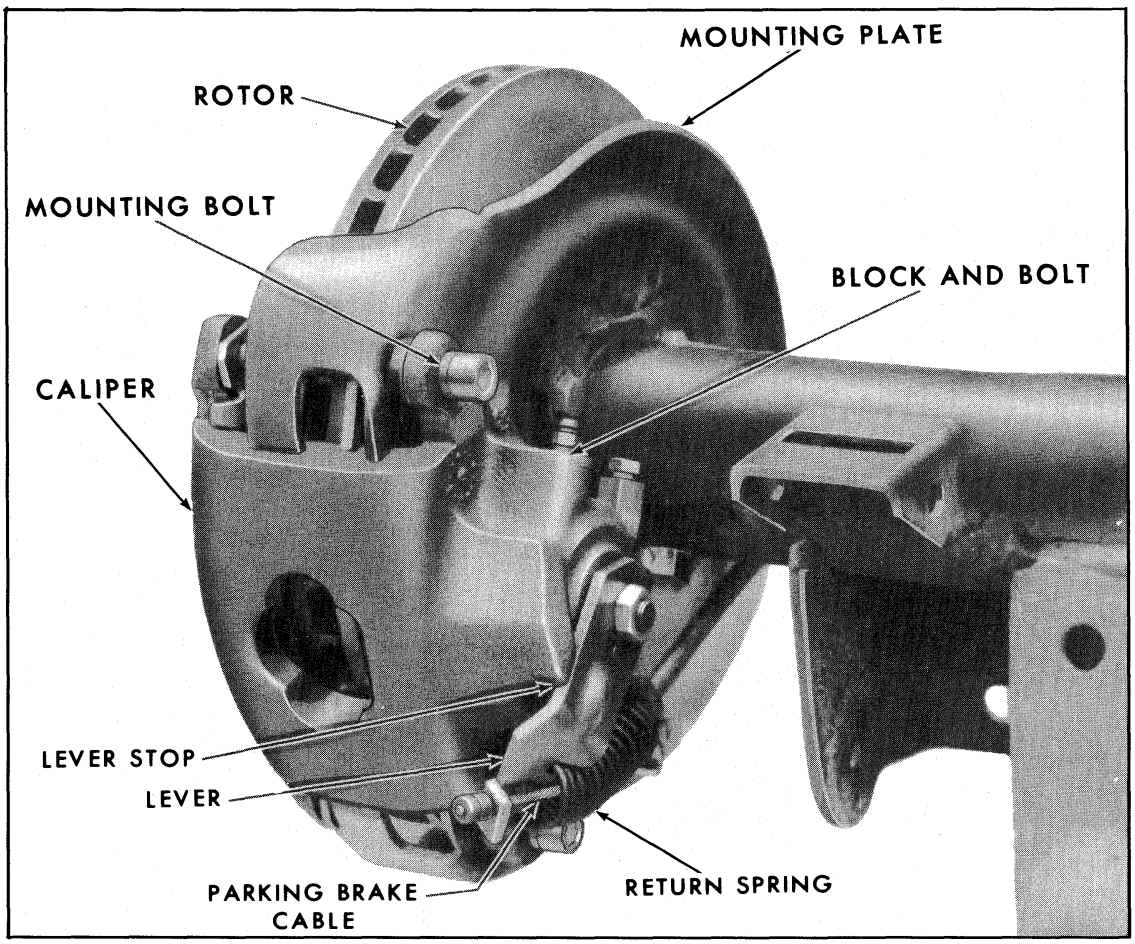


Fig. 5-64 Rear Brake Assembly - RH Brougham

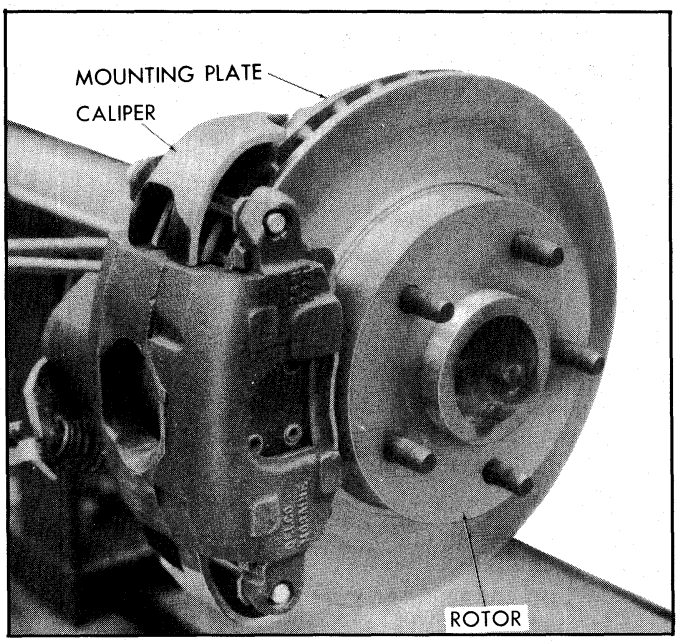


Fig. 5-65 Rear Brake Assembly - RH Seville

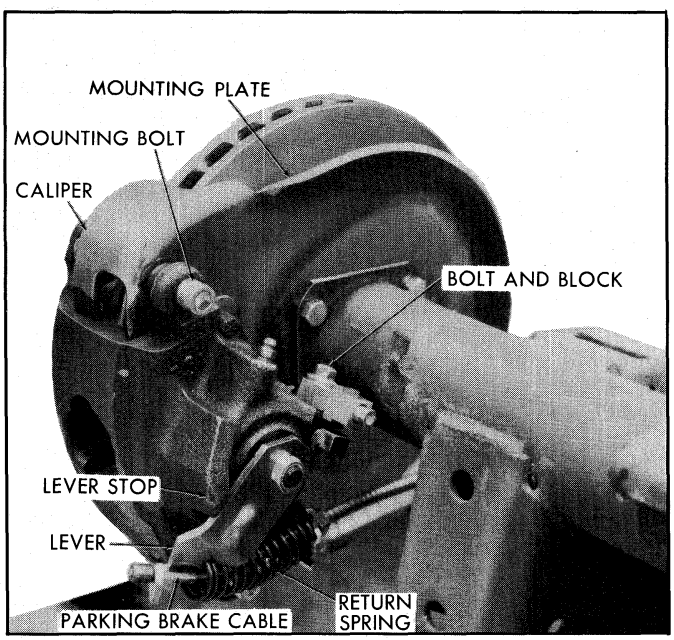


Fig. 5-66 Rear Brake Assembly Inboard view - LH Brougham

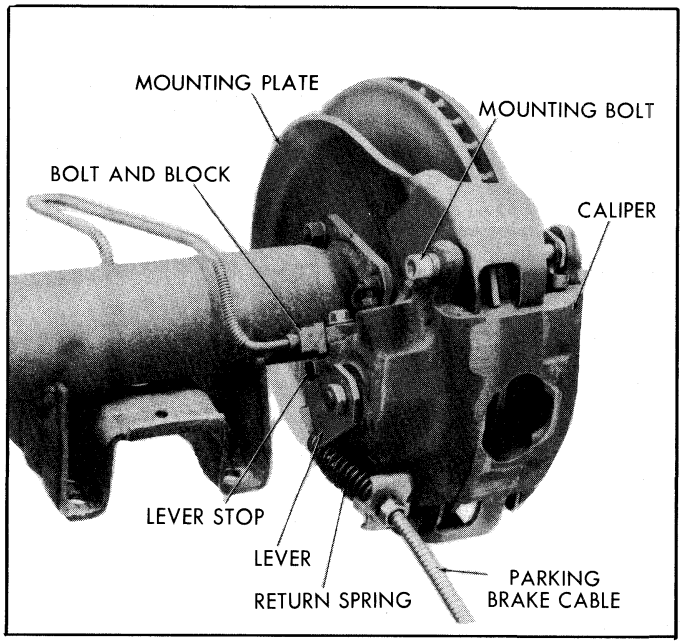


Fig. 5-67 Rear Brake Assembly Inboard View - LH Seville

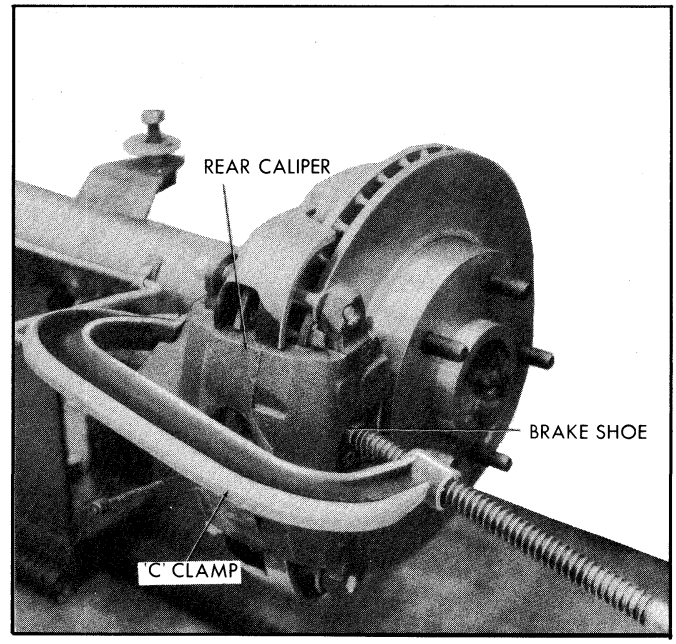


Fig. 5-69 Positioning "C" Clamp on Caliper

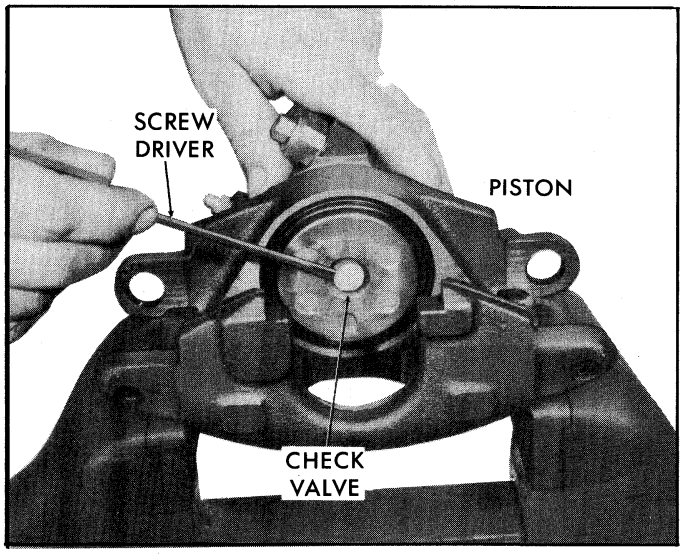


Fig. 5-68 Removing Piston Check Valve

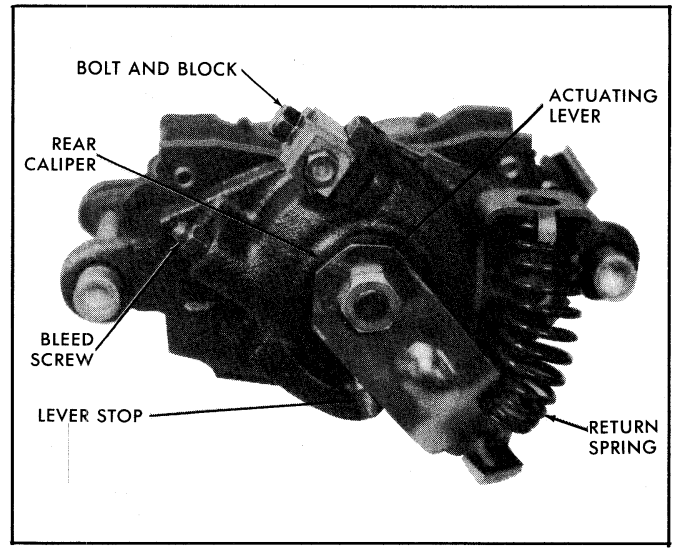


Fig. 5-70 Rear Caliper Assembly

UNIT OVERHAUL

REAR BRAKE CALIPER ASSEMBLY (Fig. 5-70)

NOTE: Eldorado piston assemblies are shorter in piston length and are not interchangeable with the assemblies for the Brougham and Seville.

a. Disassembly

1. Remove caliper from car as outlined on page 5-37.
2. Secure caliper in vise.
3. Remove two mounting sleeves and four bushings from caliper and discard.

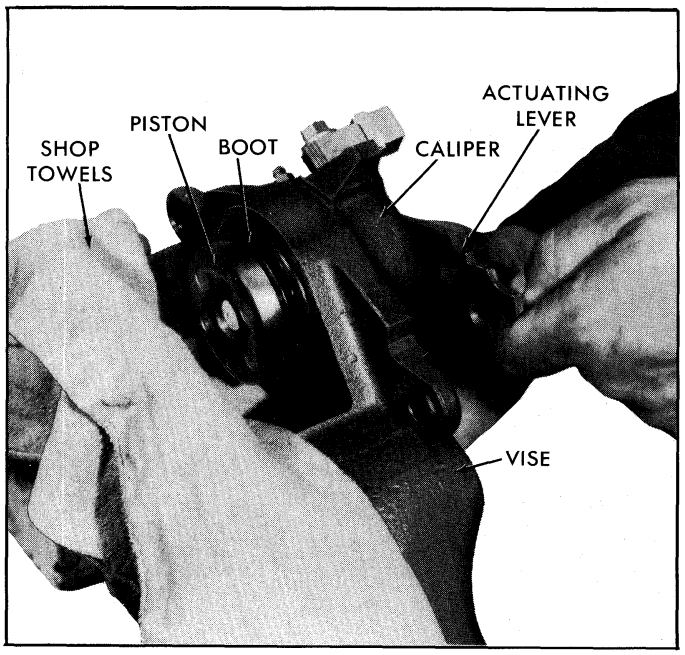


Fig. 5-71 Rotating Lever to Remove Piston

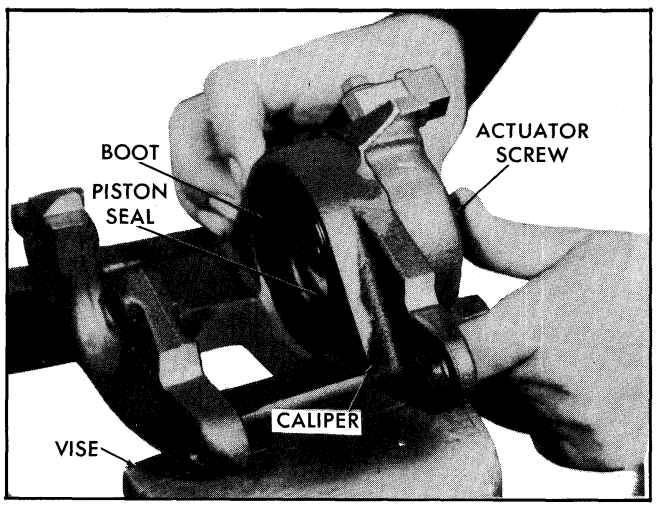


Fig. 5-72 Removing Screw from Housing

4. Remove brake shoes and lever return spring.

NOTE: Pad caliper using shop towels to catch piston and brake fluid when removing piston.

5. Rotate lever back and forth to move piston out of caliper housing, Fig. 5-71.

NOTE: If the piston will not move out of the housing by rotating the lever it can be turned out using a wrench. Remove the lock nut, lever, lever seal, and anti-friction washer. Using a 9/16 wrench turn the screw hex in normal apply direction until the piston pops out of the housing.

6. Remove piston assembly and balance spring.

7. Remove lock nut, lever, lever seal, and nylon anti-friction washer.

8. Push screw out of the housing, Fig. 5-72.

9. Remove piston seal and boot.

10. Flush caliper housing with clean denatured alcohol to remove all contaminats. (Any other cleaners may be harmful to components).

11. All passage ways should be blown out with clean air.

b. Assembly

1. Install new piston seal.

2. Install new boot onto new piston assembly. Lip of boot fits in second groove in piston, Fig. 5-73.

3. Assemble new thrust washer and seal onto actuator screw.

4. Fit actuator screw in piston assembly. Pistor assemblies are identified by stamped letter L or R on the enc of the adjustew screw.

These letters should match the chart.

5. Coat piston seal with a thin film of clean brake fluid

6. Fit the balance spring into the piston assembly spring retainer and start assembly into caliper housing, Fig. 5-73.

7. Use tool J-23072 to push piston all the way back in the housing, Fig. 5-74.

NOTE: Piston must be pushed in straight or the actuator screw seal will be damaged as it passes through the hole in the rear of the piston bore.

8. Before removing tool J-23072, install nylon anti-friction washer lubricated with silicone, new lever seal, lever and lock nut.

NOTE: Install lever away from stop. Rotate in apply direction and hold in position. Torque nut to 25 foot-pounds, Fig. 5-75.

9. Remove tool J-23072, rotate lever back to stop.

10. Install parking brake lever return spring.

11. Using tool J-26296 drive boot until seal bottoms in housing, Fig. 5-76.

12. Install linings as described on page 5-37.

13. Install caliper as described on page 5-39.

REAR CALIPER LETTER CODE

MODEL OR VEHICLE	CAR LOCATION	SCREW	LEVER	CASTING
BROUGHAM - ALL	L & R	L	L	L
ELDORADO	L	L	L	L
ELDORADO	R	R	R	R
SEVILLE	L	L	L	R
SEVILLE	R	R	R	R

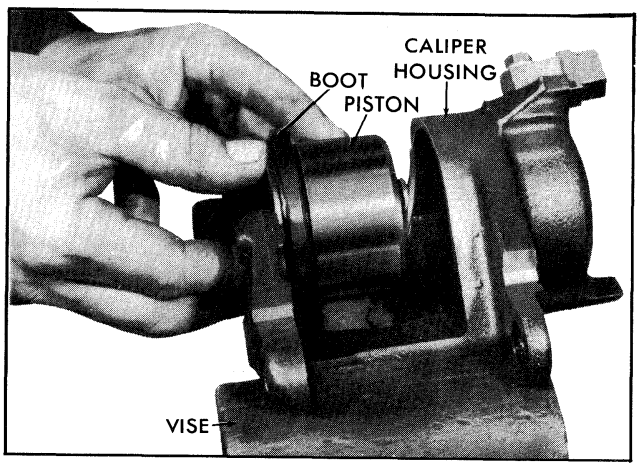


Fig. 5-73 Positioning Piston into Caliper

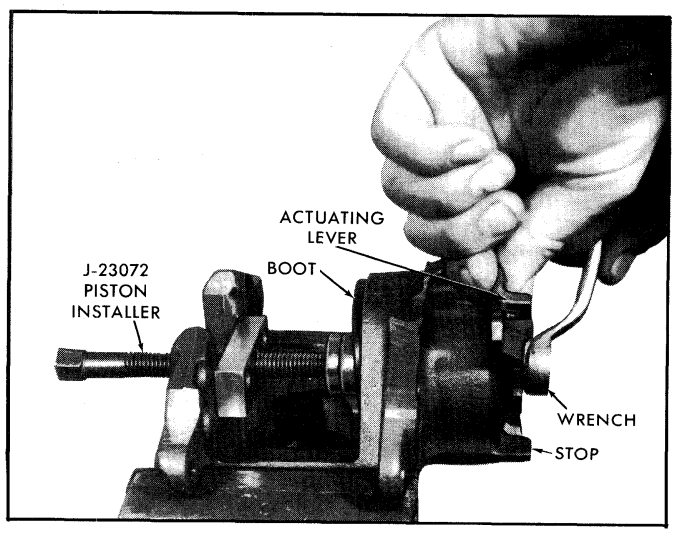


Fig. 5-75 Securing Piston in Housing

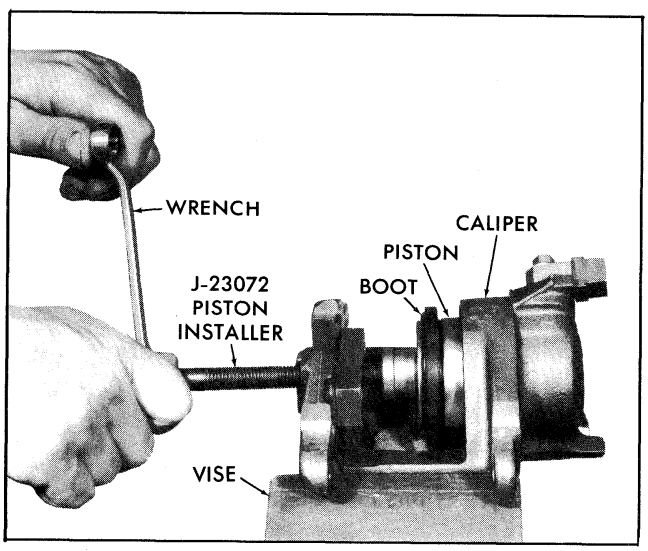


Fig. 5-74 Installing Piston into Housing

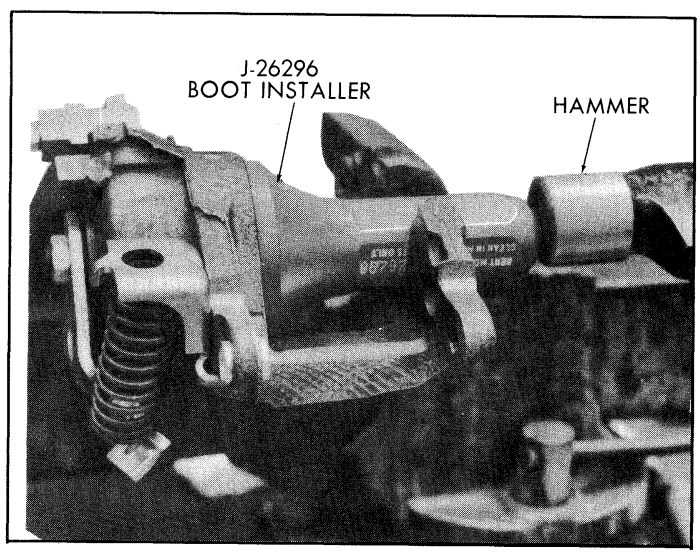


Fig. 5-76 Driving Boot into Housing

SPECIFICATIONS

POWER BOOSTER	
Type	Tandem Vacuum Diaphragm
Size, DeVille and Brougham	200mm x 200mm
Limousine and Commercial Chassis	8 1/2" x 8 1/2"
Seville	8" x 8"
MASTER CYLINDER	
Type	Dual
Piston Diameter	1.125"
Piston Stroke (Maximum)	
Brougham	1.468"
DeVille — Limousine — Commercial Chassis	1.408"
Seville	1.401"

SPECIFICATIONS (Cont'd.)

BRAKE COMBINATION VALVE	
Metering Valve — Hold Off Pressure	
Limousine and Commercial Chassis	130 PSI
DeVille	75 PSI
Brougham and Seville	None
Proportioning Valve — Hydraulic Pressure to Rear Brakes	
Brougham, Seville, Limousine and DeVille	41% above 470 PSI
Commercial Chassis	None
Tell Tale Differential Switch	
Activation Pressure	75-300 PSI
FRONT BRAKES	
DeVille, Brougham and Seville	Discs
Type	Floating Caliper and Cast Iron Ventilated
Rotor Diameter	300mm
Thickness — New	26.35mm
Minimum after Refinishing	24.9mm
Replacement (Minimum)	24.5mm
Thickness Variation — Circumferentially at any Radius	.013mm
Radially	.08mm
Flatness (Radially) T.I.R.	.05mm
Lateral Run Out — Maximum T.I.R.	.13 (.03mm within 30°)
Finish — Smoothness	.5-15 micro-meters
Type	Non-Directional
Total Swept Area	1528cm²
Caliper — Piston Diameter	2 15/16
Brake Lining	
Material	Molded Organic
Size, Outboard	5.4 x 1.92 x .40"
Inboard	5.4 x 1.92 x .43"
Lining Retained to Shoe By	Eyelets
Total Area	38.36 sq. in.
FRONT BRAKES	
Limousine and Commercial Chassis	
Type	Floating Caliper and Cast iron Ventilated Disc
Rotor Diameter	12 inches
Thickness — New	1.285"
Minimum after Refinishing	1.220"
Replacement (Minimum)	1.215"
Thickness Variation — Circumferentially at any Radius	.0005"
Radially	.003"
Flatness (Radially) T.I.R.	.002"
Lateral Run Out — Maximum T.I.R.	.005" (.001" within 30°)
Finish — Smoothness	20-60 micro-inch
Type	Non-Directional
Total Swept Area	236.80 sq. in.
Caliper — Piston Diameter	2 15/16
Brake Lining	
Material — Limousine	Molded Asbestos
Commercial Chassis	Semi-Metallic
Size, Outboard	5.4 x 1.92 x .40
Inboard	5.4 x 1.92 x .43
Lining Retained to Shoe By	Eyelets and Rivets
Total Area	38.36 sq. in.
REAR BRAKES	
DeVille	
Type	Cast Iron & Steel Finned Drum
Drum Diameter — New	11.000"
Maximum after Refinishing	11.060"
Replacement (Maximum)	11.090"
Run Out (Inside Diameter) Maximum	.006"
Diameter Change Within 360°	.002"
Within 30°	.001"

SPECIFICATIONS (Cont'd.)

Total Swept Area	138.23 sq. in.
Wheel Cylinder Diameter	1"
Brake Lining	
Material	Molded Organic
Size, Primary	8.95 x 2.0 x .25"
Secondary	11.59 x 2.0 x .29"
Lining Retained to Shoe By	Rivets
Total Area	76.63 sq. in.
Return Spring Color	
Primary LH-RH	Orange
Secondary LH-RH	Unpainted
Hold Down Spring Color	
Primary LH-RH	Unpainted
Secondary LH-RH	Unpainted
REAR BRAKES	
Limousine and Commercial Chassis	
Type	Cast Iron & Steel Finned Drum
Drum Diameter — New	12.000"
Maximum after Refinishing	12.060"
Replacement (Maximum)	12.090"
Run Out (Inside Diameter) Maximum	.005"
Diameter Change Within 360°	.0015"
Total Swept Area	188.5 sq. in.
Wheel Cylinder Diameter	15/16"
Brake Lining	
Material	Molded Organic
Size, Primary	11.00 x 2.5 x .23"
Secondary	12.36 x 2.5 x .26"
Lining Retained to Shoe By	Rivets
Total Area	110.72 sq. in.
Return Spring Color	
Primary LH-RH	Maroon
Secondary LH	Yellow
Secondary RH	Unpainted
Hold Down Spring Color	
Primary LH-RH	Gray
Secondary LH-RH	Green
REAR BRAKES	
Brougham and Seville	
Type	Floating Caliper and Cast Iron Discs
Rotor Diameter	283mm
Thickness — New	24.75mm
Minimum after Refinishing	23.13mm
Replacement (Minimum)	23.00mm
Thickness Variation — Circumferentially at any Radius	.013mm
Flatness (Radially)	.05mm
Lateral Run Out — Maximum	.076mm (.025mm within 45°)
Finish — Smoothness	.4 to 2.0 micro-meters
Type	Non-Directional
Total Swept Area	1530cm²
Caliper Piston Diameter	2 1/2"
Brake Lining	
Material	Molded Organic
Size, Outboard	5.4 x 1.92 x .40"
Inboard	5.4 x 1.92 x .43"
Lining Retained to Shoe By	Eyelets
Total Area	38.36 sq. in.

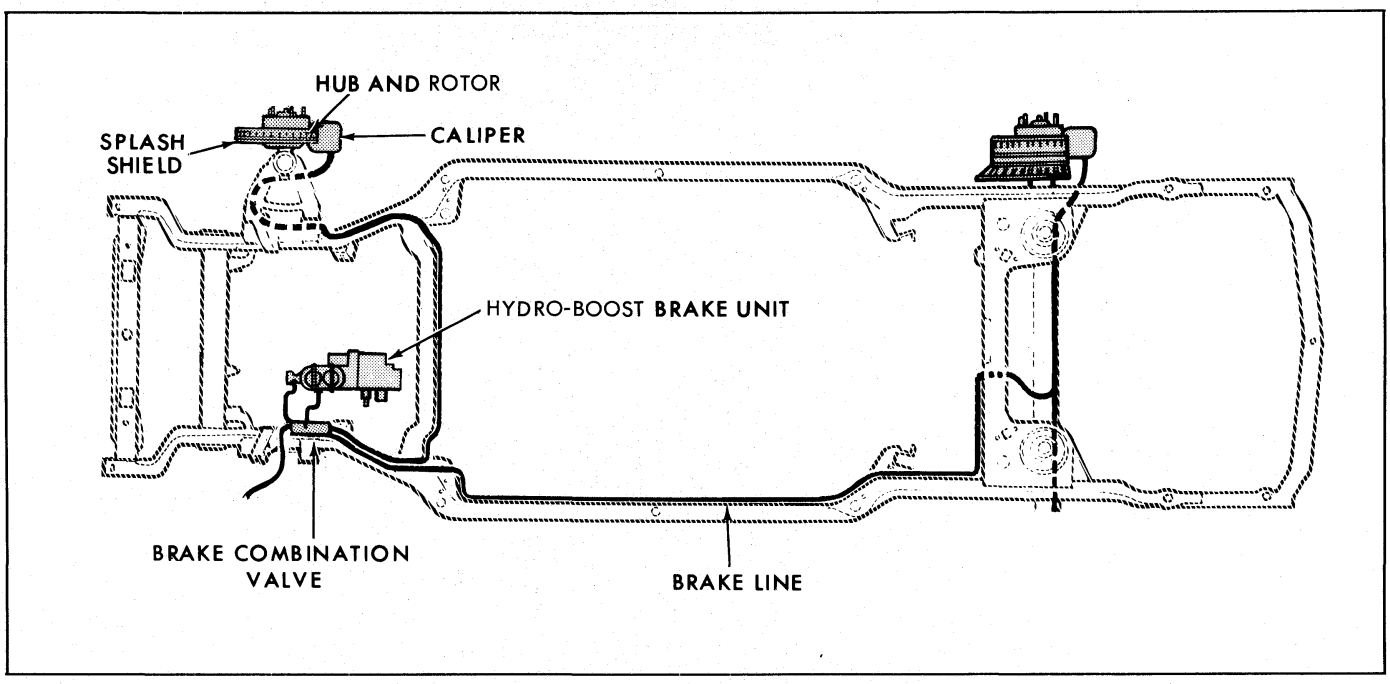


Fig. 5-77 Location of Components - Eldorado

ELDORADO DISC BRAKES
GENERAL DESCRIPTION

A four wheel disc brake system with Hydro-boost is used exclusively on the Eldorado.

The 11 inch diameter single piston-type disc brakes with an integral parking brake with automatic adjusting provisions and new brake linings are used in the rear. The front and rear brake caliper and lining are not interchangeable.

FRONT DISC BRAKES (Fig. 5-77)

The single piston sliding caliper front disc brake used on the Eldorado is serviced in the same manner as those installed on other Cadillac cars.

The following items are distinctive to the Eldorado.

HUB AND ROTOR (Fig. 5-77)

The Eldorado rotor is loose mounted or "floating" as opposed to an integral unit on other cars. The rotor and hub are separate components so that rotor replacement does not require replacing the hub and bearings.

The rotor is held in place by lug nuts and may be removed as easily as a brake drum once the caliper is removed. The rotor is 11" in diameter on the Eldorado only.

BRAKE COMBINATION VALVE (Fig. 5-77)

The combination valve is mounted on a bracket to the rear of the left side upper shock absorber mounting bracket and is secured to the frame side rail by two tapping screws. No metering valve function is used with four wheel disc brakes.

The remaining service operations on the combination valve remain unchanged.

SINGLE PISTON SLIDING CALIPER REAR DISC BRAKES (Caliper Functional Description) (Fig. 5-78)

The cone and piston move out as one part upon hydraulic apply. The nut remains stationary on the high lead screw, and a gap develops between the cone and nut.

Assuming some lining wear, the cone and piston do not return to their starting position (leaves a small gap equal to lining wear between cone and nut).

A 50 pound adjusting spring causes the nut to rotate on the high lead screw to close the gap (caliper has adjusted).

For a mechanical park brake apply, the lever is rotated by means of a conventional cable apply mechanism.

Lever rotation causes the high lead screw to turn, which causes the nut to progress down the screw, leading thru the cone and the cone/clutch interface of the piston resulting in a clamp load on the linings.

The caliper adjusts only when there is no pressure over the cone, thus, allowing it to rotate on the clutch interface (it will not automatically adjust on hydraulic apply).

The clutch interface prevents the cone from turning when the parking brake is applied.

BRAKE DIAGNOSIS CHART—ELDORADO

NOTE: Operation of Tell-Tale Brake Light may be checked as outlined on Page 8-93

CAUSE / Symptom	Excessive Brake Pedal Travel	Brake Pedal Travel Gradually Increases	Excessive Brake Pedal Effort	Excessive Braking Action	Brakes Slow to Respond	Brakes Slow to Release	Brakes Drag	Uneven Braking Action (Side to Side)	Uneven Braking Action (Front to Rear)	Scraping Noise from Brakes	Brakes Squeak During Application	Brakes Squeak During Stop	Brakes Chatter (Roughness)	Brakes Groan at End of Stop	Brakes Tell-Tale Glows	Excessive Parking Brake Pedal Travel	No Reserve Stopping
Leaking Brake Line or Connection	X	XX	X						X						XX		
Leaking Piston Seal	X	XX	X	X				X							X		
Leaking Master Cylinder	X	XX	X												X		
Air in Brake System	XX		X						X						XX		
Contaminated or Improper Brake Fluid	X				X	X	X								X		
Damaged Power Head *			X	X	X	X	XX										XX
Worn Out Brake Lining			X	X				X	X	X	X	X		X			
Uneven Brake Lining Wear Replace	X			X				X	X	X	X	XX		X	X		
Glazed Brake Lining - Sand			XX		X			X	X		X	X					
Incorrect Lining Material - Replace			X	X				X	X			X		X			
Contaminated Brake Lining - Replace				XX				XX	XX	X	X	X		X			
Heat Spotted or Scored Rotors				X				X	X		X	X	XX	X			
Out-of-Parallel Brake Rotor	X												XX				
Excessive Rotor Run-Out	X												X				
Faulty Rear Caliper Automatic Adjusters							X	X	X							X	
Brake Assembly Attachments - Missing or Loose	X						X	X	X	X		X	X	X			
Restricted Brake Fluid Passage		X	X		X	X	X	X	X						X		
Improperly adjusted Stoplight Switch or Cruise Control Vacuum Dump							X										
Faulty Proportioning Valve			X	X	X	X	X		X								
Brake Pedal Linkage Interference or Binding			X		X	XX	XX										
Improperly Adjusted Parking Brake Cables							X									X	
Incorrect Front End Alignment								XX									
Incorrect Tire Pressure								X	X								
Incorrect Wheel Bearing Adjustment	X									X			X				
Loose Front Suspension Attachments							X	X		XX			X	X			
Out-of-Balance Wheel Assemblies													XX				
Incorrect Body Mount Torque Need to Slightly Increase or Decrease Pedal Effort													X	XX			
Operator Riding Brake Pedal			X				X		X					X			
Sticking Caliper Piston							XX										
Parking Brake Pedal							X										
Not Fully Released															X		

XX – Indicates more probable cause(s)
X – Indicates other causes
* – See Hydro-boost Diagnosis

DIAGNOSIS

PARKING BRAKE

If excessive parking brake pedal travel, adjust parking brake cables and check pedal travel. If pedal travel is correct but, upon releasing, adjusting levers are off the stops, either return springs are faulty or automatic adjusters are not adjusting. Replace return springs or piston and screw assemblies as necessary.

NOTE: Levers must be on caliper stops after completion of adjustment.

ON-CAR SERVICE

NOTE: The service information that follows pertains only to the Eldorado. For service procedures not given, refer to the forward portion of this section, as these procedures are the same as for the other Cadillac models.

ROTOR ASSEMBLY REMOVAL AND INSTALLATION (Front)

a. Removal

1. Raise car and remove front wheel.
2. Remove two bolts which hold caliper to steering knuckle.

NOTE: It is not necessary to remove brake hose from caliper when removing rotor for service.

3. Remove cotter pin, loosen upper spherical joint nut and slip brake hose collar out of its clip. The slack gained will permit removal of caliper without pulling hose.
4. Slide caliper off rotor and support by a hook-shaped wire fastened to upper suspension arm.

CAUTION: *Do not allow caliper to hang from brake hose as this could result in possible damage to hose.*

5. Mark a wheel stud and a corresponding place on the rotor to assist in installation.
6. Remove the rotor by sliding it off the hub.

b. Installation

1. Inspect hub flange and rotor mating surfaces to make sure that they are free of dirt and other foreign material. Clean as required.
2. If reinstalling original rotor, align index marks on hub and rotor and slide rotor over hub pilot diameter, making sure that rotor is seated against hub flange.

NOTE: If rotor replacement is necessary, the new rotor may be assembled to the hub in any position. It is not necessary to replace both rotors if one is all right.

3. Position caliper on rotor and line up holes in caliper ears with holes in steering knuckle. Make sure brake hose is not twisted, as its natural curvature is essential to maintain proper hose-to-suspension clearance through full movement of suspension and steering parts.
4. Wipe all dirt and corrosion from the caliper mounting bolts. Do not use abrasives, as they will remove protective plating. Lubricate smaller ends of bolts with silicone lubricant.
5. Start either bolt into the inboard ear of the caliper and into the steering knuckle. At this point it is necessary to be sure that the bolt passes under the retaining ear on the inboard shoe to maintain the shoe in position in the caliper, Fig. 5-16.
6. Pass the bolt on through the outboard ear on the caliper until the threads on the bolt can be started into the steering knuckle.
7. Repeat steps 5 and 6 in placing remaining bolt into caliper assembly.

See "CAUTION" page 5-31 for steps 8, 12, 13.

8. Tighten caliper mounting bolts to 30 foot-pounds.
9. Pump brake pedal to seat lining against rotors.
10. Clinch upper ears of outboard shoe by positioning 12" pliers with one jaw on top of upper ear and one jaw in notch on bottom of shoe, opposite upper ear, see. Fig. 5-17.

NOTE: After clinching, there should be no radial clearance between the shoe ears and caliper housing.

11. If radial clearance exists, repeat clinching procedure.
12. Center brake hose collar in clip and tighten spherical joint nut to 60 foot-pounds. Install cotter pin.
13. Install wheels, tighten wheel mounting nuts to 130 foot-pounds and lower car.
14. Allow car weight to be supported on front wheels and inspect front brake hoses for twisted condition. If necessary, correct as described on page 5-53.
15. Before moving the vehicle, pump the brake pedal two or three times to insure firm pedal.

REAR BRAKE CALIPER (Fig. 5-78)

a. Removal

1. Remove two thirds of total fluid capacity in front master cylinder reservoir and discard fluid.

NOTE: Removing fluid prevents reservoir overflow when the piston is pushed back in its bore to remove the caliper.

2. Raise car on hoist.
3. Remove wheel disc and wheel and tire assembly.
4. Install one wheel mounting nut, flat side toward rotor to keep rotor from falling when caliper is removed, Fig. 5-79.
5. Loosen tension on parking brake cable at equalizer.
6. Remove cable from parking brake lever, Fig. 5-80.
7. Remove return spring, lock nut, lever, lever seal, and anti-friction washer.

NOTE: Lever must be held in place while removing nut.

8. Clean any contamination from caliper surface in the area of the lever seal.
9. Using a 7 inch (or larger) "C" clamp with the solid end on the lever stop, Fig. 5-81, and screw end on the back of the outboard lining assembly, turn clamp until piston bottoms in the caliper.

NOTE: Do not position "C" clamp, lube the caliper housing surface (under the lever seal), with silicone, Fig. 5-78.

11. Install new anti-friction washer, lever seal and lever.

NOTE: Install lever on hex with arm pointing downward.

12. Rotate lever toward front of car and while holding in this position, install nut and torque to 25 foot-pounds. Then rotate lever back to stop.
13. Install lever return spring and remove "C" clamp, Fig. 5-81.

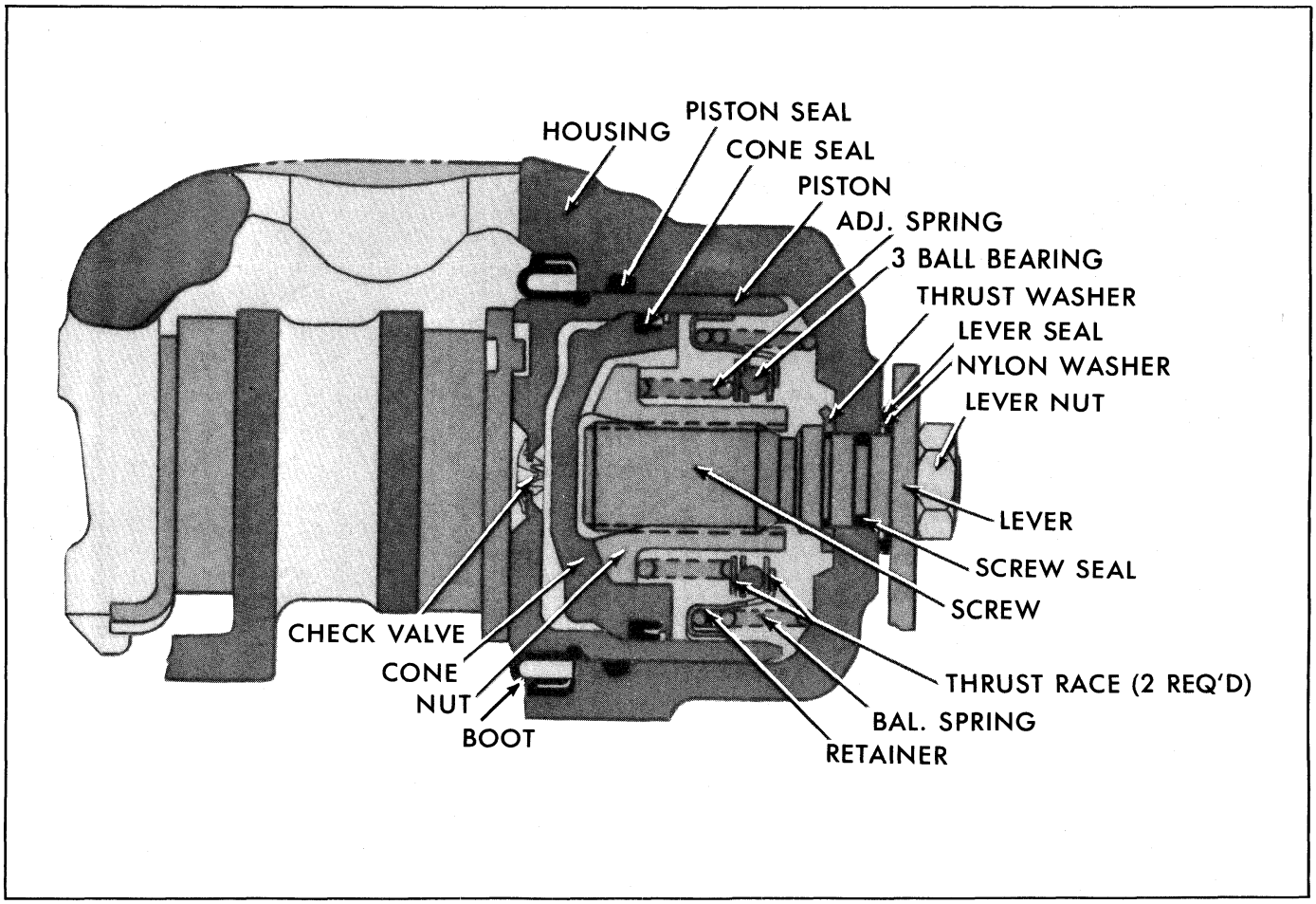


Fig. 5-78 Rear Brake Caliper - Cross Section View

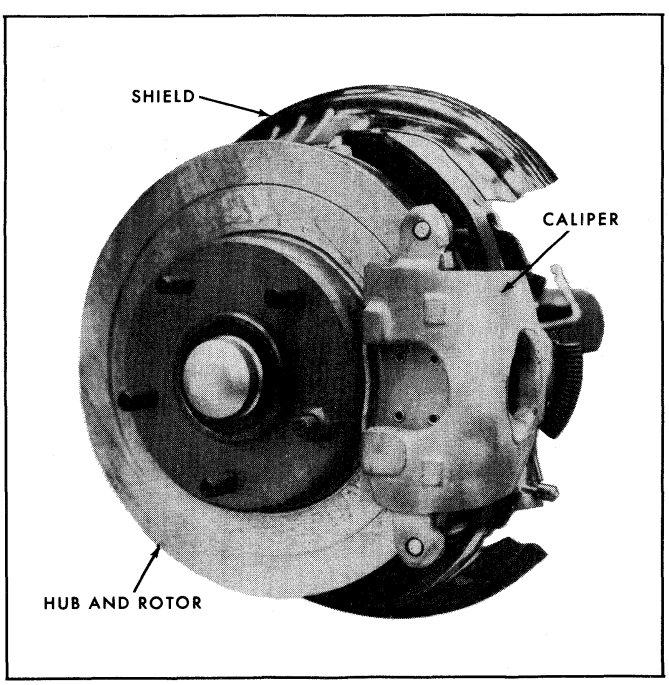


Fig. 5-79 Rear Brake Assembly - Eldorado

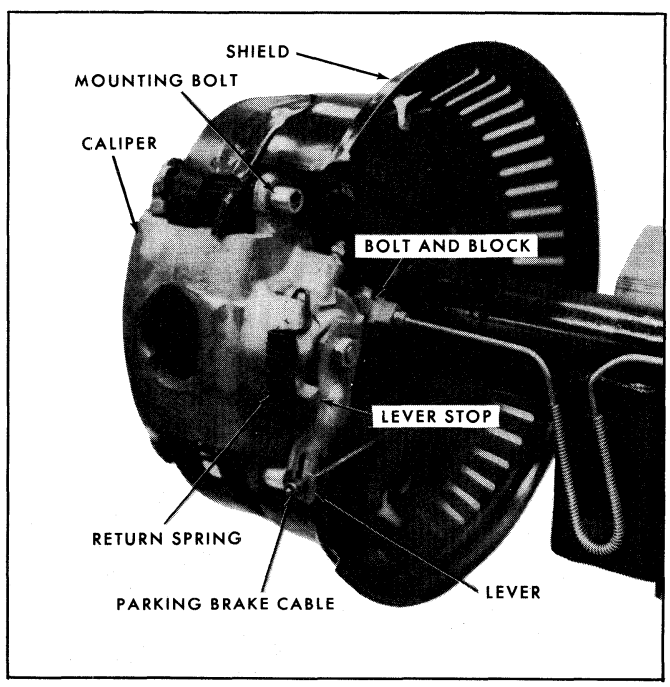


Fig. 5-80 Rear Brake Assembly - Inboard View

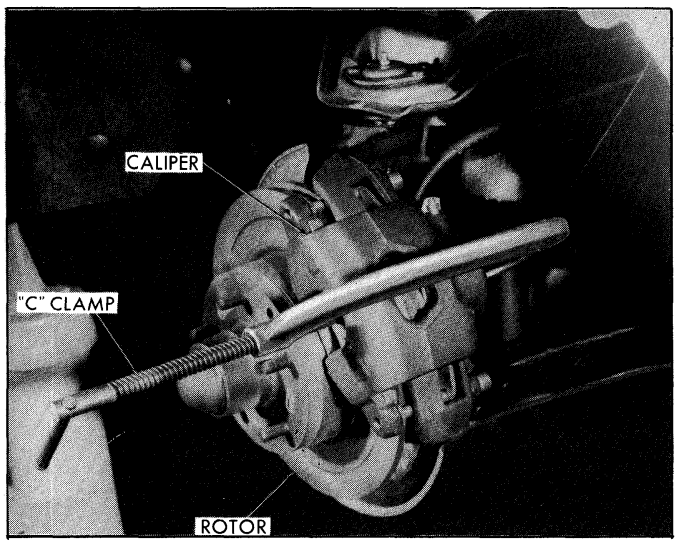


Fig. 5-81 Positioning "C" Clamp on Caliper

NOTE: Return springs are color coded, red for right hand caliper and black for left hand.

14. Remove brake line from caliper and plug openings to retain fluid and prevent entrance of dirt.

NOTE: If brake line nut is seized, brass bolt and block on caliper can be removed with brake line attached by removing bolt, and block copper washers after removing caliper mounting bolts. Be sure to plug openings.

15. Remove caliper mounting bolts and remove caliper together with brake shoes; then remove shoes.

b. Inspection

1. Clean dirt and corrosion from face of piston.

2. Examine piston and check valve area for fluid leaks by looking for excessive moisture around boot area. Check dust boot for cuts, cracks or other damage which would affect its ability to seal piston bore. If leaks are present replace dust boot.

CAUTION: *Do not use air for cleaning caliper because of the possibility of unseating dust boot.*

3. Check piston boot seal for leaks. Replace piston seal and boot seal if leaking.

4. Check for leaks at threaded end of actuator screw. If leaking, replace seal. If bore is scratched or nicked, replace caliper.

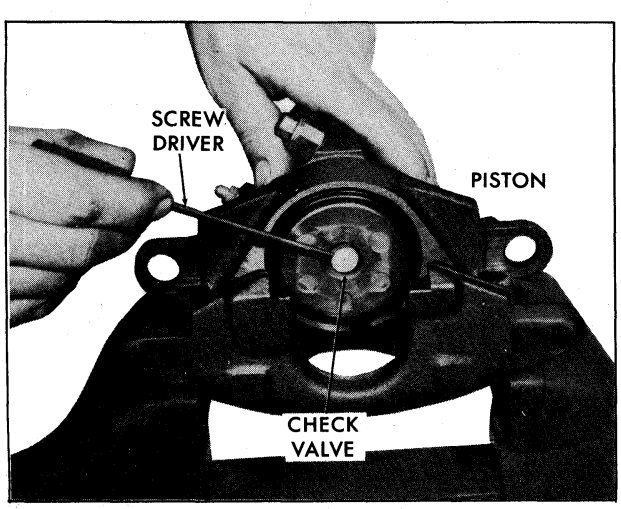


Fig. 5-82 Removing Piston Check Valve

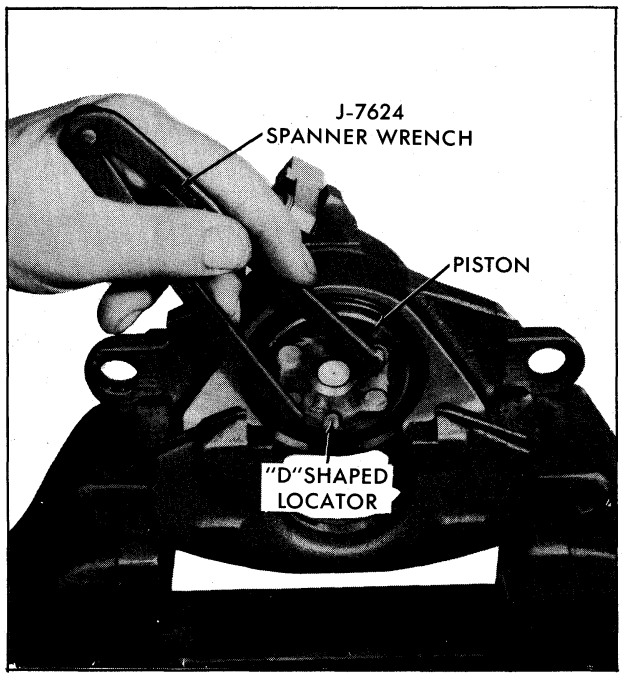


Fig. 5-83 Turning Piston in Bore

c. Lining Replacement

1. Remove and discard two caliper mounting sleeves and four bushings.

2. Using silicone lube, install new bushings and sleeves.

NOTE: Sleeves are installed in inner bushings.

3. Remove and discard piston check valve and install new piston check valve, Fig. 5-82.

WARNING: FRONT BRAKE SHOES MUST NOT BE USED ON REAR CALIPERS.

4. Position new inboard shoe assembly on piston. The D-shaped tab must fit in the indentation provided in the piston. If piston requires rotation, use special tool J-7624 to turn it, Fig. 5-83.

5. Install new outboard shoe assembly.

6. Wipe all dirt from caliper mounting bolts. Do not use sand paper or wire brush as this will damage the plating. If bolts are corroded or damaged they should be replaced.

d. Installation

NOTE: If brass bolt and block was removed with brake pipe, unplug fittings and install bolt and block using two new copper gaskets. Torque bolt to 30 foot-pounds maximum.

1. Slide caliper over rotor and install mounting bolts. Insure that all sleeves, bushings and pins are well lubricated with silicone.

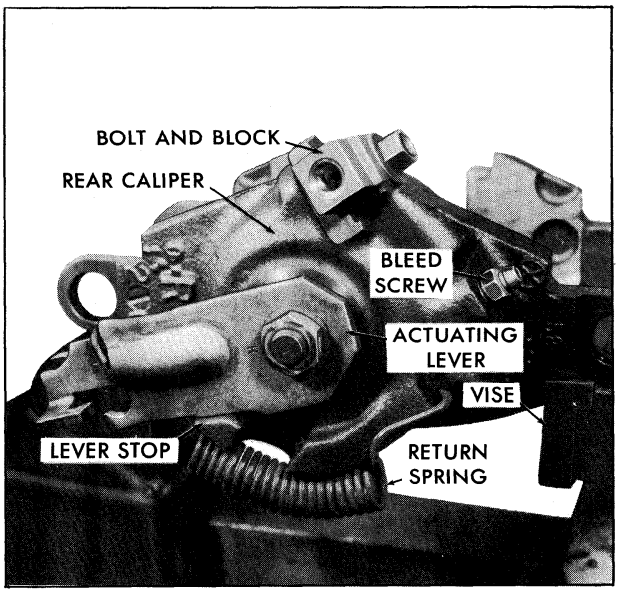


Fig. 5-84 Securing Caliper in Vise

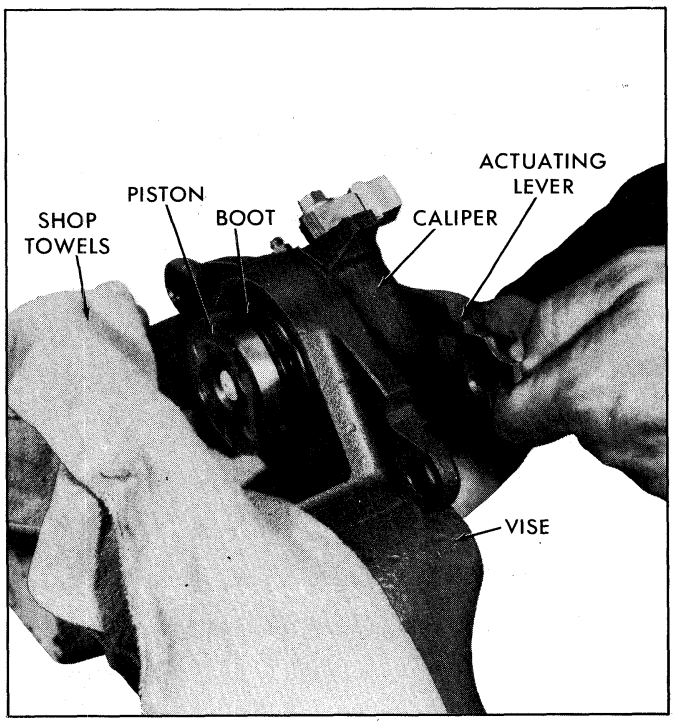


Fig. 5-85 Rotating Lever to Remove Piston

NOTE: Mounting bolt should go under inboard shoe ears.

2. Torque caliper mounting bolts to 30 foot-pounds. See "CAUTION" on page 5-32.

3. Unplug fittings and install brake line tube nut into caliper.

4. Pump brake pedal to seat lining against rotor.

5. Clinch upper ear of outboard shoe by positioning 12" pliers with one jaw on top of upper ear and one jaw in notch on bottom of shoe, opposite upper ear, see Fig. 5-17.

NOTE: After clinching, there should be no radial clearance between the shoe ears and caliper housing.

6. If radial clearance exists, repeat clinching procedure.

7. Connect parking brake cables and adjust as outlined on page 5-53.

8. Bleed rear brake system as outlined on page 5-9.

9. After bleeding, apply brake several times hydraulically (service brake) to insure adjustment.

10. Remove one wheel mounting nut used to retain rotor and install wheel and tire assembly.

11. Lower car.

12. Torque wheel mounting nuts to 130 foot-pounds.

13. Install wheel disc.

REAR BRAKE CALIPER ASSEMBLY

a. Disassembly

CAUTION: *Power steering fluid and brake fluid cannot be mixed. If brake seals contact steering fluid or steering seals contact brake fluid, seal damage will result.*

1. Remove caliper from car as outlined on page 5-48.

2. Secure caliper in vise as shown in Fig. 5-84.

3. Remove two mounting sleeves and four bushings from caliper and discard.

4. Remove brake shoes and lever return spring.

NOTE: Pad caliper using shop towels to catch piston and brake fluid when removing piston.

5. Rotate lever back and forth to move piston out of caliper housing, Fig. 5-85.

NOTE: If the piston will not move out of the housing by rotating the lever it can be turned out using a wrench. Remove the lock nut, lever, lever seal, and anti-friction washer. Using a 9/16 wrench turn the screw hex clockwise on the right hand caliper and counter-clockwise on the left until the piston pops out of the housing.

6. Remove piston assembly and balance spring.

7. Remove lock nut, lever, lever seal, and anti-friction washer.

8. Push screw out of the housing, Fig. 5-86.

9. Remove piston seal and boot.

10. Flush caliper housing with clean denatured alcohol to remove all contaminants.

11. All passage ways should be blown out with clean air.

b. Assembly

1. Install new piston seal.

2. Install new boot onto new piston assembly. Lip of boot fits in groove provided in piston, Fig. 5-87.

3. Assemble new thrust washer and seal onto new actuator screw.

4. Fit actuator screw in new piston assembly. Piston assemblies are identified by stamped letter on the end of the adjuster nut. "L" designates left and "R" right. These letters should match the letter on the caliper housing.

NOTE: The caliper and the actuator screw are marked "R" for the right side of the car and "L" for the left or drivers side of the car. The parking brake will not work if these parts are not on correct side of car.

5. Coat piston seal with a thin film of clean brake fluid.

6. Fit the balance spring into the piston assembly spring retainer and start assembly into caliper housing, Fig. 5-87.

7. Use tool J-23072 to push piston all the way back in the housing, Fig. 5-88.

NOTE: Piston must be pushed in straight or the actuator screw seal will be damaged as it passes through the hole in the rear of the piston bore.

8. Before removing tool J-23072, install lubricated anti-

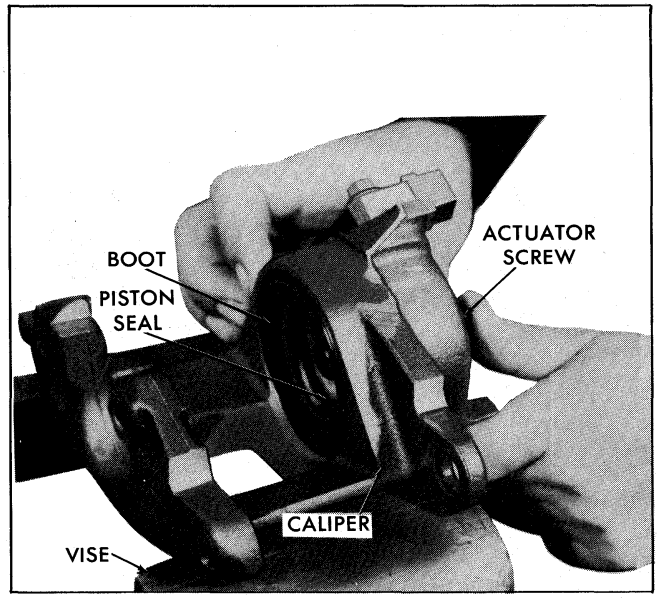


Fig. 5-86 Removing Screw From Housing

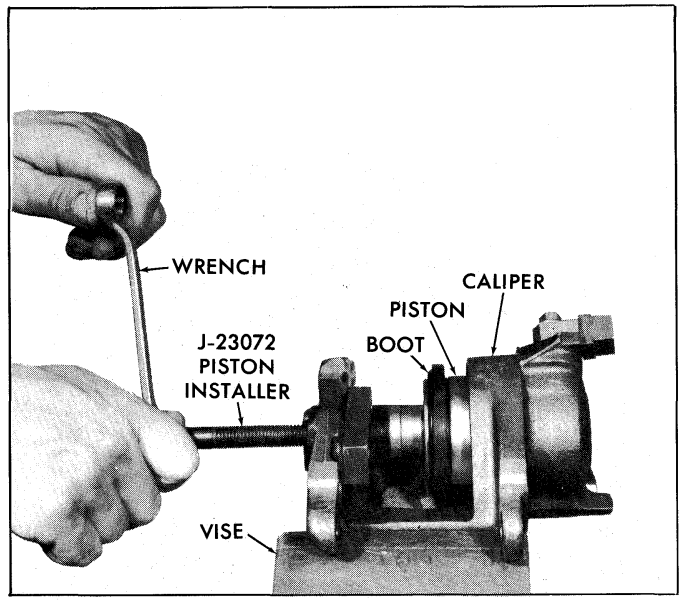


Fig. 5-88 Installing Piston into Housing

friction washer, new lever seal, lever and lock nut, Fig. 5-89.

NOTE: Install lever away from stop. Rotate forward and hold in position. Torque nut to 25 foot-pounds.

9. Remove tool J-23072, rotate lever back to stop and install return spring.

NOTE: Return springs are color coded, red for right hand caliper and black for left hand.

10. Using tool J-26296 drive boot until seal bottoms in housing, Fig. 5-90.

11. Install linings following Note C. page 5-50.

12. Install caliper following Note D. page 5-51.

PARKING BRAKE

a. Front Cable

The procedure for removing and installing the front parking brake cable is described on page 5-52.

b. Removal–Rear Cable

1. Release parking brake.
2. Raise rear of car and position on jack stands.
3. Loosen equalizer nut and remove equalizer.
4. Remove cable from equalizer.
5. Remove clips retaining parking brake cable to lower control arm brackets on left side and at each caliper support plate.
6. Remove cable ends from parking brake actuator.
7. Remove control arm hooks, and remove conduit from exhause hanger clip.

c. Installation–Rear Cable

1. Connect parking brake cable ends to actuator operating levers.
2. Install retainers at caliper support plates.

NOTE: Pull on cable and check operation of cable and brake mechanisms.

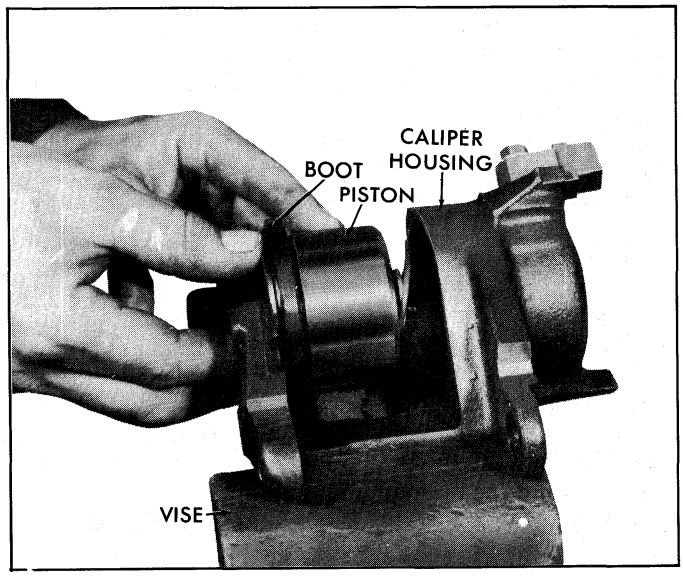


Fig. 5-87 Positioning Piston into Caliper

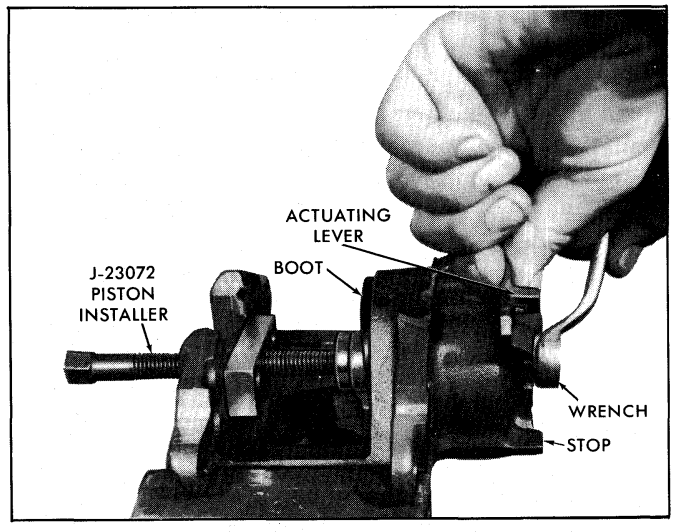


Fig. 5-89 Securing Piston in Housing

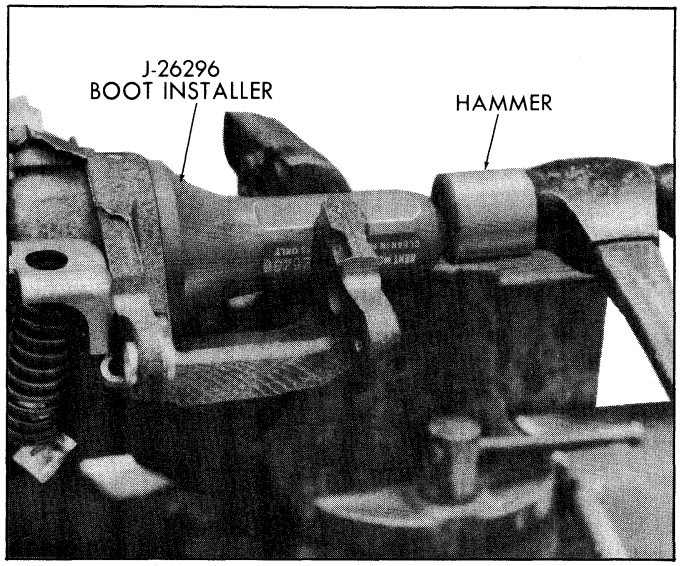


Fig. 5-90 Driving Boot into Housing

3. Position brake cable to lower control arm brackets on left side of car, and secure with clips.
4. Install conduit in exhaust hanger clip.
5. Install cable in equalizer.
6. Tighten equalizer nut.
7. Adjust parking brake as described on page 5-53.

PARKING BRAKE ADJUSTMENT (Fig. 5-91)

1. Lubricate parking brake cables at equalizer hooks and underbody rub points, and check for free movement of all cables.
2. Make sure parking brake pedal is in fully released position.
3. Raise rear wheels off floor.
4. Hold brake cable stud from turning and tighten equalizer nut until cable slack is removed.
5. Make sure caliper levers are against stops on caliper housing.
6. If levers are off stops, loosen cable until levers do return to stops.
7. Operate parking brake pedal several times to check adjustment.

NOTE: After cable adjustment is performed, parking brake pedal should travel 4 to 5 1/2 inches with approximately 125 pounds force on pedal.

8. Lower rear wheels.

NOTE: Levers must be on caliper stops after completion of adjustment.

BRAKE COMBINATION VALVE

a. Removal

1. Raise hood.
2. Disconnect wiring connector from valve.
3. Disconnect three brake pipes from top and one from rear of valve and remaining brake pipe from bottom of valve.
4. Remove two bolts securing valve to frame bracket and remove valve.

b. Installation

1. Position valve to frame bracket and secure with two bolts.
2. Install brake pipe to bottom of valve and one brake pipe to rear of valve and three on top.
3. Connect wiring connector to valve.

NOTE: When replacing a combination valve, rear brake bleeding can be accomplished by allowing brake fluid to flow from the rear brake pipe nut at the valve. Back off this nut one turn and catch fluid flow in a cloth or a container until air is eliminated.

The front brakes should be bled at the calipers in the usual manner. Then, before driving car, be sure a firm pedal is obtained.

4. Bleed brakes as described on page 5-9.
5. Close hood.

SERVICING STEEL BRAKE LINES AND FLEXIBLE HOSES

Hydraulic pressure is transferred to the brake calipers through steel brake lines, flexible hoses, and a brake combination valve.

The steel brake lines and flexible hoses should be inspected every spring and fall for damage that may occur from various road hazards.

While the flexible hoses and steel lines require no periodic servicing, it may be necessary to replace damaged hoses or lines in the following manner.

a. Removal–(Front Wheels)

1. Disconnect steel brake line from hose at frame bracket by turning steel tubing nut out of hose fitting. Cap fitting to prevent loss of fluid and entrance of dirt.
2. Remove U-shaped retainer from hose fitting at frame support bracket and remove hose from bracket.
3. Remove cotter pin and nut securing upper spherical joint to knuckle and remove clip securing brake hose to joint stud.
4. If right front hose is being replaced, remove clip retaining hose to frame.
5. Turn hose out of inlet fitting of caliper and remove and discard copper gasket. If hose is to be reused, cap end fittings to prevent dirt from entering hose.

b. Installation–(Front Wheels)

1. Install new copper gasket on caliper end of hose (male end).
2. Tighten hose in caliper inlet to 30 foot-pounds maximum torque.

CAUTION: *Never tighten hose in caliper inlet with hose attached at frame end, as this will twist the hose and may cause possible damage.*

3. Install brake hose clip on upper spherical joint stud and install retaining nut on stud. Tighten spherical joint nut finger tight.

When assembling front brake hoses at the frame attachment bracket, front standing height must be set to 13.50 inches as measured along shock absorber from centerline of top mounting bolt to centerline of bottom mounting bolt, before hose is assembled to bracket.

CAUTION: *Hose must not be twisted when assembled as possible damage or interference may occur.*

This measurement can be obtained by using Tool J-24842. Insert bottom of tool in lower suspension arm below shock mounting bracket. Compress suspension and insert top of tool into upper shock mounting bracket, Fig. 5-92.

NOTE: Do not twist hose any more than necessary during this operation as its natural curvature is essential to maintain proper hose-to-suspension clearance through full movement of suspension, steering and

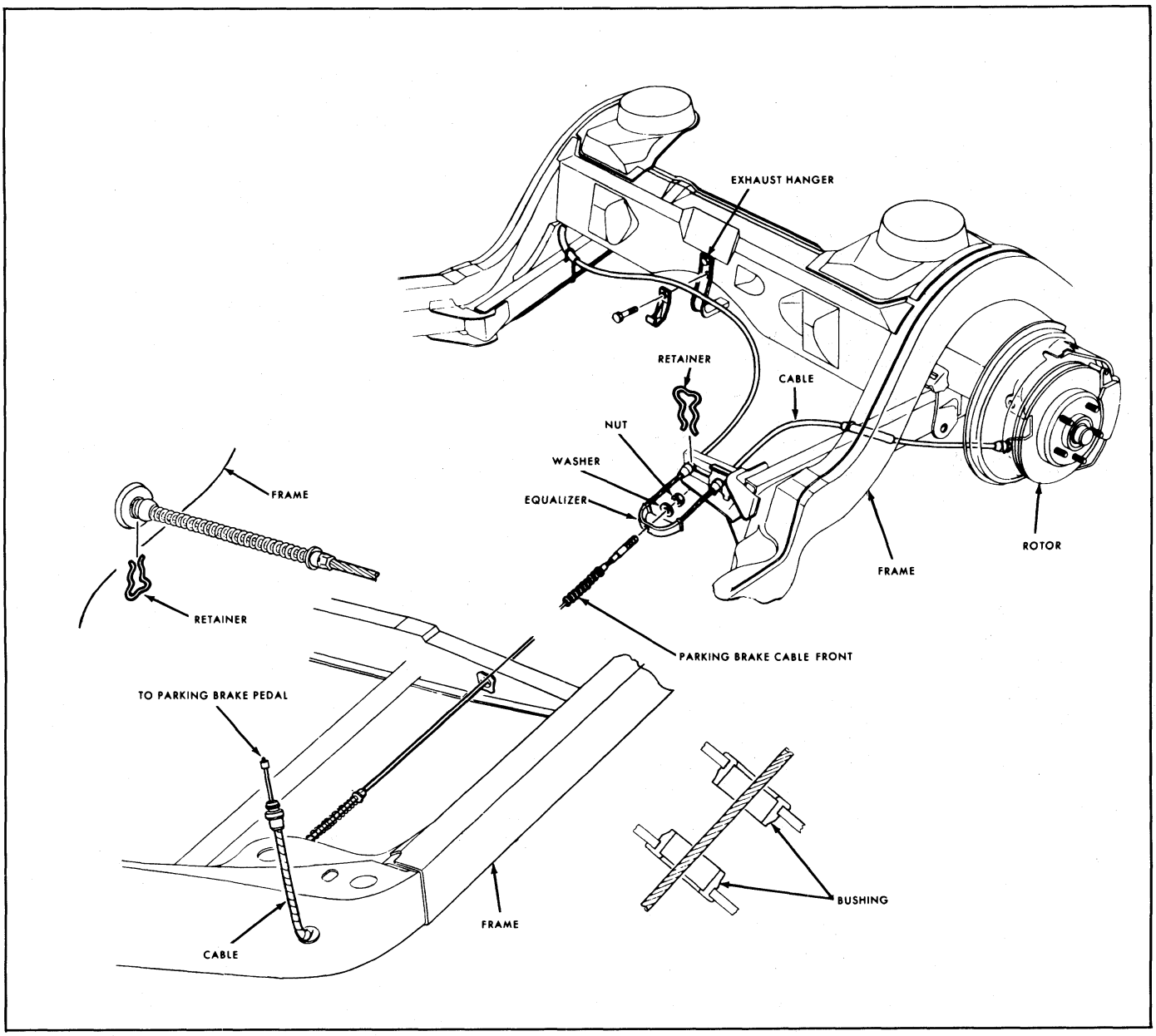


Fig. 5-91 Parking Brake Cables (Eldorado)

driving parts.

4. With suspension in position (front wheels straight ahead) pass female end of hose through frame support bracket, allowing hose to seek its own position. Insert hex of hose fitting into the 12-point hole in support bracket in the position that will require the least twist in hose.

5. Install U-shaped retainer to secure hose to frame support bracket.

6. If right front hose is being replaced, install clip securing hose to frame.

7. Inspect by turning wheels from stop-to-stop while observing hose position. Be sure that hose does not touch any other part at any time during steering travel. If contact does occur, remove hose retainer, and if necessary loosen upper spherical joint nut, and reposition hose as necessary. Replace retainer, tighten spherical joint nut finger tight, and reinspect.

8. When hose is properly positioned, torque spherical joint nut to 60 foot-pounds minimum.

See "CAUTION" page 5-32.

NOTE: If cotter pin cannot be installed, tighten nut to next hole and install cotter pin.

CAUTION: *When installing cotter pin, make sure ends of pin are pinched tight against flat of nut. DO NOT let end of cotter pin extend down toward outer drive axle seal.*

9. Install steel brake line fitting into brake hose at frame support bracket and tighten fitting to 20 foot-pounds maximum torque.

10. Bleed brakes as described on page 5-9.

c. Removal–Hydraulic Brake Lines (Rear Wheels)

1. Disconnect steel brake lines at rear caliper junction block. Cap fitting to prevent dirt from entering wheel cylinder.

2. Disconnect brake line at brake line junction fitting on rear axle.

3. If left brake line is being removed, bend clip open and

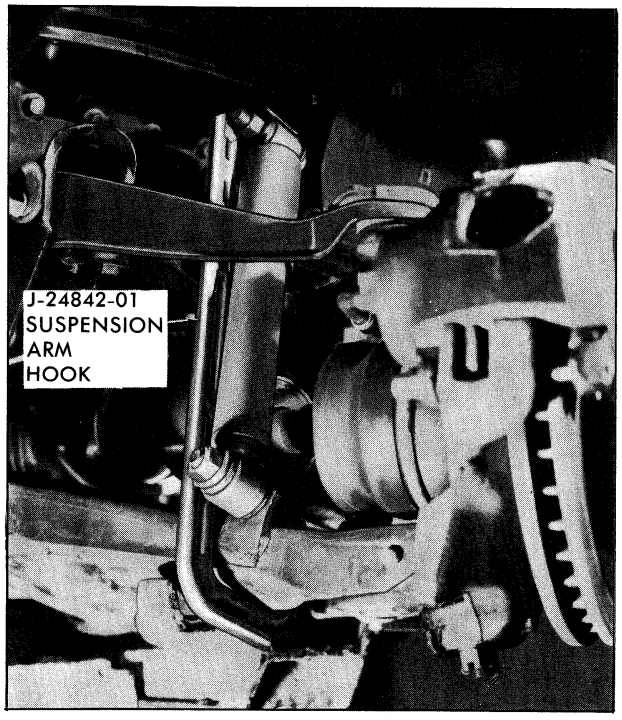


Fig. 5-92 Suspension Arm Hook Installed

remove line.

4. If right brake line is being removed, bend clips open and remove line.

d. Installation–Hydraulic Brake Lines (Rear Wheels)

1. Position brake line to rear axle and hand start tube nuts into calipers and junction block.

a. If right brake line is being installed, bend clips over retaining lines to rear axle.

b. If left brake line is being installed, bend clip retaining line to rear axle.

2. Tighten line to brake line junction fitting on rear axle, tighten to 20 foot-pounds maximum torque.

3. Tighten brake line to rear caliper fitting, tighten to 20 foot-pounds maximum torque.

4. Bleed all brakes as described on page 5-9.

e. Removal–Hydraulic Brake Hose (Rear Wheels)

1. Disconnect steel brake line from hose. Cap line.

2. Remove retainer securing forward end of brake hose to frame.

3. Remove bolt from junction block on axle.

4. Disconnect rear axle lines from junction block. Cap lines.

f. Installation–Hydraulic Brake Hose (Rear Wheels)

1. Connect rear axle lines to junction block. Tighten fittings to 20 foot-pounds maximum torque.

2. Bolt junction block to axle.

3. Pass female end of hose through frame allowing hose to seek its own position.

4. Install retainer to secure hose to frame.

5. Place steel tube connector in hose fitting and tighten to 20 foot-pounds maximum torque.

CAUTION: *Do not allow hose to twist out of its normal position as this may cause damage.*

6. Bleed all brakes as described on page 5-9.

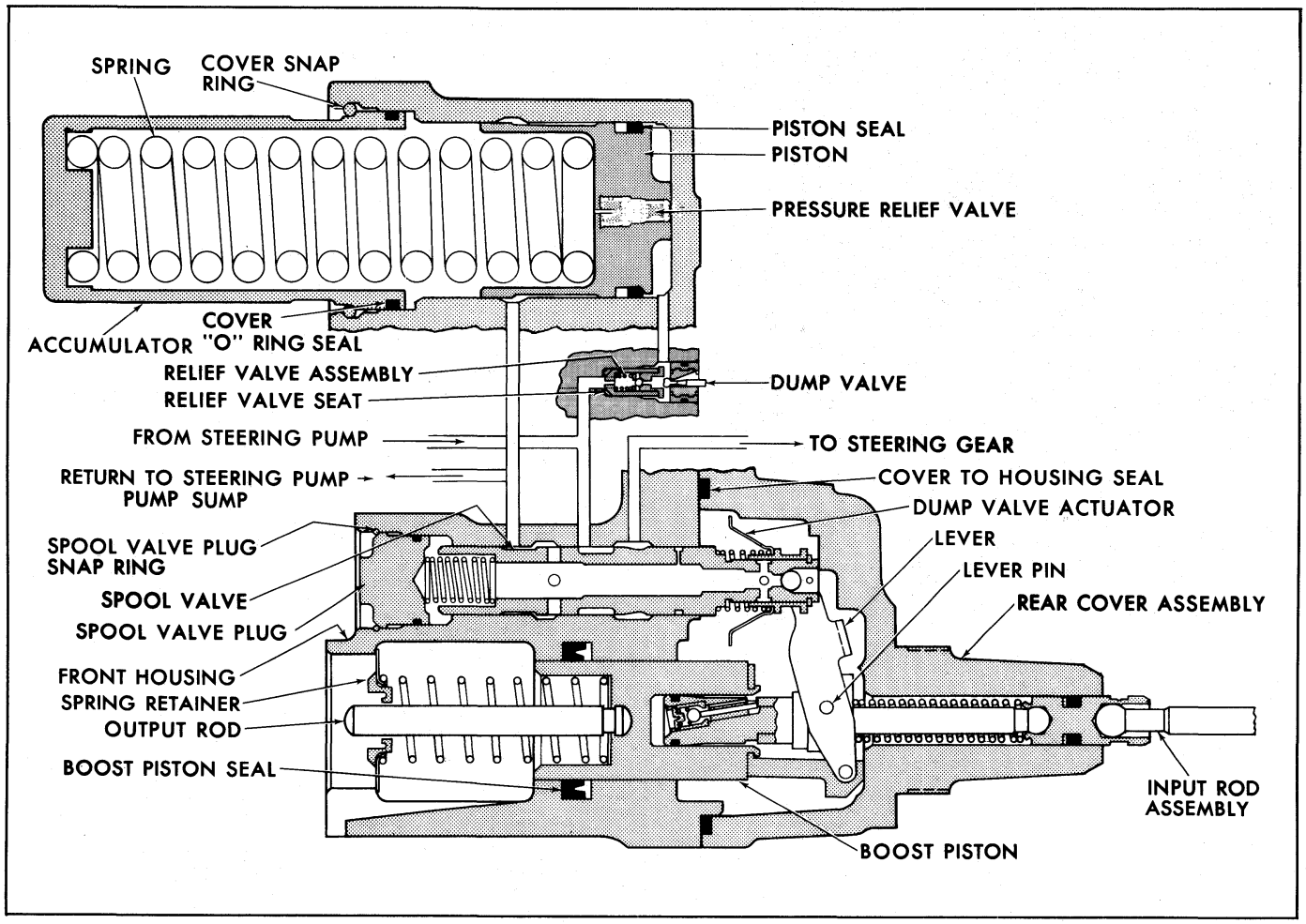


Fig. 5-93 Hydro-Boost - Cutaway View

BRAKES-HYDRO-BOOST

GENERAL DESCRIPTION

"Hydro-boost" is a hydraulically operated power brake booster. It is installed on Eldorados, Fig. 5-93.

The hydraulic brake booster consists of an open center spool valve and a hydraulic cylinder combined into a single housing. The power steering pump provides the hydraulic fluid pressure to operate both the power brake booster and power steering gear.

A dual master cylinder is bolted to the brake booster and is operated by a push rod projecting from the booster cylinder bore.

The Hydro-boost also has a reserve (accumulator) system which stores sufficient fluid under pressure to provide at lease (3) power assisted brake applications in the event that the power steering pump fluid flow is interrupted.

DIAGNOSIS

Prior to performing the Booster Function Tests, or the Accumulator Leakdown Test, the following preliminary checks must be made:

CAUTION: *Power steering fluid and brake fluid cannot be mixed. If brake seals contact steering fluid or steering seals contact brake fluid, seal damage will result.*

1. Check all power steering and brake lines and connections for leaks and/or restrictions.

2. Check and fill brake master cylinder with brake fluid.

3. Check and fill power steering pump reservoir with power steering fluid. Insure fluid is not aerated (air mixed with fluid).

4. Check power steering pump belt for tension and/or damage. Adjust if necessary.

5. Check engine idle speed and adjust if necessary.

6. Check steering pump pressure. See page 3B-20.

HYDRO-BOOST DIAGNOSIS

CONDITION	CAUSE	CORRECTION
Excessive Brake Pedal Effort	Loose or broken power steering pump belt.	Tighten or replace the belt.
	No fluid in power steering reservoir.	Fill reservoir and check for external leaks.
	Leaks in power steering, booster or accumulator hoses.	Replace faulty parts.
	Leaks at tube fittings, power steering, booster or accumulator connections.	Tighten fittings or replace tube seats, if faulty.
	External leakage at accumulator.	Replace "O" ring and retainer.
	Faulty booster piston seal causing leakage at booster flange vent.	Overhaul with new seal kit.
	Faulty booster input rod seal with leakage at input rod end.	Replace booster.
	Faulty booster cover seal with leakage between housing and cover.	Overhaul with new seal kit.
	Faulty booster spool plug seal.	Overhaul with spool plug seal kit.
Slow Brake Pedal Return	Excessive seal friction in booster.	Overhaul with new seal kit.
	Faulty spool action.	Flush steering system while pumping brake pedal.
	Broken piston return spring.	Replace spring.
	Restriction in return line from booster to pump reservoir.	Replace line.
	Broken spool return spring.	Replace spring.
Grabby Brakes	Broken spool return spring.	Replace spring.
	Faulty spool action caused by contamination in system.	Flush steering system while pumping brake pedal.
Booster Chatters – Pedal Vibrates	Power steering pump belt slips.	Tighten belt.
	Low fluid level in power steering pump reservoir.	Fill reservoir and check for external leaks.
	Faulty spool operation caused by contamination in system.	Flush steering system while pumping brake pedal.
Accumulator Leak Down – System does not hold charge	Contamination in steering hydro-boost system	Flush steering system while pumping brake pedal.
	Internal leakage in accumulator system	Overhaul unit using accumulator rebuild kit and seal kit.

SEAL LEAK DIAGNOSIS

1. **Input Rod Seal:** A damaged seal will show up as a fluid leak onto the drip pan from the mounting bracket vent hole. The booster must be removed from the car and replaced.

2. **Power Piston Seal:** Power piston seal damage will be noticed by fluid leaking out at the common master cylinder-brake booster vent and a possible reduction in power assist. The booster must be removed from the car and disassembled. The piston should be checked for any scratches that may be the cause of the leak. If scratches are present, then the power piston must be replaced. If no excessive scratches are present, then the booster Seal Kit can be used to replace the appropriate seals.

3. **Housing Seal:** If the housing seal is damaged, fluid

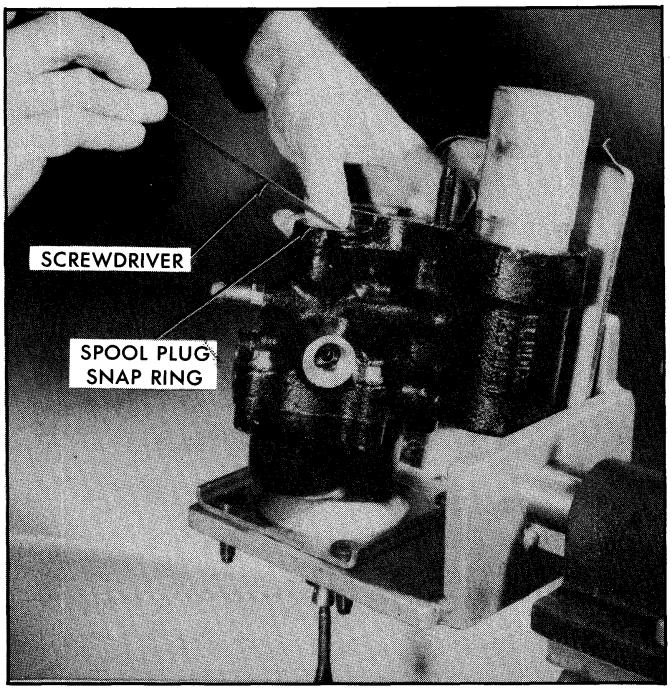


Fig. 5-94 Removing Spool Plug Snap Ring

will leak out from between the two housings onto the drip pan. The booster must be removed from the car and disassembled. The booster Seal Kit should be used to replace the housing and power piston seals.

4. **Spool Valve Plug "O" Ring Seal:** Damage to this seal will be noticed by fluid leaking out past the plug. The booster need not be removed from the car. The master cylinder should be disconnected from the booster.

Press in on spool plug, insert a small screw driver between snap ring and housing bore. This unseats one side of the spool plug snap ring from its groove in the bore. Then remove the snap ring from the bore, Fig. 5-94.

5. **Accumulator Piston Seals, Plunger Seat Seal Ring, and Check Valve Seal Ring:** Any damage to these seals would cause internal leakage. This would cause the accumulator to leak down resulting in the loss of reserve stopping. Seals must be replaced with their assemblies.

6. **Accumulator "O" Ring Seal:** Damage to this seal will result in fluid leakage past the accumulator spring cap. The seal can be replaced while the booster is installed on the car. The strap securing the drip pan to the booster must be removed and a catch basin placed under the booster to catch the fluid when the accumulator spring cap is removed.

CAUTION: *Before removing the spring cap the brake pedal must be pumped 4-5 times to deplete accumulator pressure.*

Remove the accumulator cap using a large "C" clamp and small punch as outlined on page 5-59. Caution must be taken to insure that no dirt or rust are introduced into the booster when the cap is removed. Replace the "O" ring and reassemble the accumulator cap to the booster using a new retaining ring.

TROUBLE SHOOTING AND TESTING

The Hydro-Boost differs from vacuum brake boosters not only in the source of power (hydraulic versus vacuum) but in the fact that it is also a part of another major sub-system of the car - the power steering system. Therefore, problems or malfunctions in the steering system may affect the operation of the booster, just as a problem in the booster may affect the steering system. The following noises are associated with the Hydro-boost system and may or may not be cause for customer complaint. Some are normal and for the most part temporary in nature. Others may be a sign of excessive wear or the presence of air in either the booster or the steering system.

1. Moan or low frequency hum usually accompanied by a vibration in the pedal and/or steering column may be observed during parking maneuvers or other very low speed maneuvers. This may be caused by a low fluid level in the power steering pump or by air in the power steering fluid due to holding the pump at relief pressure (steering wheel held all the way in one direction) for an excessive amount of time (more than 5 seconds). Check the fluid level and fill to mark. System must sit for 1 hour with the cap removed to remove the air. If the condition persists, this may be a sign of excessive pump wear and the pump should be checked following the shop manual procedure.

2. At or near power runout, (brake pedal near fully depressed position) a high speed fluid noise (faucet type) may be heard. This is a normal condition and will not be heard except in emergency braking conditions.

3. Whenever the accumulator pressure is used, a slight hiss may be noticed. It is the sound of the hydraulic fluid escaping through the accumulator valve, and is completely normal.

4. After the accumulator has been emptied, and the engine is started again, another hissing sound may be heard during the first brake application or the first steering maneuver. This is caused by the fluid rushing through the accumulator charging orifice. It is normal and will only be heard once after the accumulator is emptied. However, if this sound continues, even though no apparent accumulator pressure assist was made, it could be an indication that the accumulator is not holding pressure and should be checked using the procedure for Accumulator Leakdown Test.

5. After bleeding, a "gulping" sound may be present during brake applications as noted in the bleeding instructions.

BOOSTER FUNCTIONAL TEST

With the engine off apply the brake pedal several times until the accumulator is completely depleted. Depress the service brake pedal (approximately 40 pounds pedal force) and start the engine. The pedal should fall and then push back against driver's foot.

ACCUMULATOR LEAKDOWN TEST

Start engine and charge accumulator by either applying the service brake (approximately 100 pounds pedal force) or by turning the steering wheel from stop to stop. Turn off engine and let car sit for one hour. After one hour there should be three power assisted applies with engine stopped.

ON-CAR SERVICE

HYDRAULIC POWER BRAKE BOOSTER

a. Removal

CAUTION: *Power steering fluid and brake fluid cannot be mixed. If brake seals contact steering fluid or steering seals contact brake fluid, seal damage will result.*

NOTE: Pump brake pedal 4 or 5 times with engine stopped to empty accumulator of fluid which is under pressure.

Remove two nuts securing master cylinder to booster and carefully move master cylinder away from booster, with brake lines attached.

2. Remove three hydraulic lines from brake booster. Plug and cap all ports and lines to prevent loss of fluid and entrance of dirt.

3. Remove retainer and washer that secures booster pedal rod to brake pedal arm.

4. Remove four nuts that secure booster to firewall.

NOTE: Pedal rod should never be pried off pedal arm as this could damage booster.

5. Working under hood, loosen booster from firewall and move booster pedal rod inboard until it disconnects from brake pedal arm. Remove spring washer from brake pedal arm.

6. Remove booster from car.

b. Installation

1. Install spring washer on brake pedal arm and position brake booster to firewall with booster pedal rod extending through firewall. Install rod on brake pedal arm.

2. Secure booster to firewall and brake pedal bracket with four nuts. Torque nuts to 15 foot-pounds.

3. Install retainer and washer securing booster pedal rod to brake pedal arm.

4. Position master cylinder to booster and secure with two nuts. Torque nuts to 20 foot-pounds.

5. Unplug and uncap all lines and ports and install three hydraulic lines to brake booster. Torque to 30 foot-pounds.

6. Bleed steering system as outlined on page 5-59.

HYDRO-BOOST BLEEDING PROCEDURE

Whenever the booster is removed and reinstalled, the steering system should be bled as outlined below.

CAUTION: *Power steering fluid and brake fluid cannot be mixed. If brake seals contact steering fluid or steering seals contact brake fluid, seal damage will result.*

1. Install power steering fluid in steering pump until the level in the pump is at the base of the pump reservoir neck.

2. Disconnect the battery lead from the H.E.I. distributor to prevent engine from starting.

3. Raise front of car and turn wheels all the way to the left.

4. Crank engine for a few seconds.

5. Check fluid level and add fluid to "Add" mark on dipstick, if necessary.

6. Lower car, connect battery lead, and start the engine. Check fluid level and add fluid to "Add" mark on dipstick, if necessary.

7. With the engine running, turn wheels from side to side to bleed the air from the system. Insure that the fluid level remains above the internal pump casting.

8. The above procedure should remove all air from the steering/Hydro-boost system. If the fluid is foaming after bleeding, turn the engine off and let the system sit for one hour and repeat Step 7.

The Hydro-boost is basically self-bleeding, and the above procedure will normally bleed the air from the booster unit. However, ocasionally air will be trapped in the top of the rear cover. When this happens, the booster may emit a "gulping" noise when the brake is applied. Normally, this condition will disappear after running the engine for a few minutes while lightly pumping the brake. After the "gulping" sound disappears, the pump fluid level should be checked and fluid added if necessary.

UNIT OVERHAUL

HYDRAULIC BRAKE BOOSTER OVERHAUL

If work is to be done on accumulator piston, it must be performed first, as outlined on page 5-60.

a. Disassembly

CAUTION: *Power steering fluid and brake fluid cannot be mixed. If brake seals contact steering fluid or steering seals contact brake fluid, seal damage will result.*

1. Remove booster from car as outlined on page 5-59.

2. Secure booster mounting bracket in vise with pedal rod pointing down, Fig. 5-95.

3. Pump pedal rod 4 or 5 times to insure that accumulator is depleted.

4. Cut strap securing accumulator cap to drip pan.

5. Using Socket J-25085 loosen five torx head bolts securing front housing to rear cover.

NOTE: Rear cover refers to part of booster that is attached to mounting bracket.

6. While holding front housing, remove torx head bolts.

NOTE: Have pan ready to catch and discard leaking fluid.

7. Carefully lift off front housing, leaving spool valve and power piston assembly attached to rear cover, Fig. 5-96.

CAUTION: *Care should be taken when handling the front housing as the accumulator contains a high rate spring in compression.*

8. Remove output rod and piston return spring from power piston assembly and spool valve spring from valve. Remove output rod retainer assembly from front housing.

9. Remove spool valve from power piston assembly by rotating it out of lever arm. Compare spool valve condition to Fig. 5-97. Valve must be replaced or may be reinstalled as indicated. Remove large "figure eight" seal from groove in cover and discard seal.

10. Remove power piston seal from bore and discard seal.

11. Inspect power piston. If scratches, big enough to be

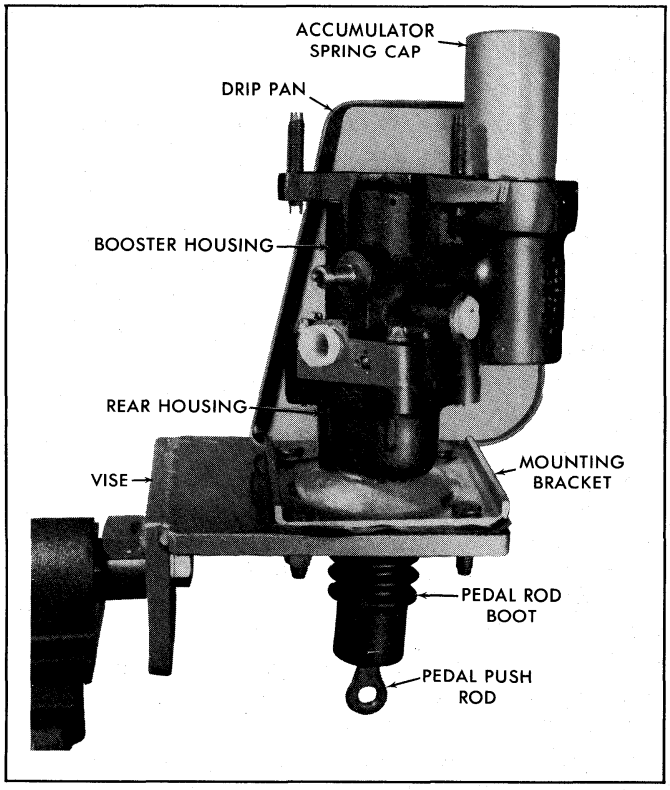


Fig. 5-95 Booster Secured in Vise

felt with a fingernail, are present then piston must be replaced.

12. Using diagonal cutters snip off end of connecting pin,

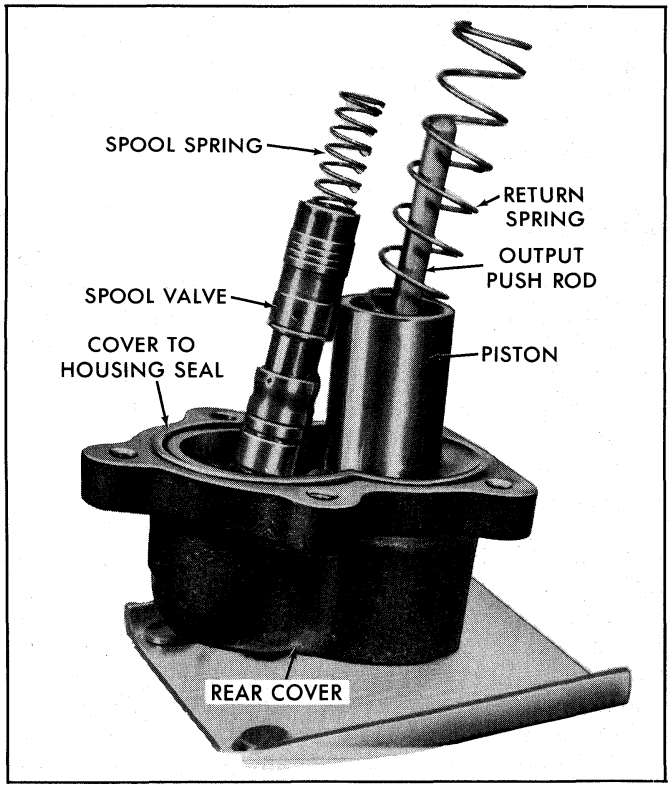


Fig. 5-96 Booster Housing Removed

Fig. 5-98.

13. Push pin out using small punch and remove piston.

14. Flush housing assemblies with clean power steering fluid.

b. Assembly

1. If piston was removed, slide connecting bracket on new piston into small yoke in lever and push new pin through hole.

2. Using Tool J-26410, mushroom end of pin, Fig. 5-99. Insure that lever movement is free with no binding.

3. Grasp rear cover and drip pan assembly (with power piston and pedal rod) by mounting bracket in a vise. Housing seal groove should face up.

4. Install new housing seal in groove in rear cover.

5. Install new power piston seal in front housing, Fig. 5-100.

6. Insert spool valve spring and spool valve assembly into bore in front housing, Fig. 5-101.

7. Pull up on power piston and extend lever to accept sleeve on spool valve.

8. While holding lever extended with one hand, bring front housing with spool valve assembly directly over rear cover and slide lever pins into slot in sleeve, Fig. 5-102.

9. Center power piston in bore and begin to lower front housing down onto rear cover. Before power piston contacts power piston seal, push seal protector tool, J-25053 through piston bore until it seats in power piston, Fig. 5-103.

10. Push two housings together and remove tool J-25053.

11. Replace five Torx bolts and torque to 20 foot-pounds.

12. Install output rod, spring and new spring retainer.

13. Secure new output rod retainer using mechanics deep 7/8" socket and tap in place with a hammer, Fig. 5-104.

14. Mount new decal on accumulator spring cap and install new strap to support drip pan.

15. Remove booster from vise and install on car as outlined on page 5-59.

SPRING ACCUMULATOR OVERHAUL

NOTE: After January, 1977, pneumatic accumulators will be installed on all Eldorado cars. Refer to page 5-62 for disassembly and assembly.

a. Disassembly

CAUTION: *Power steering fluid and brake fluid cannot be mixed. If brake seals contact steering fluid or steering seals contact brake fluid, seal damage will result.*

1. Remove booster from car as outlined on page 5-59.

2. Secure booster mounting bracket in vise with pedal rod pointing down.

3. Pump pedal rod 4 or 5 times to insure that accumulator is depleted.

4. Using a large "C" clamp (12" minimum), depress accumulator spring cap, Fig. 5-105, and insert a punch into small hole in front housing, unseating retainer ring. Remove the retaining ring, Fig. 5-106.

NOTE: Tool J-22222-2 can be placed over spring cap before depressing to steady cap.

5. Slowly back clamp off until spring tension on cap is released. Remove clamp, spring cap, and accumulator spring.

CAUTION: *Extreme care must be taken when removing accumulator spring cap as it contains a high rate compressed spring.*



Fig. 5-97 Spool Valve Condition

6. If shop air is available, plug gear and return ports. Holding a hand over accumulator piston, pressurize booster with shop air through inlet port, Fig. 5-107. Piston will back out of housing bore. If shop air is not available, use a hook made from a stiff piece of wire. Engage the hook in the piston fluid inlet hole. Using a suitable tool for leverage, wrap wire around tool and pry against housing to remove piston from bore and discard piston.

7. Disassemble booster as outlined on page 5-59.

8. Using a small diameter wire hook, remove charging valve and valve seat, Fig. 5-108.

b. Assembly

1. Using clean power steering fluid as a lubricant, lower charging valve bore in front housing, Fig. 5-109.

2. Assemble booster as outlined on page 5-59.

3. Insert new accumulator piston assembly in front housing bore. If piston cannot be inserted all the way, push pedal rod in to relieve trapped air pressure below piston.

NOTE: Care must be taken not to disturb relief valve while installing accumulator spring in piston.

4. Mount new "O" ring (1.987 ID) to accumulator cap. Position cap and retainer under tool J-22222-2 and using large "C" clamp, depress accumulator cap down over spring into bore in front housing. Secure cap with a new retainer ring and remove "C" clamp.

5. Install new strap to support drip pan to accumulator spring cap.

6. Remove booster from vise and install on car as outlined on page 5-59.

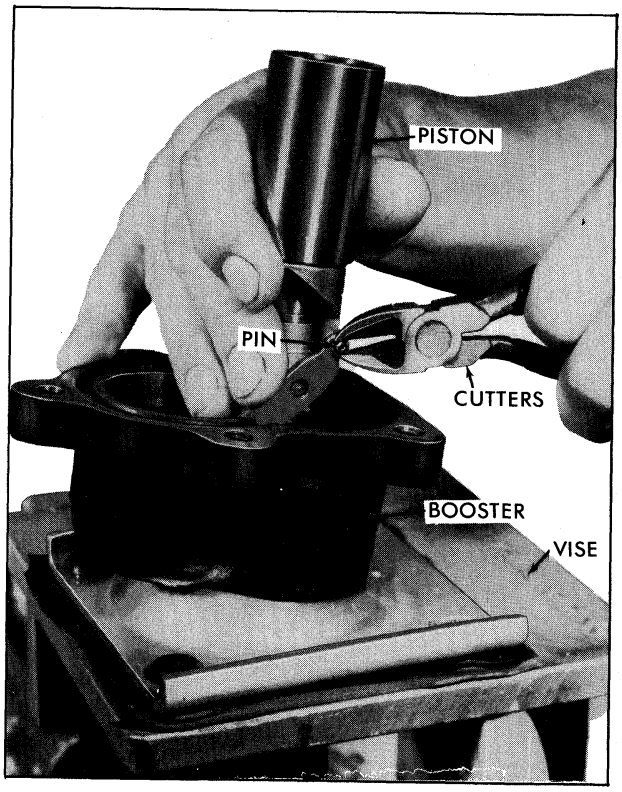


Fig. 5-98 Cutting Piston Pin

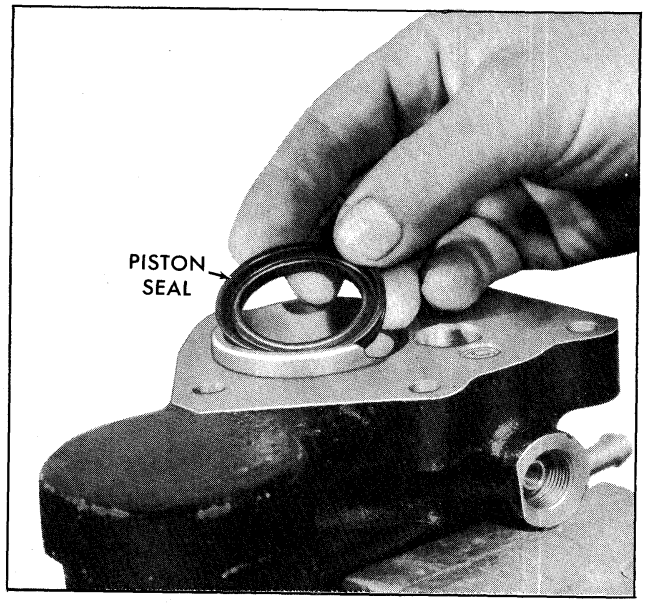


Fig. 5-100 Installing Piston Seal

WARNING: HEED THE FOLLOWING WHEN HANDLING THE ACCUMULATOR AS IT CONTAINS COMPRESSED GAS OR PERSONAL INJURY MAY RESULT.

1. DO NOT APPLY HEAT TO THE ACCUMULATOR.

2. DO NOT ATTEMPT TO REPAIR AN INOPERATIVE ACCUMULATOR. ALWAYS REPLACE WITH A NEW ASSEMBLY.

3. BEFORE DISPOSING OF AN INOPERATIVE ACCUMULATOR, DRILL A 1/16 INCH DIAMETER HOLE THROUGH THE END OF THE ACCUMULATOR CAN. DO NOT DRILL THROUGH PISTON END.

4. BE SAFE! PROTECT YOUR EYES. WEAR APPROVED SAFETY GLASSES.

PNEUMATIC ACCUMULATOR OVERHAUL (Fig. 5-110)

Disassembly

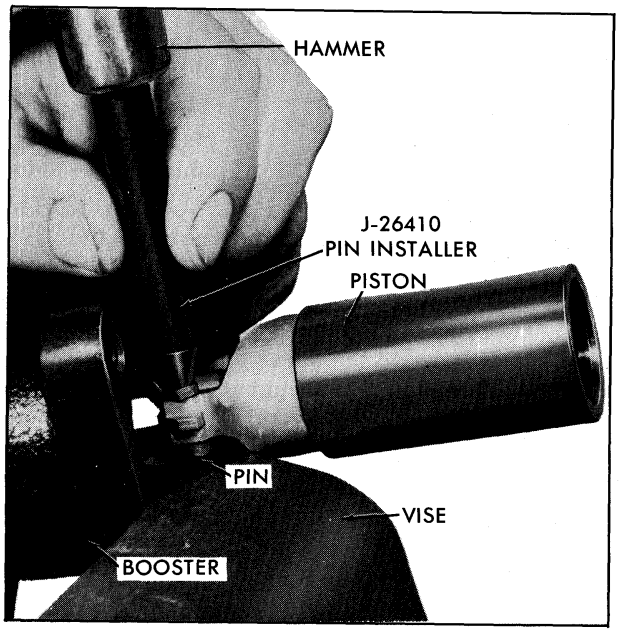


Fig. 5-99 Staking Piston Pin

1. Pump service brake pedal 4 or 5 times to insure that the accumulator is depleted. Engine must be off to deplete the accumulator.

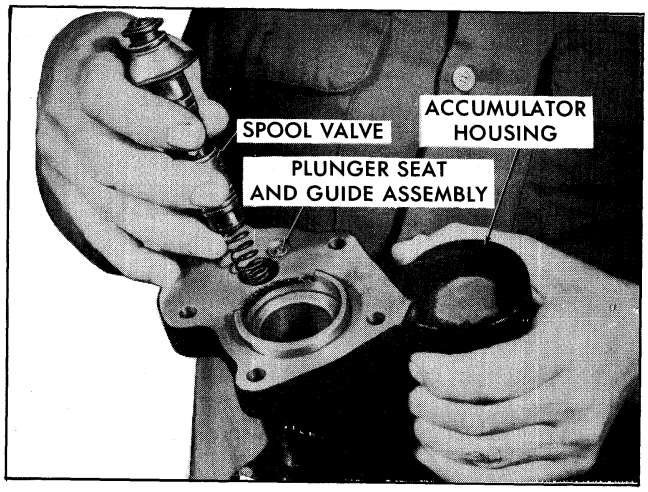


Fig. 5-101 Installing Spool Valve in Housing

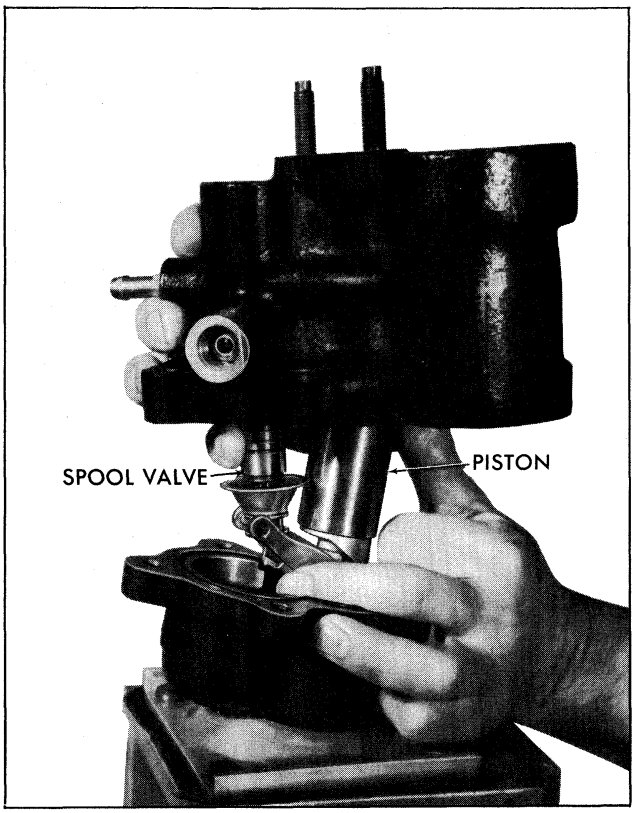


Fig. 5-102 Engaging Lever Pins in Spool Valve Sleeve

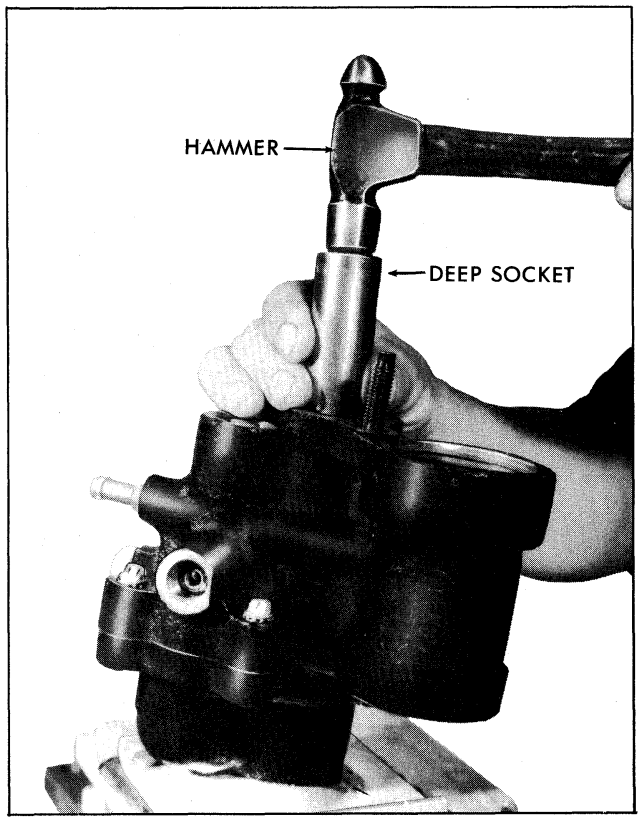


Fig. 5-104 Securing Output Rod Spring Retainer

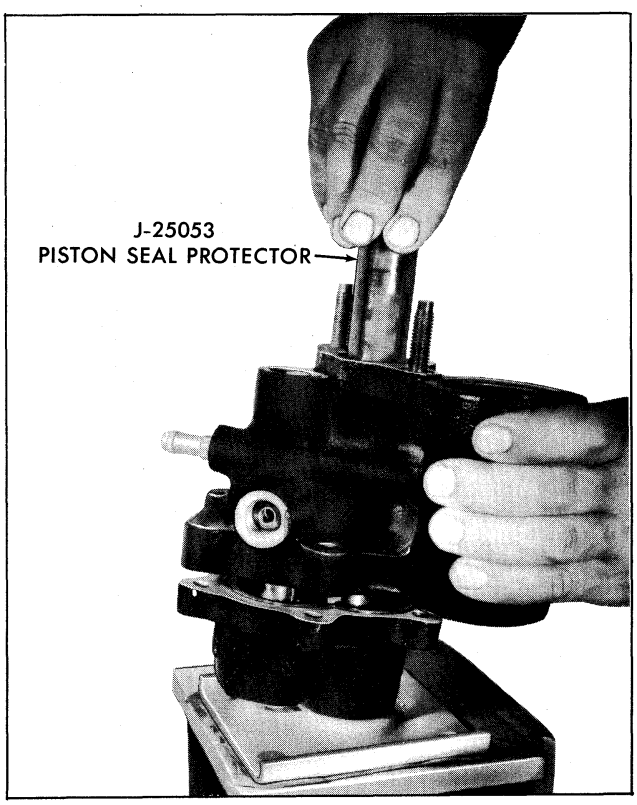


Fig. 5-103 Installing Piston Seal Protector

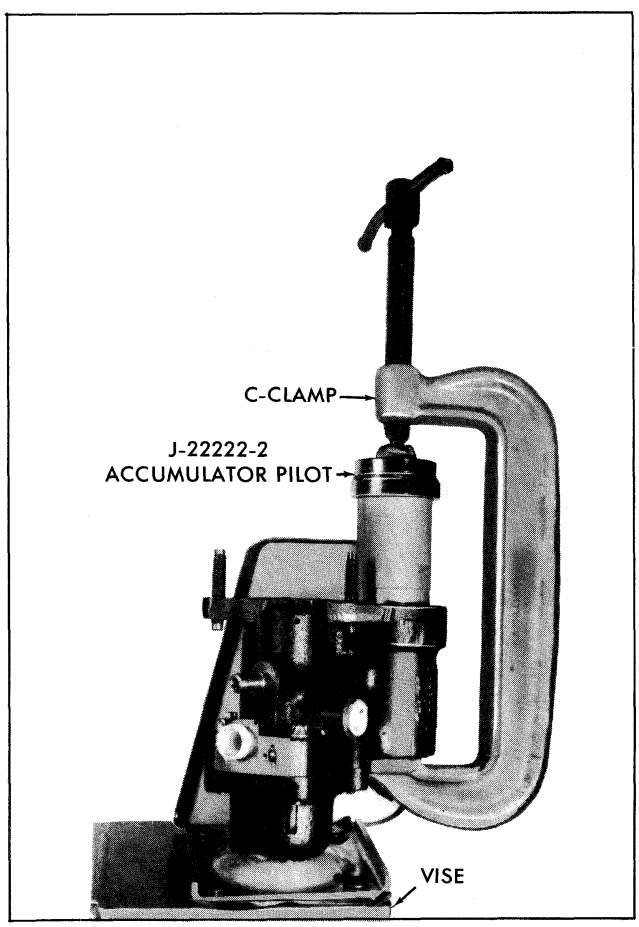


Fig. 5-105 Depressing Accumulator Spring Cap

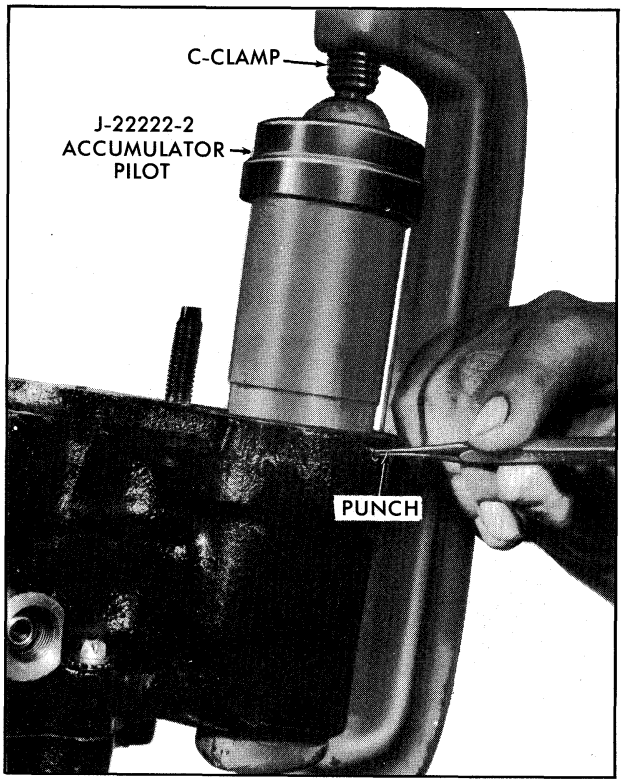


Fig. 5-106 Unseating Retaining Ring

2. Remove booster from car.
3. Secure booster mounting bracket in vise with pedal rod pointing down.

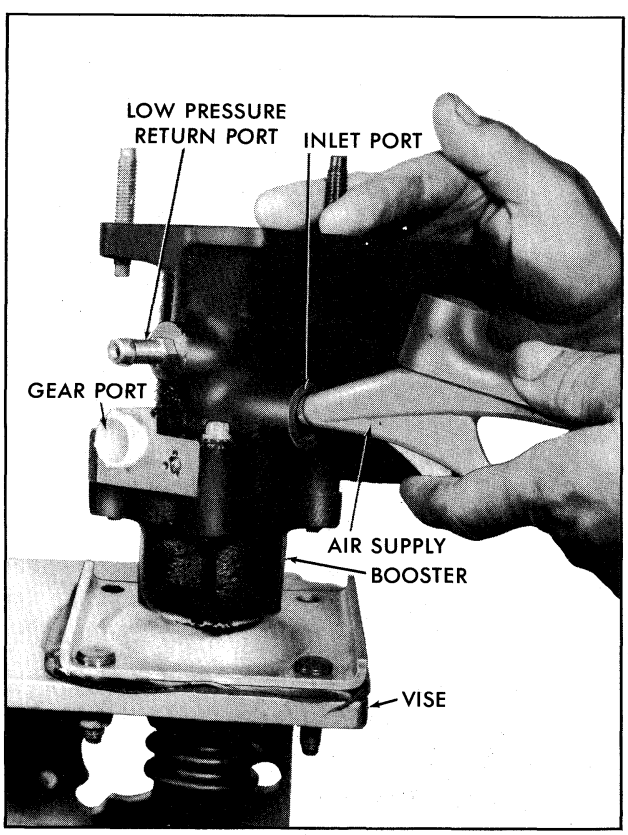


Fig. 5-107 Removing Accumulator Piston

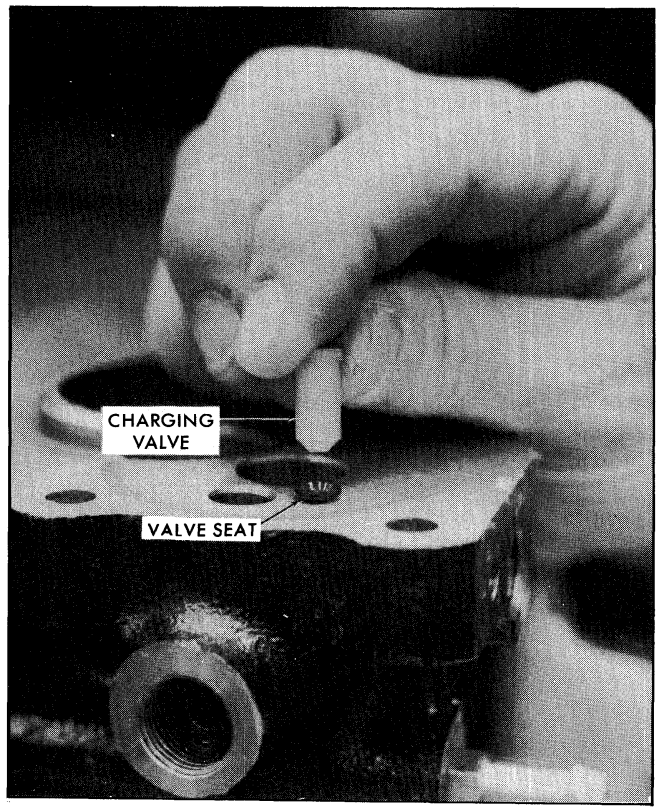


Fig. 5-108 Removing Charging Valve and Valve Seat

4. Place the accumulator retaining cap, Tool J-26889 over the master cylinder stud and restrain with a nut as shown in Fig. 5-111.

5. Using a large "C" clamp (6" minimum), depress the accumulator can, Fig. 5-111 and insert a punch into the small hole in the housing unseating the retainer ring. Flip the ring out with a small screwdriver.

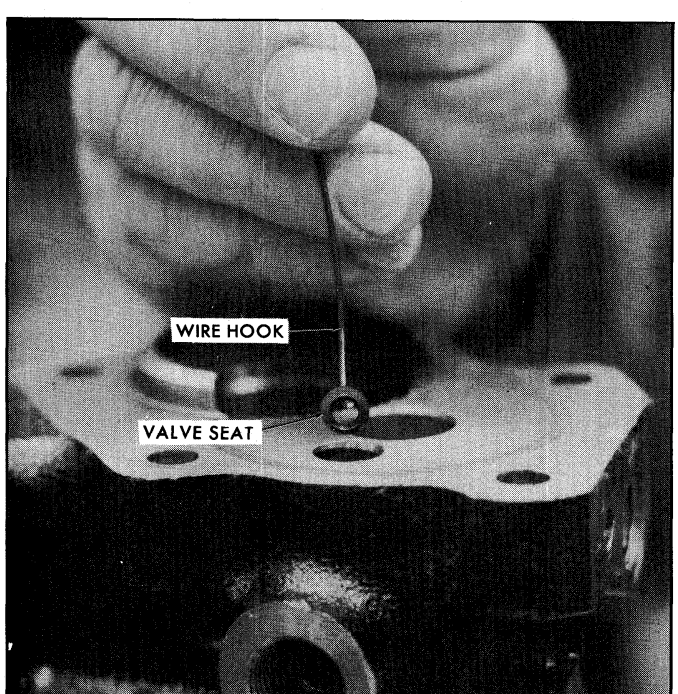


Fig. 5-109 Installing Charging Valve and Valve Seat

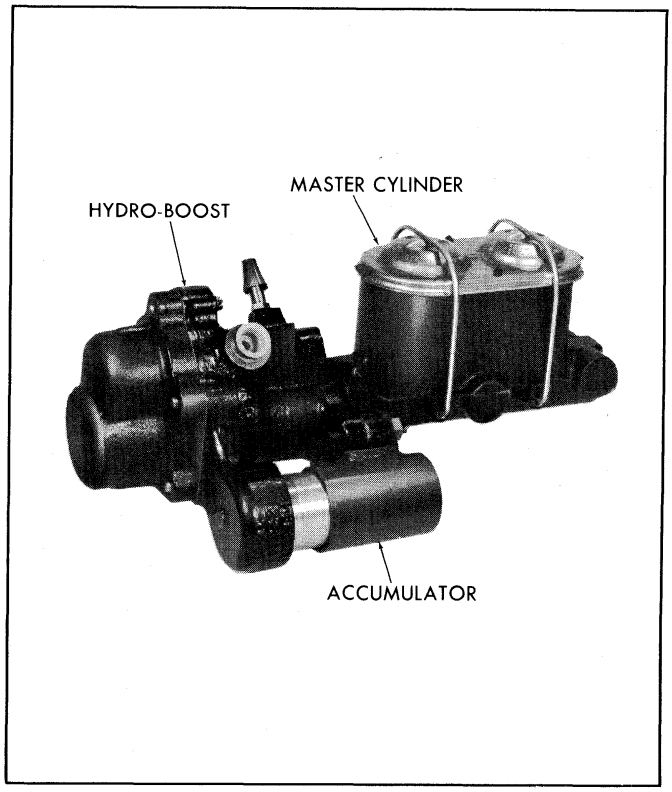


Fig. 5-110 Pneumatic Accumulator

NOTE: If the can is not easily compressed (approx. .100") the accumulator is still charged. This indicates an internal problem with the accumulator valves and the booster must be disassembled.

6. Slowly back the clamp off until tension on can is released. Remove clamp, retaining cap, and accumulator.

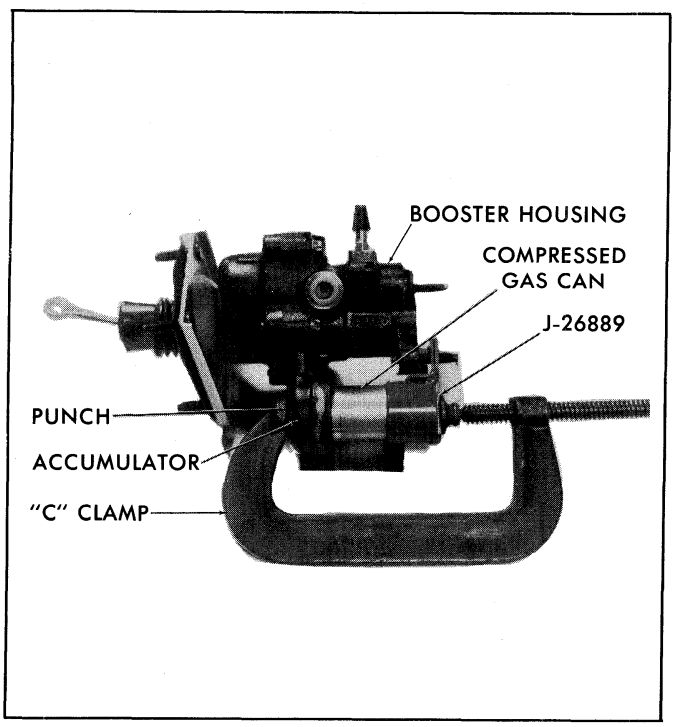


Fig. 5-111 Depressing Accumulator Can

b. Assembly

1. Using clean power steering fluid as a lubricant on the accumulator can seal, locate the accumulator can in the housing and place the retaining ring over the can.

2. Repeat Step 4 from the Disassembly procedure above.

3. Compress the can with the "C" clamp making certain the can goes in straight.

4. Snap the retaining ring into the housing groove by pushing it down all the way around with a small screwdriver. This will secure the accumulator can to the housing and permit removal of the "C" clamp and retaining cap, Fig. 5-111.

CAUTION: *Carefully check to make sure the snap ring was completely installed in the above step.*

5. Remove the booster from the vise and install on the car.

6. Install the master cylinder and accumulator retaining cap, and close the car hood. Test the unit by starting the engine and bumping the steering wheel against the stop a few times. Stroke the service brake pedal to approx. 100 lbs. force 4 or 5 times.

7. Remove the retaining test cap and put master cylinder nut back on.

8. Check power steering pump fluid level and fill as required.

TROUBLE SHOOTING AND TESTING PNEUMATIC ACCUMULATOR

1. When the accumulator pressure is used a slight hiss is noticed. This is the normal sound of hydraulic fluid passing thru the accumulator valves.

2. After the accumulator has been emptied, and the engine is started again, another hissing sound may be heard during the first brake application or the first steering maneuver. This sound is normal and should be heard only once after the accumulator is emptied.

Checking the Reserve System

1. Start engine and charge accumulator by applying the service brake or by turning the steering wheel from stop to stop. Turn off engine and let vehicle sit for one hour. After one hour there should be at least two power assisted applications with the engine off.

2. If the reserve system will not retain a charge for one hour but functions normally immediately following charging, the accumulator valves are at fault and the booster must be disassembled and the valves replaced.

3. If the accumulator can be heard charging and discharging, but it does not hold a charge, disassemble the booster and replace the valves.

4. Deplete the accumulator by pressing the service brake pedal 4 or 5 times. If the accumulator can has lost its gas charge it is possible to rotate or wobble the accumulator can with respect to the housing. Replace the accumulator assembly.

TORQUE SPECIFICATIONS—ELDORADO ONLY

Material Number	Application	Size	Foot-Pounds
280M	Bearing Retainer to Knuckle	3/8-16	35
286M	*Brake Backing Plate to Rear Axle Housing	3/8-24	40
301M	Upper Spherical Joint Nut	1/2-20	60
280M	Rear Caliper Inlet Bolt and Block to Caliper	7/16-20	30 max.
Special	*Caliper Mounting Bolts	Special	30
Special	Parking Brake Cable Lever to Caliper Actuator Screw	7/16-20	25
Special	Front Caliper Inlet Hose	3/8-24	30 max.
Special	Rear Caliper Brake Line Tube Nut	3/8-24	20 max.
Special	Rear Brake Line to Rear Axle Junction Fitting	Special	10
Special	Rear Brake Line to Rear Brake Hose	7/16-24	20 max.
286M	Hydraulic Brake Booster to Firewall	3/8-16	15
Special	Hydraulic Lines to Booster	5/8-18	30
Special	Hydraulic Brake Booster Front Housing to Rear Cover Screw	Special	20
286M	Wheel Mounting Nuts	1/2-20	130

NOTE: Refer to back of Manual, Page 10-1, for bolt and nut markings and steel classifications.

**CAUTION: This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.*

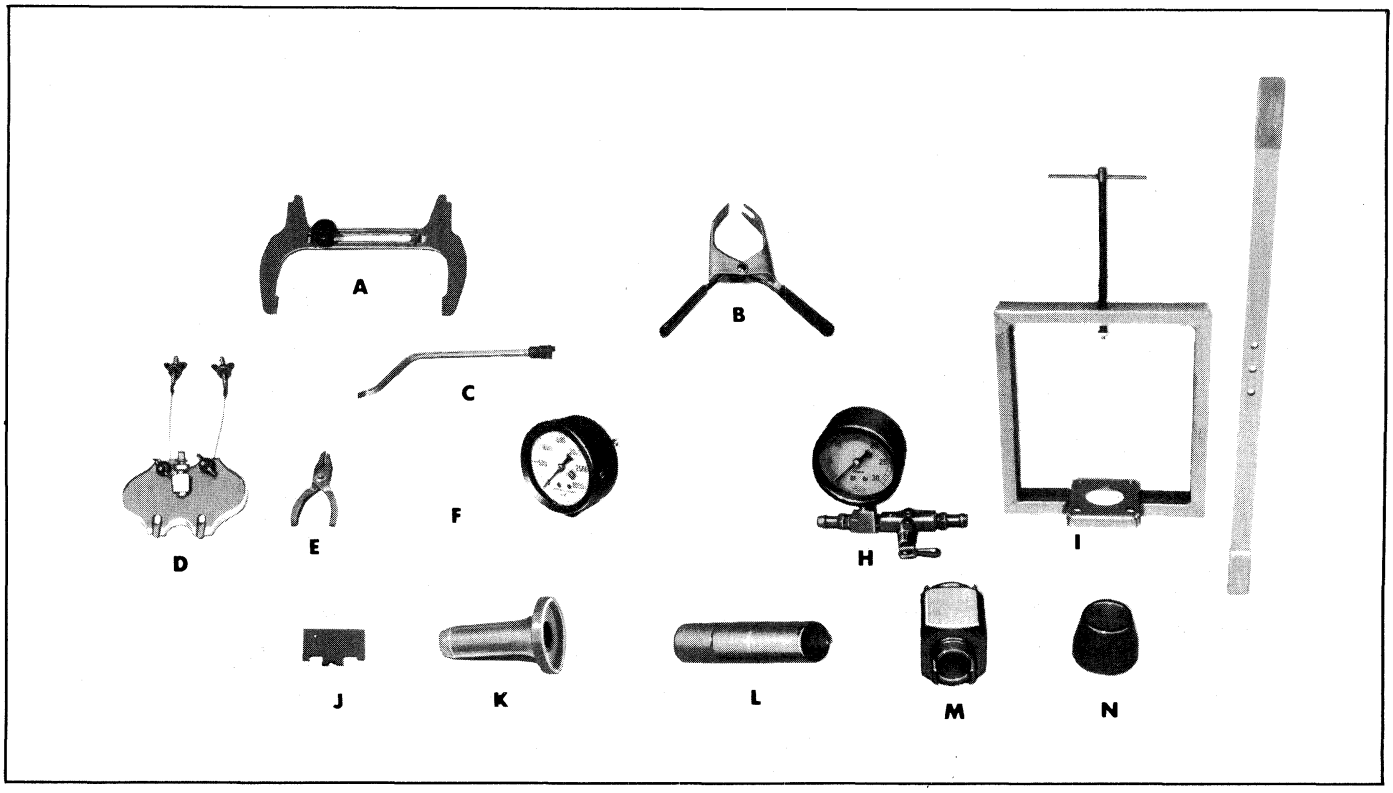


Fig. 5-112 Special Tools - Brakes

Key	Tool No.	Name	Key	Tool No.	Name
A	J-21177	Brake Adjusting Caliper	H	J-23108	Leak Testing Adapter
B	J-23770	Brake Combination Valve Bleeder	I	J-23456	Power Unit Holding and Separating Fixture
C	J-8049	Brake Spring Remover and Installer	J	J-22647	Push Rod Gage
			K	J-22904	Boot Installer
D	J-23518-1	Brake Bleeder Adapter	L	J-23175	Control Valve Retainer Installer
	J-23518-12	Bleeder Adapter Cover Cables			
E	J-4880	Snap Ring Pliers	M	J-23101	Power Piston Holding Fixture
F	J-24657	Brake Combination Valve Pressure Gage	N	J-23188	Seal Protector

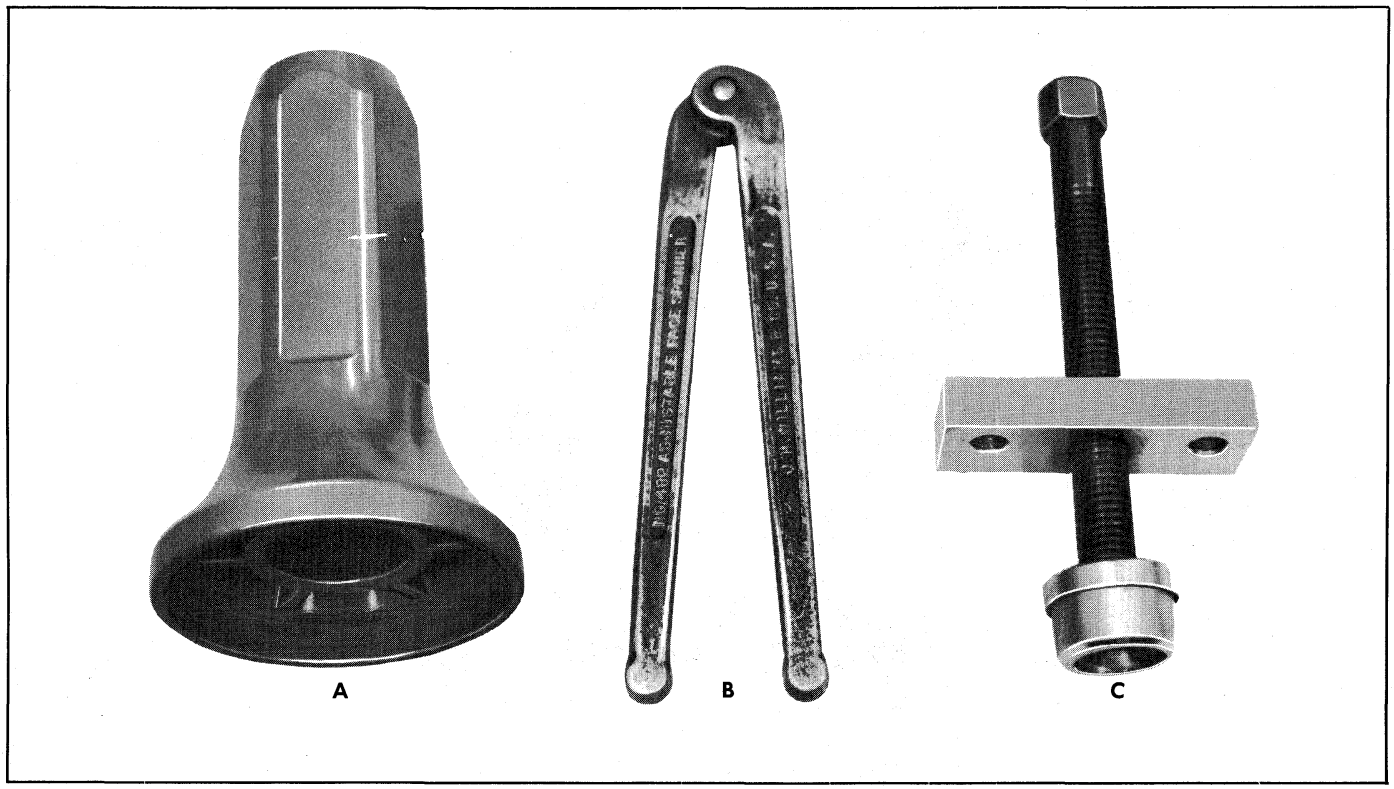


Fig. 5-113 Special Tools - Rear Disc Brakes

Key	Tool No.	Name	Key	Tool No.	Name
A	J-26296	Dust Boot Installer	C	J-23072	Rear Caliper Piston Installer
B	J-7624	Spanner Wrench			

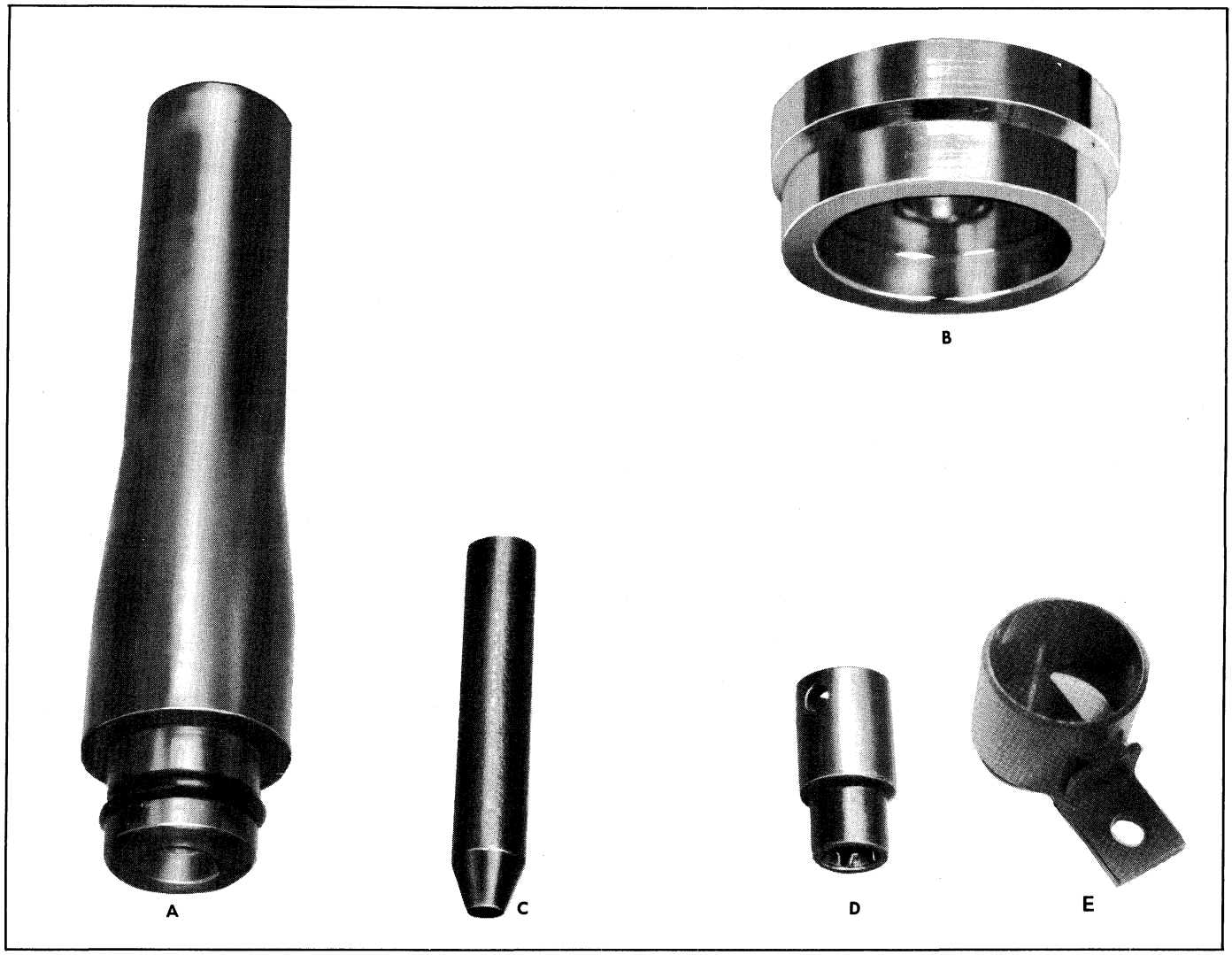


Fig. 5-114 Special Tools–Hydro-Boost

Key	Tool No.	Name	Key	Tool No.	Name
A	J-25053	Piston Seal Protector	C	J-26410	Boost Piston Pin Installer
B	J-22222-2	Accumulator Pilot	D	J-25085	Torx Socket
			E	J-26889	Accumulator Retaining Cap

INTRODUCTION

Engine Performance Diagnosis procedures are guides that will lead to the most probable causes of engine performance complaints. They consider all of the components of the fuel, ignition, and mechanical systems that could cause a particular complaint, and then outline repairs in a logical sequence.

The procedures are based on Symptoms that are listed in the Table of Contents.

Each Symptom is defined, and it is vital that the correct one be selected based on the complaints reported or found.

Review the Symptoms and their definition to be sure that only the correct terms are used.

The words used may not be what you are used to in all cases, but because these terms have been used interchangeably for so long, it was necessary to decide on the most common usage and then define them. If the definition is not understood, and the exact Symptom is not used, the Diagnostic procedure will not work.

It is important to keep two facts in mind:

(1) The procedures are written to diagnose problems on cars that have "run well at one time" and that time and wear have created the condition.

(2) All possible causes cannot be covered, particularly with regard to emission controls that affect vacuum advance. If doing the work prescribed does not correct the complaint, then either the wrong Symptom was used or a more detailed analysis will have to be made, by referring to the Specific Component Section of the Service Manual.

All of the Symptoms can be caused by worn out or defective parts such as Spark Plugs, ignition Wiring, etc. If time and/or mileage indicate that parts should be replaced, it is recommended that it be done.

ENGINE PERFORMANCE DIAGNOSIS

Problem - Diesəling

1. Make visual checks of the following for sticking.

a. Carburetor, choke, and throttle linkage

b. Fast idle cam

See cleaning, inspection, and adjustment of carburetor, Page 6C-20.

2. Check and reset ignition timing, idle, RPM and check idle solenoid for proper operation. Refer to emission label.

3. Remove carbon with top engine cleaner. Follow instructions on can. If condition still exists, suggest that owner try different gasoline.

Problem - Detonation

1. Check for obvious overheating problems.

a. Low coolant

b. Loose fan belt

c. Restricted air flow, etc.

2. Check ignition timing per emission control information label.

NOTE: If timing is too early - speed up engine to see if timing mark moves. If not, check for stuck mechanical advance. Refer to Page 6D-33. Repair as necessary and recheck timing.

3. Remove carbon with top engine cleaner. Follow instructions on can. If condition still exists, suggest that owner try different gasoline.

Problem - Stalls or Rough Idle - Cold

1. With engine running, remove air cleaner cover and filter. Damper door in air cleaner snorkel should be closed when engine is cold. It may be necessary to place cold wet rag over sensor to close it if engine is too warm.

If damper door does not close, apply vacuum directly to vacuum motor. If door closes, replace sensor. If door stays open, replace vacuum motor.

2. Visually check the following:

a. Hot air tube to air cleaner connection and condition of hot air stove.

b. Vacuum hoses for splits, kinks and proper connections. See Hose Routing charts, Page 6E-24.

c. Air leaks at carburetor mounting and intake manifold.

d. Ignition wires for cracking, hardness and proper connections. Repair or replace as necessary.

3. Check the following for sticking:

a. Carburetor, choke, and throttle linkage.

b. Fast idle cam.

c. Carburetor flooding.

See cleaning, inspection and adjustment of carburetor, Page 6C-20.

4. With engine running, visually check vacuum break linkage for movement while removing and reinstalling vacuum hose. If the linkage does not move and vacuum is at hose, replace vacuum break assembly.

5. With engine off, check all choke adjustments, Page 6C-27.

6. Check engine timing and idle speed. See emission control information label.

7. Remove vacuum hose from E.G.R. valve and connect an extra hose from any manifold vacuum source to valve. If RPM doesn't drop, valve is leaking. See E.G.R. Section, Page 6E-20 for further functional tests, cleaning, and/or replacement.

8. Check E.F.E. valve.

Disconnect E.F.E. hose from tube and connect an extra vacuum hose from any manifold vacuum source to E.F.E. tube.

Observe actuator linkage for movement. If no movement, repair as necessary. Refer to, Page 6E-3 for further test and/or repair.

Problem - Stalls or Rough Idle - Hot

1. With engine running, remove air cleaner cover and filter. Damper door in air cleaner snorkel should be open. If closed and engine is hot, check temperature operation of sensor unit. See air cleaner temperature test, Page 6E-15.

2. Visually check the following:

a. Vacuum hoses for splits, kinks and proper connections. See hose routing charts, Page 6E-24.

b. Air leaks at carburetor mounting and intake manifold.

c. Ignition wires for cracking, hardness and proper connections.

Repair or replace as necessary.

3. Check engine timing and idle speed. See emission control information label.

4. Check P.C.V. valve for proper operation by placing finger over inlet hole in valve end several times. Valve should snap back. If not, replace valve.

5. Remove vacuum hose from E.G.R. valve and connect an extra hose from any manifold source to valve. If RPM doesn't drop, valve is leaking. See E.G.R., Page 6E-20 for

TABLE OF CONTENTS DEFINITION

SYMPTOM		PAGE
Dieseling	Engine continues to run after the switch is turned off. It runs unevenly and makes knocking noises.	6-1
Detonation	A mild to severe ping, usually worse under acceleration. The engine makes sharp metallic knocks that change with throttle opening. Sounds like pop corn popping.	6-1
Stalls	The engine quits running. It may be at idle or while driving.	6-1
Rough Idle	The engine runs unevenly at idle. If bad enough, it may make the car shake.	
Miss	Steady pulsation or jerking that follows engine speed, usually more pronounced as engine load increases. Not normally felt above 1500 RPM or 30 mph. The exhaust has a steady spitting sound at idle or low speed.	6-2
Hesitates	Momentary lack of response as the accelerator is depressed. Can occur at all car speeds. Usually most severe when first trying to make the car move, as from a stop sign. May cause the engine to stall if severe enough.	6-2
Surges	Engine Power variation under steady throttle or cruise. Feels like the car speeds up and slows down with no change in the accelerator pedal.	6-3
Sluggish	Engine delivers limited power under load or at high speed. Won't accelerate as fast as normal; loses too much speed going up hills, or has less top speed than normal.	6-3
Spongy	Less than the anticipated response to increased throttle opening. Little or no increase in speed when the accelerator pedal is pushed down a little to increase cruising speed. Continuing to push the pedal down will finally give an increase in speed.	6-3
Poor Gas Mileage	Self describing.	6-3.6-4
Cuts Out	Temporary complete loss of power. The engine quits at sharp, irregular intervals. May occur repeatedly, or intermittently. Usually worse under heavy acceleration.	
Hard Start — Cold	Self describing	6-4
Hard Start — Hot	Self describing	6-5

further functional tests, cleaning and/or replacement.

6. Adjust carburetor idle speed and mixture screws. Refer to emission control information label for idle speed. If idle mixture adjustment is necessary - refer to carburetor adjustment, Page 6C-12.

7. Remove carbon with top engine cleaner. Follow instructions on can. If idle is still rough, run a cylinder compression check.

Problem - Miss

1. Visually check the following:

a. Vacuum hoses for splits, kinks and proper connections. See hose routing charts, Page 6E-24.

b. Air leaks at carburetor mounting and intake manifold.

c. Ignition wires for cracking, hardness and proper connections. Repair or replace as necessary.

2. Disconnect air cleaner and E.G.R. vacuum hoses and cap both vacuum sources.

3. Remove one spark plug wire at a time with insulated pliers. If there is an R.P.M. drop on all cylinders, go to rough idle (hot) diagnosis charts on page 6C-7.

4. If there is no R.P.M. drop on one or more cylinders, remove spark plug(s) and check for:

A. Cracks

B. Wear

C. Improper gap

D. Burned Electrodes

E. Heavy deposits

Repair or replace as necessary.

5. Check spark plug wires by connecting ohmmeter to ends of each wire in question. If meter reads over 50,000 ohms, replace wire(s).

6. Visually check distributor cap and rotor for moisture, dust, cracks, carbon track, burns, etc. Clean and/or repair as necessary.

7. Perform compression check on questionable cylinder(s). If compression is low, repair as necessary.

8. Remove rocker covers. Check for bent push rods, worn rocker arms, broken valve springs, worn cam shaft lobes. Repair as necessary.

Problem - Hesitates

1. Visually check the following:

a. Vacuum hoses for splits, kinks and proper connections. See hose routing charts, Page 6E-24.

b. Air leaks at carburetor mounting and intake manifold.

c. Check ignition wires for cracking, hardness and proper connections. Repair and replace as necessary.

2. **Note: Cold Engine Only**

Check the following for sticking or faulty operation:

a. Carburetor, choke, and throttle linkage.

b. Fast idle cam.

See cleaning, inspection and adjustment of carburetor, Page 6C-20.

3. Check carburetor accelerator pump operation.

With air cleaner removed and engine off, hold choke valve open and look for gas squirt in carburetor bore while moving throttle. If weak or no pump squirt, check and adjust the following. Pump rod adjustment, see Carburetor Adjustment, Page 6C-25.

4. If no pump squirt, remove carburetor air horn and repair pump system as necessary.

See air horn removal, cleaning and inspection, Page 6C-25 for proper procedures.

Check float level adjustment before replacing air horn and pump rod adjustment after assembly. See Float Adjustment, Page 6C-25.

5. Disconnect and plug vacuum advance hose, connect tachometer and timing light. Set ignition timing and idle speed to specification on emission label.

6. With engine running, remove air cleaner cover and filter. Damper door in air cleaner snorkel should be closed when engine is cold. It may be necessary to place cold wet rag over sensor to close if engine is too warm.

If damper door does not close, apply vacuum directly to vacuum motor. If door closes, replace sensor. If door stays open, replace vacuum motor.

Problem - Surges

1. With engine running, remove air cleaner cover and filter. Damper door in air cleaner snorkel should be closed when engine is cold. It may be necessary to place cold wet rag over sensor to close if engine is too warm.

If damper door does not close, apply vacuum directly to vacuum motor.

2. Visually check the following:

a. Vacuum hoses for splits, kinks and proper connections. See hose routing charts, Page 6E-24.

b. Air leaks at carburetor mounting and intake manifold.

c. Ignition wires for cracking, hardness and proper connections. Repair or replace as necessary.

3. Check ignition timing per emission control information label. Vacuum advance hose should be disconnected and plugged.

NOTE: To check mechanical advance, observe timing marks. It should advance as throttle is opened and return to mark as throttle is closed.

4. With engine off, remove vacuum hose from distributor vacuum advance. Connect vacuum pump and apply 15" vacuum. Vacuum should hold steady for 15 seconds. If vacuum drops, replace vacuum advance unit.

5. Check carburetor fuel inlet filter. Replace if dirty or plugged.

6. Test fuel pump by connecting hose from carburetor fuel feed line to a suitable container.

Start engine and let idle for 15 seconds.

a. Mechanical pump should supply 1/2 pint or more. If not, go to step 7. If OK, go to step 9.

7. To check mechanical fuel pump, disconnect inlet hose at pump and connect a vacuum gauge. Crank or run engine until maximum vacuum is reached. If less than 12 inches, replace pump. If vacuum reading is 12 inches or more, go to step 8.

8. Check fuel lines and hoses for splits, leaks or kinks by disconnecting each section of line and connect vacuum gauge. Crank or run engine until vacuum gauge peaks. Vacuum should be at least 12 inches. If less, repair or replace defective line or hose.

9. If fuel lines and pump check O.K., remove tank unit, replace strainer and clean fuel tank, if necessary.

10. Remove spark plugs. Check for cracks, wear, improper gap, burned electrodes, heavy deposits. Repair or replace as necessary.

11. Remove carburetor, clean and adjust, Page 6C-20.

Problem - Sluggish or Spongy

1. Remove air cleaner cover and check air filter for dirt or being plugged. Replace as necessary.

2. With engine running, damper door in air cleaner snorkel should be closed when engine is cold. It may be necessary to place cold wet rag over sensor to close if engine is too warm.

If damper door does not close, apply vacuum directly to vacuum motor. If door closes, replace sensor. If door stays open, replace vacuum motor.

3. Check ignition timing per emission label. Disconnect and plug vacuum advance hose.

NOTE: To check mechanical advance, observe timing marks. It should advance as throttle is opened and return to mark as throttle is closed.

4. Remove air cleaner and check for full throttle valve opening in carburetor by depressing accelerator pedal to floor; also check for full choke valve opening. Repair as necessary. See carburetor cleaning and inspection, page 6C-20.

5. Remove vacuum hose from E.G.R. valve and connect an extra hose from any manifold vacuum source to valve. If RPM doesn't drop, valve is leaking. See E.G.R. Section 6E for further functional tests, cleaning, and/or replacement.

6. With engine off, remove vacuum hose from distributor vacuum advance. Connect vacuum pump and apply 15" vacuum. Vacuum should hold steady for 15 seconds. If vacuum drops, replace vacuum advance unit.

7. Remove spark plugs. Check for cracks, wear, improper gap, burned electrodes, heavy deposits. Repair or replace as necessary.

8. Remove carburetor air horn and check the following:

a. Power piston for freeness

b. Dirt in carburetor

c. Float adjustment

d. Metering rods

e. Power valve(s)

Refer to carburetor cleaning and inspection, page 6C-20.

Problem - Poor Gasoline Mileage

1. With engine running, remove air cleaner cover and filter. Check filter for dirt or being plugged. Replace as necessary.

Damper door in air cleaner snorkel should be closed when engine is cold. It may be necessary to place cold wet rag over sensor to close it if engine is too warm.

If damper door does not close, apply vacuum directly to vacuum motor. If door closes, replace sensor. If door stays open, replace vacuum motor.

2. Visually check the following:

a. Vacuum hoses for splits, kinks and proper connections. See hose routing charts, Page 6E-24.

b. Air leaks at carburetor mounting and intake manifold.

c. Ignition wires for cracking, hardness and proper connections. Repair or replace as necessary.

3. Check ignition timing per emission control information label. Disconnect and plug vacuum advance hose.

NOTE: To check mechanical advance, observe timing mark. It should advance as throttle is opened and return to mark as throttle is closed.

4. Check carburetor choke linkage and settings. Clean and repair as necessary. See carburetor choke adjustments, cleaning and inspection, page 6C-20.

5. With engine off, remove vacuum hose from distributor vacuum advance. Connect vacuum pump and apply 15" vacuum. Vacuum should hold steady for 15 seconds. If vacuum drops, replace vacuum advance unit.

6. Remove spark plugs, check for cracks, wear, improper gap, burned electrodes, heavy deposits. Repair or replace as necessary.

7. If in previous checks, adjustments have not been made that could improve mileage, remove carburetor air horn and check the following:

a. Power piston for freeness
b. Dirt in jets and metering passages
c. Metering rods
d. Power valve
e. Float adjustment

See carburetor cleaning, inspection, and adjustments, page 6C-20.

8. Suggest owner fill tank and recheck mileage.

Problem - Cuts Out

1. Check ignition wires, boots, cap and coil for:

a. Damage
b. Deterioration
c. Loose connections
d. Carbon tracking

Clean, tighten and/or replace defective parts as necessary.

2. Connect secondary voltage output meter or scope to engine.

Using insulated pliers, check output as each spark plug wire is removed. Output voltage should read:

a. 25 KV or above
b. No arcing should occur

If any reading is below specification or arcing occurs, with engine off, remove distributor cap and visually inspect for moisture, dust, cracks, burns, etc.

Check distributor for:

a. Worn shaft
b. Bare or shorted wires
c. Faulty pick up coil, module, ignition coil, and condenser.

Repair or replace defective parts as necessary.

3. Remove spark plugs. Check for cracks, wear, improper gap, burned electrodes, heavy deposits. Repair or replace as necessary.

4. Check carburetor fuel inlet filter. Replace if dirty or plugged.

5. Test fuel pump by connecting hose from carburetor fuel feed line to a suitable container.

Start engine and let idle for 15 seconds. Pump should supply 1/2 pint or more. If not, go to step 7.

6. To check fuel pump, disconnect inlet hose at pump and connect a vacuum gauge. Crank or run engine until maximum vacuum is reached. If less than 12 inches, replace pump. If vacuum reading is 12 inches or more, go to step 8.

7. Check fuel lines and hoses for splits, leaks or kinks by disconnecting each section of line and connecting a vacuum gauge. Crank or run engine until vacuum gauge peaks. Vacuum should be at least 12 inches. If less, repair or replace defective line or hose as necessary.

8. If fuel pump and fuel lines check O.K., remove tank unit, replace strainer and clean fuel tank, if necessary.

Problem - Hard Starting - Cold (Engine Cranks O.K.)

1. Visually check the following:

a. Vacuum hoses for splits, kinks and proper connections. See hose routing charts, Page 6E-24.

b. Air leaks at carburetor mounting and intake manifold.

c. Ignition wires for cracking, hardness, proper connections, and carbon tracking.

Repair or replace as necessary.

2. Check ignition timing per emission control information label.

NOTE: If timing is too early - speed up engine to see if timing mark moves. If not, check for stuck mechanical advance. Refer to page 6D-33. Repair as necessary and recheck timing.

3. Check the following:

a. Choke, throttle linkage and fast idle cam for sticking.

b. Carburetor flooding.

Clean and repair as necessary. If repairs are necessary, see carburetor, cleaning and inspection, page 6C-20.

4. Connect secondary voltage output meter or scope to engine.

Using insulated pliers, check output with spark plug wire removed. Output voltage should read 25 KV or above.

If any reading is below specifications or arcing occurs, stop engine, remove distributor cap and visually inspect for moisture, dust, cracks, burns, etc.

Check distributor for:

a. Worn shaft

b. Bare and shorted wires

c. Faulty pick up coil, module, ignition coil and shorted condenser. Repair or replace as necessary.

5. Remove spark plugs. Check for cracks, wear, improper gap, burned electrodes, heavy deposits.

Repair or replace as necessary.

6. Test fuel pump by connecting hose from carburetor fuel feed line to a suitable container.

Start engine and let idle for 15 seconds. Pump should supply 1/2 pint or more. If more than 1/2 pint, check filter in carburetor. Replace if necessary. If less than 1/2 pint, for mechanical pump go to step 7.

7. Disconnect inlet hose at pump and connect a vacuum gauge. Crank or run engine until maximum vacuum is reached. If less than 12 inches, replace pump. If more than 12 inches, go to step 8.

8. Check fuel lines and hoses for splits, leaks or kinks by disconnecting each section of line and connect vacuum gauge. Crank or run engine until vacuum gauge peaks. VAcuum should be at least 12 inches. If less, repair or replace defective line or hose.

9. If fuel lines and pump check O.K., remove tank unit, replace strainer and clean fuel tank, if necessary.

Problem - Hard Starting - Hot (Engine cranks O.K.)

1. Visually check the following:

a. Vacuum hoses for splits, kinks and proper connections. See hose routing charts, page 6E-24.

b. Air leaks at carburetor mounting and intake manifold.

c. Ignition wires for cracking, hardness, proper connections, and carbon tracking.

Repair or replace as necessary.

2. Check ignition timing per emission control information label.

NOTE: If timing is too early - speed up engine to see if timing mark moves. If not, check for stuck mechanical advance. Refer to page 6D-33. Repair as necessary and recheck timing.

3. Check the following:

a. Choke, throttle linkage and fast idle cam for sticking.

b. Carburetor flooding.

Clean and repair as necessary. If repairs are necessary, see carburetor, cleaning and inspection, page 6C-20.

4. Connect secondary voltage output meter or scope to engine. Using insulated pliers, check output with spark plug wire removed. Output voltage should read:

a. 25 KV or above.

b. No arcing should occur.

If any reading is below specifications or arcing occurs, turn off engine, remove distributor cap and visually inspect for dust, cracks, burns, etc.

Check distributor for:

a. Worn shaft

b. Bare and shorted wires

c. Faulty pick up coil, module, ignition coil, and shorted condenser. Repair or replace as necessary.

5. Remove spark plugs. Check for cracks, wear, improper gap, burned electrodes, heavy deposits.

Repair or replace as necessary.

6. Also check steps 6, 7, 8, 9 - Hard Starting - Cold

ENGINE MECHANICAL — EXCEPT SEVILLE

TABLE OF CONTENTS

General Description 6A-
Service Procedures 6A-
Engine R and I 6A-
Engine Mounts 6A-
Intake Manifold 6A-
Oil Pump 6A-
Exhaust Manifold 6A-
Valve Covers 6A-
Cylinder Head 6A-
Oil Pan 6A-
Engine Front Cover 6A-
Dipstick 6A-

GENERAL DESCRIPTION

The 1977 Cadillac engine, except Seville, is of the overhead valve, 90° V-8 design. The cylinder bore diameter is 4.082 inches and the piston stroke is 4.060 inches, providing a piston displacement of 425 cubic inches (7.0 Litres). The engine has a compression ration of 8.2:1. A three quarter view of the engine is shown in Fig. 6A-1.

The reduction in displacement was obtained by reducing both the bore and the stroke by slightly less than one fourth inch. Weight of the engine is reduced approximately 100 pounds over previous designs by re-designing many castings and components but retaining major dimensions.

The firing order is 1-5-6-3-4-2-7-8.

The crankshaft is designed to provide a 4.060 inch stroke. The cast nodular iron crankshaft has two and one-half inch diameter connecting rod journals and incorporates five three and one-quarter inch diameter main bearing journals with shell-type inserts of steel-backed aluminum and steel-backed babbitt construction. End thrust of the crankshaft is taken by the center main bearing. Six counterweights are integral with the crankshaft.

Connecting rods for pistons of opposite cylinders are carried side by side on the same crankpin. Shell type connecting rod bearings are steel-backed with a bearing material overlay.

The cast aluminum pistons use two compression rings and one oil ring. To provide a non-scuffing surface when the engine is new, the pistons are tin-plated.

Piston pins are press-fitted into the connecting rods. Broached grooves in each piston pin bore direct oil from the cylinder wall to the piston pin to provide adequate lubrication.

The camshaft is supported by five steel-backed babbitt bearings. It is driven by the crankshaft through a timing chain at the front of the engine. Both the crankshaft and camshaft sprockets have locaing marks to provide correct valve timing when the timing chain is installed. Wide camshaft lobe design assures minimum lobe wear.

A drive gear, cast as an integral part of the camshaft, meshes with the driven gear on the distributor drive shaft, Fig. 6A-2. The distributor drive shaft rotates in a clockwise direction when viewed from above. This shaft also drives the oil pump.

Hydraulic valve lifters are used to maintain zero operating clearance throughout the valve train. This arrangement assures quiet operation and eliminates the need for valve tappet adjustments. The lifters operate in guide holes bored in the cylinder block. The valve lifter plunger and lifter body are selectively fitted in matched pairs. The push rods ride in cups in the lifters and extend up through openings in the cylinder heads to the rocker arms. The valve operating mechanism is illustrated in Figs. 6A-3 and 6A-4.

A full flow type oil filter is attached to the oil pump housing. The filter assembly incorporates a throw away type filter element and a spring loaded by-pass valve integral with the pump assembly, to assure that the engine oil supply is not interrupted if the element should become clogged.

Oil capacity of the engine crankcase on all series cars except the Eldorado is four quarts; five quarts should be added if the filter is changed.

Oil capacity of the Eldorado crankcase is five quarts; six quarts should be added if the filter is changed.

Engine Lubricating System

The oil pump is mounted on the right side near the front of the engine, Fig. 6A-4. Oil enters the pump through a screened intake pick-up pipe, and is pumped through the oil filter, through an angular passage in the cylinder block into the right longitudinal header, Fig. 6A-4, and crosses over to the left longitudinal header though intersecting vertical passages above the No. 2 camshaft bearing.

The oil continues up the left longitudinal header to the oil pressure signal switch. A dual contact oil pressure switch is used on all carbureted engines to provide a feed circuit for the carburetor electric choke as well as its function of indicating engine oil pressure. Operation of the electric choke is discussed on page 6A-6.

Main bearings No. 2, 3, and 4 are lubricated by oil from the right longitudinal header through holes drilled in the block. Main bearings No. 1 and 5 are lubricated in the same manner by oil from the left longitudinal header. The camshaft bearings are lubricated by oil from the corresponding main bearings through holes drilled in the block. Oil from each main bearing also lubricates adjacent connecting rod bearings through holes drilled in the crankshaft, Fig. 6A-4.

The longitudinal headers feed the hydraulic valve lifters through drilled passages, Fig. 6A-4. The oil then flows under

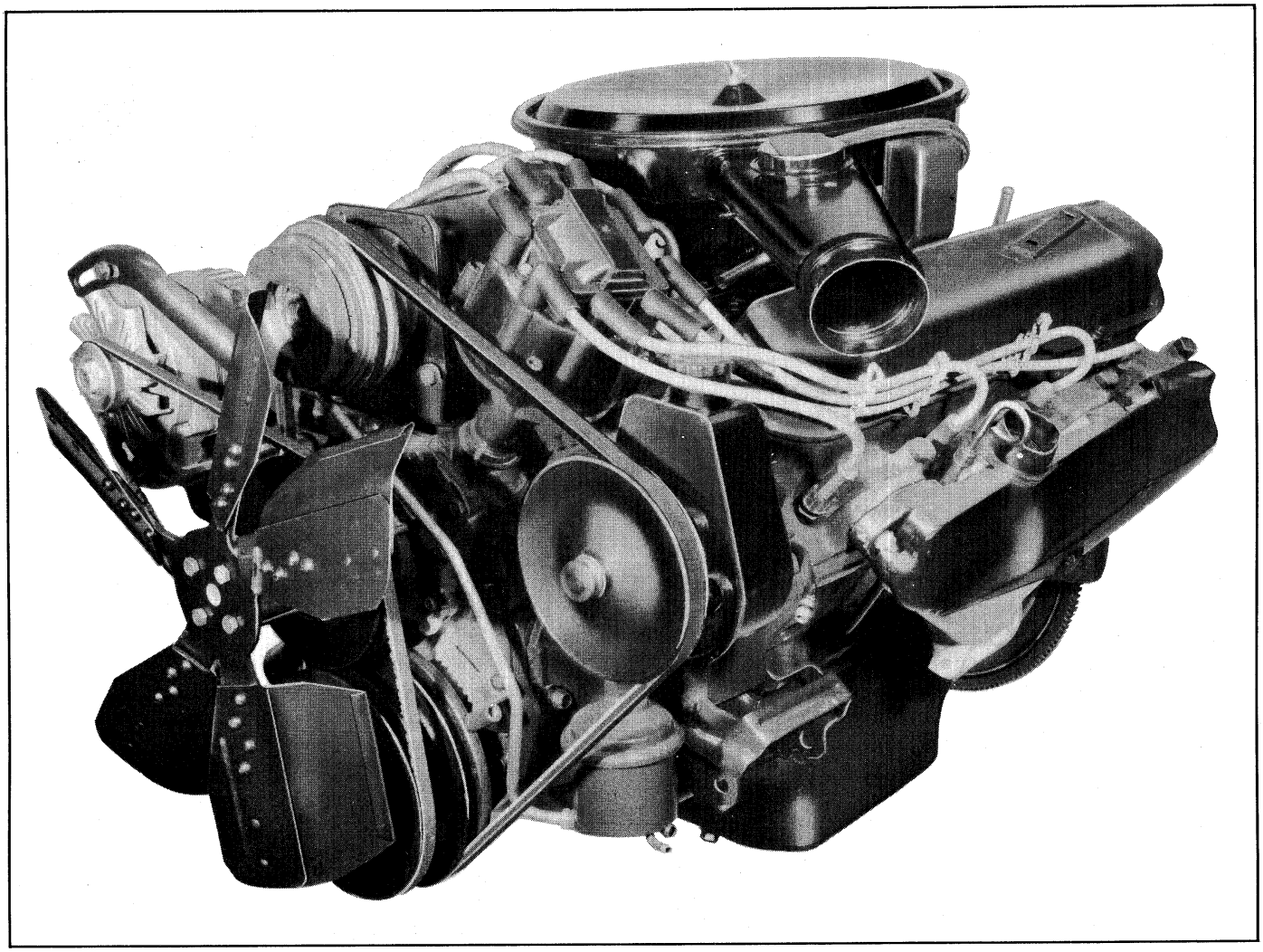


Fig. 6A-1 425 Cubic Inch Cadillac Engine

pressure into the lifters and up through the hollow push rods to the rocker arms. The amount of oil is controlled by a small metering disc in the valve lifter.

The oil comes through a small feed hole in the rocker arm and flows onto the arm, lubricating the rocker arm pivot points as well as the push rod tip and the valve tip.

Oil drains from the cylinder heads into the valve lifter compartment and returns to the oil pan through a hole on the bottom of the compartment.

Engine Mounts - Except Eldorado

The front mount design is of coordinated Corporation design with specific Cadillac rate specifications on all cars except Eldorado. The front engine mount is attached to the frame crossmember with three bolts and nuts. The engine attaching bracket is installed on the mount with a through bolt. The bracket is attached to the engine with two bolts and nuts.

The rear engine mount is attached to the transmission with two bolts with the converter bracket sandwiched between the mount and transmission. Fig. 6A-5. On the Eldorado, special mounting brackets welded to the frame provide the front attaching points and a special frame crossmember is used to provide the seat for the rear mount. Fig. 6A-6.

Exhaust Manifolds

The exhaust manifolds, except the Eldorado L.H. exhaust manifold, are designed to provide space for the upper control arms and reduce weight. Exhaust manifold attaching screws on the right hand manifold are both long and short and on the left hand manifold, all screws are short. Eldorado uses all long screws securing the left hand manifold and long and short screws on the right hand manifold. All short screws are torqued to 12 ft. lbs. and use locks to secure the screws. All long screws do not require locks but are torqued to 35 ft. lbs.

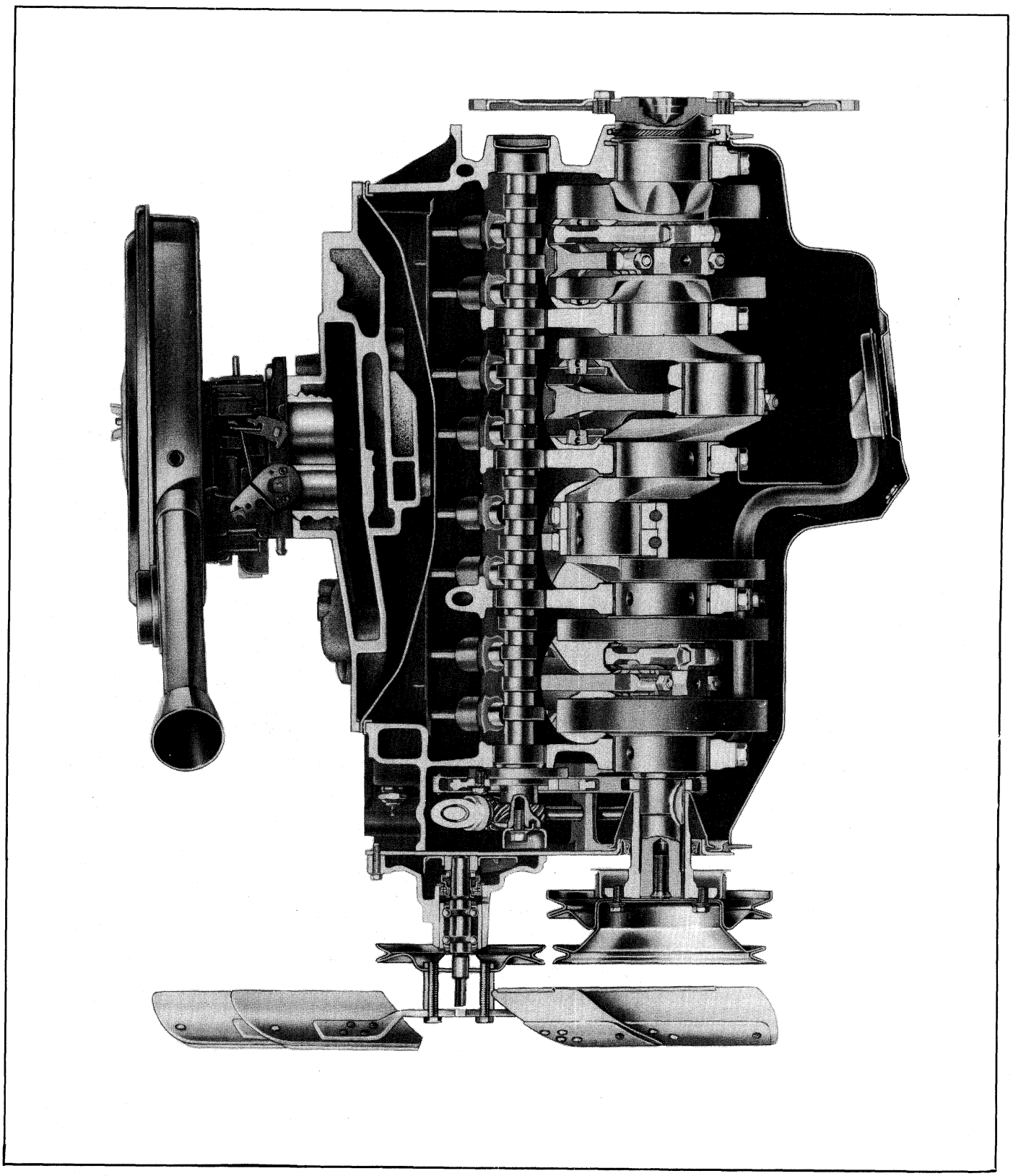


Fig. 6A-2 Engine Longitudinal Section

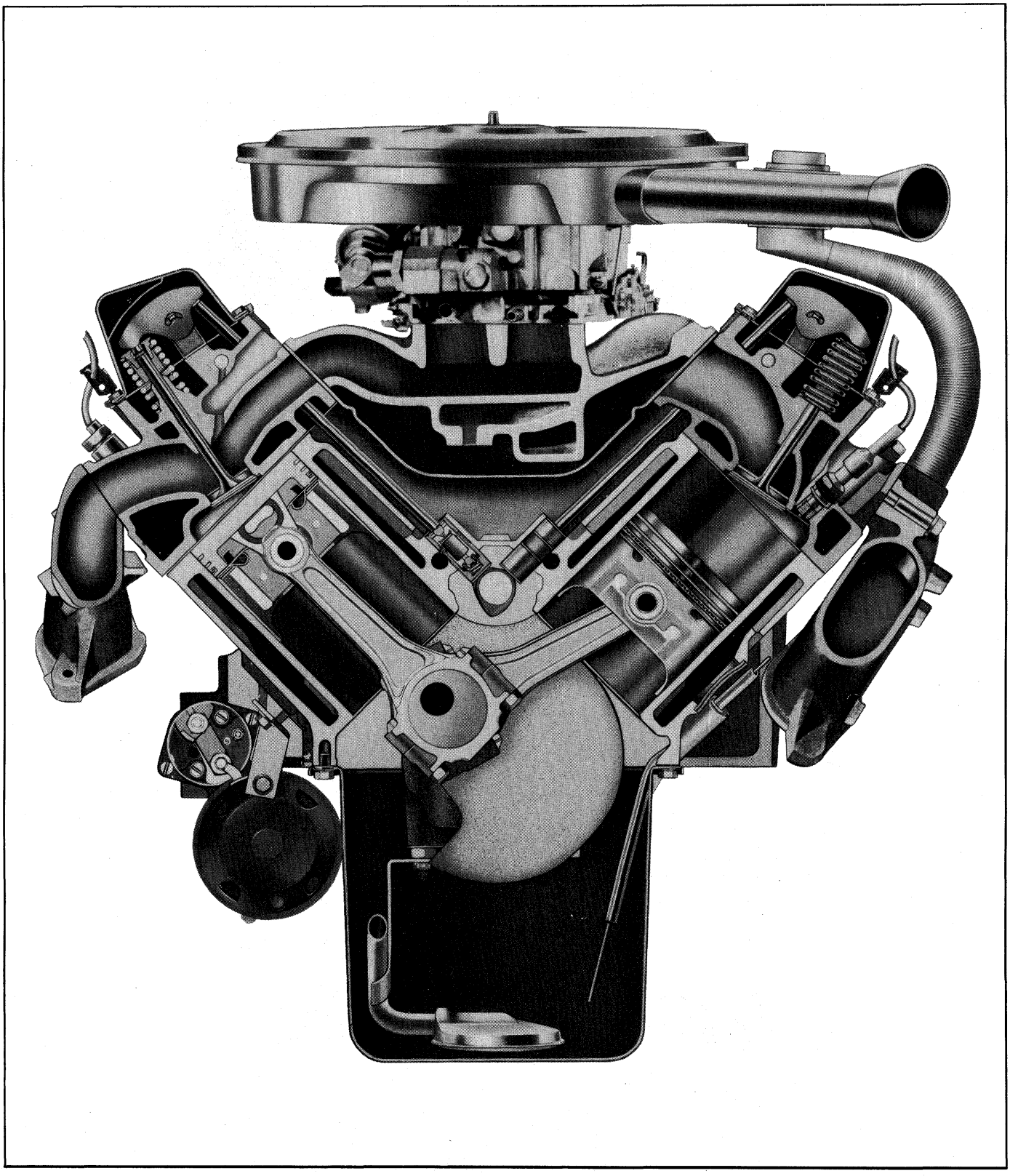


Fig. 6A-3 Engine Transverse Section

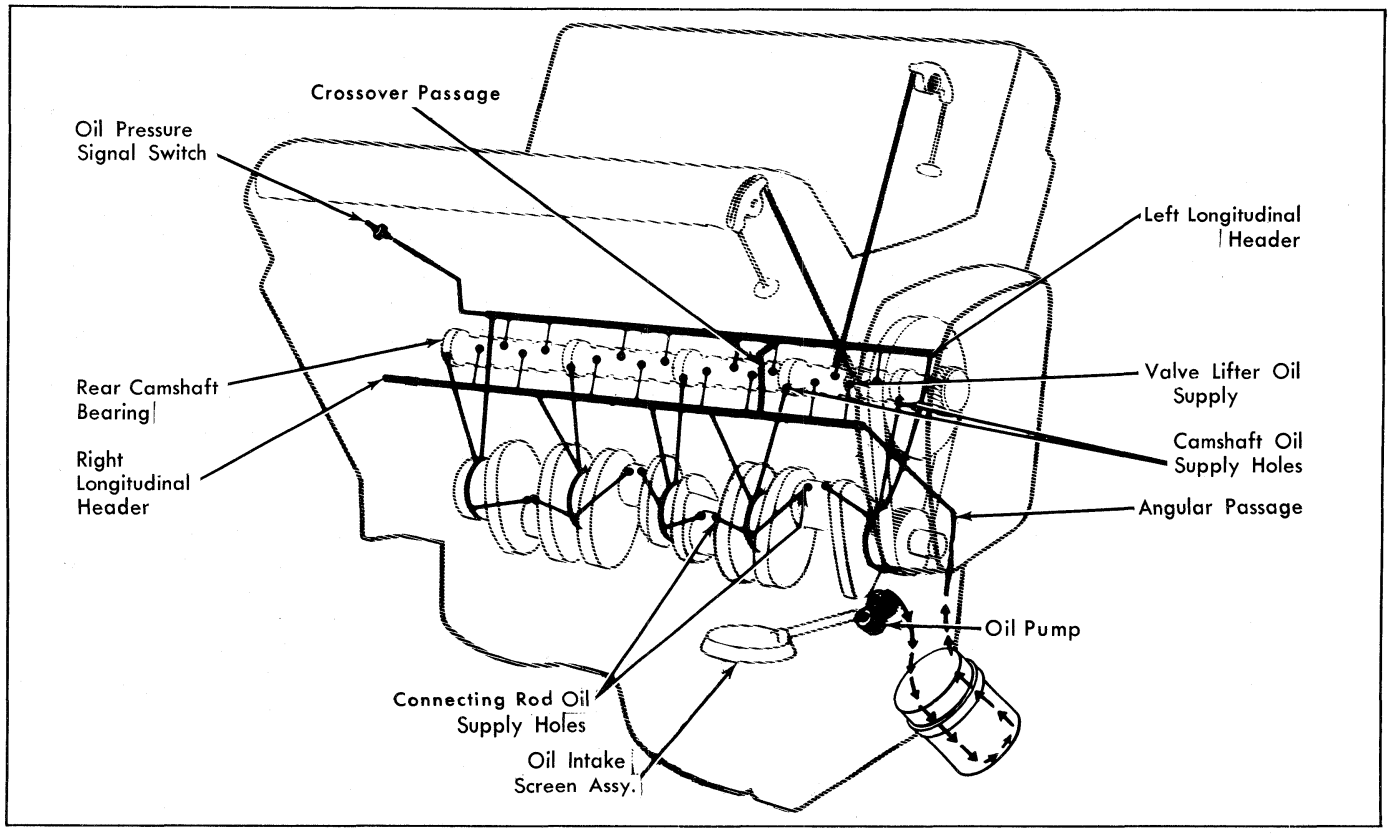


Fig. 6A-4 Engine Lubricating System

SERVICE PROCEDURES

ENGINE REMOVAL AND INSTALLATION (EXCEPT ELDORADO)

a. Removal

1. Disconnect negative battery cable.
2. Raise rear of car approximately two feet, place drain pan under radiator, and open petcock to drain radiator.
3. Remove two screws each side securing radiator cover to strut, support rods at radiator cover and one screw each side at strut. Move support rods out of way.
4. Remove two screws securing top radiator shroud to cradle and one screw securing upper radiator hose to shroud.
5. Remove nine rivets securing upper shroud to lower shroud by drilling rivets out.
6. Remove two screws and washers securing radiator cover to cradle and remove cover.
7. Remove hood as described in Section 2C.
8. Remove air cleaner and inlet duct assembly.
9. Disconnect upper radiator hose from thermostat housing.
10. Disconnect wires at the following locations: coolant temperature sender connector (green wire), HEI connector, downshift switch, engine metal temperature switch, oil pressure switch, heater turn-on switch, cruise control servo, and A/C compressor.

NOTE: On car equipped with Electronic Fuel Injection disconnect EFI manifold harness and position out of way.

11. Disconnect wiring harness from support clip and position harness out of way.
12. Disconnect brake hose from brake pipe.
13. Disconnect throttle linkage.
14. Disconnect vapor canister hose.
15. Disconnect power steering pump as described in Section 3B, and position pump out of way without disconnecting lines or hoses.
16. Remove fan as described on Page 6B-8.
17. Reposition drain pan and disconnect lower radiator hose.
18. Remove right front side spark plug wire retainer clip and position wires out of way.
19. Remove A/C compressor and position out of way on right fender with A/C lines intact, as described in Section 1.
20. Disconnect generator wiring and bend back clips securing wiring harness to right rocker arm cover. Position harness out of way.
21. Disconnect ALC vacuum line on cars so equipped.
22. Remove hose from hot water valve fitting in rear of right cylinder head.
23. Raise car on hoist.
24. Remove six screws securing transmission to engine.
24. Remove through bolt securing each engine mount to engine bracket.
25. Remove starter motor as described on Page 6D-40
27. Remove four screws securing flywheel inspection cover to transmission and remove inspection cover.

28. Remove screws securing flywheel to converter.

29. Support transmission to be independent of engine.

NOTE: It may be necessary to support transmission with separate jack.

30. Brace exhaust system so that it is supported independently of hangers. Remove two nuts securing exhaust pipe to each exhaust manifold and disengage exhaust system.

31. On E.F.I. cars relieve fuel pressure as follows:

a. Remove protective cap from pressure fitting and loosely install valve depressor J-5420 on fitting. Arrange a shop towel or suitable container so that displaced fuel will be contained. Slowly tighten valve depressor J-5420 until pressure is relieved.

b. Dispose of gasoline properly.

c. Remove valve depressor and install protective cap.

d. Remove and discard clamps securing flexible fuel hose to fuel filter on inlet side and remove hose from filter.

e. Remove and discard clamps securing flexible fuel hose connecting regulator to return line. Remove return line.

32. Disconnect and plug fuel line and vapor return line at fuel pump.

33. Lower car.

34. Move right side lifting bracket to a position such that it straddles the intake passage for #1 cylinder. On E.F.I. engines install bracket J-25511.

35. Place lifting chain in lifting brackets and connect chain-fall to lifting chain.

36. Raise engine slowly and pull forward to disengage transmission.

37. Raise engine and remove from car.

b. Installation

1. Raise transmission as high as possible.

NOTE: It may be necessary to support transmission with a separate jack.

2. Lower engine in chassis on an angle that matches position of transmission. Install two top bolts securing engine to transmission. Right screw also secures transmission dipstick and modulator line.

NOTE: During this operation use care not to damage any items in the engine compartment (e.g. transmission dipstick tube, throttle linkage, etc.) Some twisting and maneuvering of the engine is sometimes required.

3. Release the floor jack's support of the transmission, if used.

4. Lower the engine completely, seating brackets on mounts.

5. Remove lifting equipment.

6. Raise car on hoist.

7. Install four remaining screws securing engine to transmission. Torque screws to 35 foot-pounds.

NOTE: Make sure harness retaining clip is secured under upper screw on right side.

8. Install three screws securing flywheel to converter. Torque screws to 30 foot-pounds.

9. Position flywheel inspection cover to transmission and secure with four screws.

10. Install starter motor as described on Page 6D-40.

11. Raise exhaust pipes into position and secure to manifolds with two nuts each side.

12. Install through bolts securing engine bracket to engine mounts. Torque nuts to 30 foot-pounds.

13. Install lower radiator hose to water pump.

14. Install fuel and vapor return hoses to fuel pump. On E.F.I. cars install, using a new clamp, fuel line to fuel filter, and fuel return line to regulator.

15. Lower car.

16. Install power steering pump as described in Section 3B.

17. Install air conditioning compressor, securing with four screws and connect electrical lead.

CAUTION: *Make sure vapor canister hose and distributor vacuum hose are not under compressor or these hoses could be pinched off which could cause poor engine and emission control performance.*

18. Install power steering and air conditioning drive belts as described on Page 6B-12.

19. Install upper radiator hose at thermostat housing.

20. Install fan as described on Page 6B-8.

21. Route wiring harnesses along both rocker arm covers and secure with metal tabs.

22. Connect wiring at HEI, coolant temperature sender connector, downshift switch, engine temperature switch, generator, heater turn on switch, cruise control servo and oil pressure switch.

NOTE: On cars equipped with Electronic Fuel Injection, Position EFI manifold harness along bracket and secure to brackets–4 positions.

Connect injector leads as follows:

Front cylinder–red/black wires

Front-center cylinder–black/white wires

Rear-center cylinder–black/white wires

Rear cylinder–red/black wires

NOTE: Injectors may be rotated to provide proper harness routing.

23. Connect vapor canister hose.

24. Install throttle cable at linkage.

25. Install brake hose on brake line.

26. Reposition cowl-to-strut, support rods.

27. Install radiator cover, securing with two screws.

28. Install upper radiator shroud and secure to lower shroud with nine screws and "J" nuts, secure shroud to radiator cover with two screws and secure upper radiator hose brace to radiator shroud with one screw.

29. Install both radiator-to-strut support rods and secure with two screws each side at radiator cover and one each side at strut. Tighten all strut fasteners.

20. Install right side spark plug wire clip.

31. Connect hot water valve hose at rear of right cylinder head.

32. Close drain cock, fill readiator, and install cap.

33. Install air cleaner and connect heat ducts and inlet air cuct.

34. Connect ALC hose at air cleaner fitting if so equipped.

35. Connect negative battery cable.

36. Test engine for proper operation. Turn on air conditioning and check for proper operation. Turn steering wheel from stop to stop to check power steering for proper operation.

37. Shut off engine, check engine oil level. Install hood as described in Section 2C.

Engine Removal and Installation-Eldorado Only

a. Removal

1. Remove hood.

NOTE: This operation may be performed by either one or two men. The operation is simplified by constructing four hood hinge-to-retainer bolts with the heads cut off. Use two at each side and install them in the hood hinge bolt holes as the regular bolts are removed. This will serve to locate the hood during removal and installation.

The one-man operation involves supporting the front of the hood with a fan belt wrapped through the hood bracing and hooked to a chainfall.

2. Open radiator petcock and raise rear of car to facilitate draining.

3. Remove carburetor air cleaner, inlet duct, vacuum hoses and hot air ducts.

4. Remove upper radiator hose at thermostat housing and remove bracket at cradle.

5. Remove radiator cover - six screws.

6. Remove fan blade assembly as described on page 6B-8.

7. Disconnect negative battery cable, generator wires, cruise control servo and, heater turn-on switch and position harness out of way. Route spark plug wires away from top of compressor.

8. Disconnect water control valve hose at rear of block. Disconnect starter motor wiring harness at multiple connector.

9. Remove power steering pump (do not disconnect hoses) and position out of way. Remove all drive belts. (Lower power steering pump bolt is most easily removed with 9/16" flex socket, about 9" of extension, and small 3/8" drive ratchet. Position pump with hoses attached near evaporator canister).

10. Remove A/C compressor mounts (four screws, one nut), disconnect electrical lead and move compressor to top of battery.

11. Disconnect throttle linkage at throttle body or carburetor and bracket. Position cable out of way.

12. Disconnect wires on left branch of engine harness (compressor, etc.) and position out of way.

NOTE: On cars equipped with Electronic Fuel Injection disconnect manifold harness and position out of way.

13. Disconnect vacuum lines at rear of carburetor and position out of way.

14. Remove left exhaust manifold flange nuts.

15. Remove transmission cooler line bracket screw and filler pipe nut from exhaust manifold.

16. Change right hand engine lift hook to position over No. 1 intake port. On E.F.I. cars install bracket J-25511.

17. Remove upper screw securing steering gear flex coupling shroud to frame.

18. Raise car on hoist.

NOTE: A twin post hoist is preferred for this operation.

19. Remove remaining screw securing steering gear flex coupling shroud to frame and remove shroud.

20. Remove bolt and nut securing final drive bracket to motor mount.

21. Disconnect fuel pump lines and plug.

22. Remove nut and washer securing each front engine mount to frame.

23. Remove lower radiator hose.

NOTE: Drain hose and position out of way on bottom of car. Hose clamp is likely to be crushed during installation if not repositioned.

24. Remove right exhaust manifold flange nuts.

25. Remove starter motor. Do not disconnect wiring from terminals.

26. Remove flywheel inspection cover.

NOTE: It is possible to perform Step 27 without removing this cover, however, removal of the three accessible bolts is necessary so the cover may be moved to reach converter screws. One cover screw is very difficult to reach.

27. Remove flywheel-to-converter screws.

NOTE: Use a 1962 Harmonic Balancer screw #147 0868 and washer - #147 0867 to turn crankshaft.

28. Remove two lower transmission-to-block screws.

29. Remove right hand output shaft screws.

NOTE: This is easily done by one man if a long breaker bar is used. Hold tire with one hand and loosen screw with bar. When all screws are loose, use a small 3/8" drive ratchet with about 18" of extension.

30. Remove two output shaft bracket to block screws and one screw securing bracket to final drive.

31. Loosen right hand shock absorber lower mounting nut and move shock outward on stud.

32. Move drive axle as far back as possible and remove output shaft.

33. Lower car.

34. Remove four screws securing transmission to block, two at top and two at left hand side of engine.

35. Install lifting chain and chain fall.

36. Place floor jack with a soft (wood) face under transmission pan for support.

37. Remove engine.

b. Installation

1. Install engine.

NOTE: Use of longer transmission to engine screws will simplify engine locating. Install these bolts in the top two holes. Use of a long screwdriver or pry bar will provide pressure at appropriate points.

2. Install four transmission to engine screws, two at top and two at left hand side of engine.

3. Remove chain fall, jack and blocks.

4. Raise car.

5. Install two remaining screws securing transmission to engine.

6. Install screws securing converter to flywheel and remove harmonic balancer screw and washer.

7. Secure inspection cover with three screws.

8. Install starter motor.

9. Install output shaft and tighten lower shock mount nut.

10. Install right hand exhaust pipe flange nuts.

11. Install nuts with washers to engine mount studs. Torque nuts to 52 ft. lbs.

12. Install bolt and nut securing final drive bracket to left engine mount.

13. Install flex coupling shroud and secure with lower screw.

14. Connect fuel lines.

15. Install lower radiator hose.

16. Lower car.

17. Install fan blade assembly and belts as described on page 6B-8.

18. Install transmission cooler line bracket and dipstick

tube bracket.

19. Install throttle and Cruise Control linkage.

20. Install left hand exhaust pipe flange nuts.

21. Install remaining screw securing flex coupling shroud to frame.

22. Install power steering pump.

NOTE: Lower power steering pump bolt is most easily installed with a 9/16" flexible socket, about 9" of extension, and small 3/8" drive ratchet.

23. Install A/C compressor.

24. Connect heater hose to right cylinder head.

25. Connect remaining wires and vacuum hoses.

NOTE: Position and connect Electronic Fuel Injection manifold harness on E.F.I. cars.

26. Install upper radiator hose.

27. Install radiator cover.

28. Refill coolant.

29. Tension generator and power steering belts.

30. Install battery cable.

31. Install air cleaner, inlet duct and connect heat ducts.

32. Install hood and align.

33. Start engine and check for leaks.

ENGINE AND TRANSMISSION SUPPORT MOUNTS (EXCEPT ELDORADO)

Front engine mount removal (Fig. 6A-5)

1. Open hood.

2. Remove two screws each side securing, radiator cover to strut, support rods. Loosen one screw each side and position support rods out of way.

3. Remove two screws securing upper radiator shroud to radiator cover and one screw securing upper radiator hose bracket to shroud. Drill out nine rivets securing upper shroud to lower shroud and remove upper shroud.

4. Raise car on hoist.

5. Remove through bolt from mount to be replaced (left or right).

6. Loosen through bolt for opposite side.

7. Support car with stands at each front frame horn.

8. Apply pressure (hoist, jack, etc.) to oil pan. Apply pressure over entire bottom of sump with no concentration of pressure due to bumps or knobs on lift.

9. Raise engine until bracket is free from engine mount. Remove three flanged locking nuts and bolts. Remove mount by pulling straight back.

b. Front Engine Mount Installation (Fig. 6A-5)

1. Position mount in place between cylinder block and frame. Secure with three bolts, nuts and washers.

2. Lower engine until through bolt may be installed through bracket and mount from back of mount.

3. Continue lowering engine until it is in driving position.

4. Torque through bolts, right and left to 30 foot pounds.

5. Torque mount to frame bolts to 30 foot-pounds.

6. Remove stands and lower car from hoist.

7. Install upper fan shroud and secure to lower shroud with nine screws and "J" nuts.

8. Install two screws securing fan shroud to radiator cradle.

9. Position, radiator cover to strut, support rods and secure to radiator cover with two screws each side. Tighten one screw each side at strut.

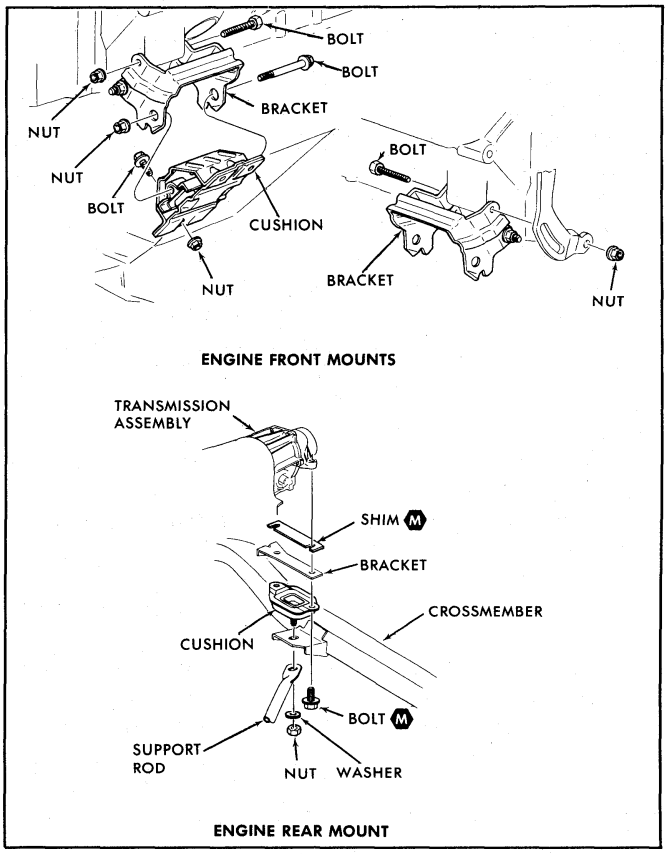


Fig. 6A-5 Engine and Transmission Mounts Except Eldorado

c. Transmission Mount Removal (Fig. 6A-5)

1. Raise car on hoist.

2. Remove two mount to transmission extension housing bolts.

3. Remove two nuts, washers, and bolts securing cross member to frame on each side.

4. Position transmission support under oil pan.

5. Remove transmission mount to frame strut.

6. Remove cross member by raising transmission or lowering vehicle.

7. Remove one nut and remove rear mount from position in crossmember.

d. Transmission Mount Installation (Fig. 6A-5)

1. Install rear mount to cross member and loosely install one nut.

2. Install cross member and secure with two nuts, washers and bolts at each side.

3. Install two bolts securing mount to transmission extension housing.

4. Install transmission mount to frame strut.

5. Remove transmission support.

6. Lower car.

Engine and Transmission Mounts–Eldorado (Fig. 6A-6)

a. Left Front Engine Mount Removal

1. Remove radiator cover and disconnect negative battery cable.

2. Raise car and remove nut and washer from engine mount stud.

3. Remove capscrew securing transmission cooler lines

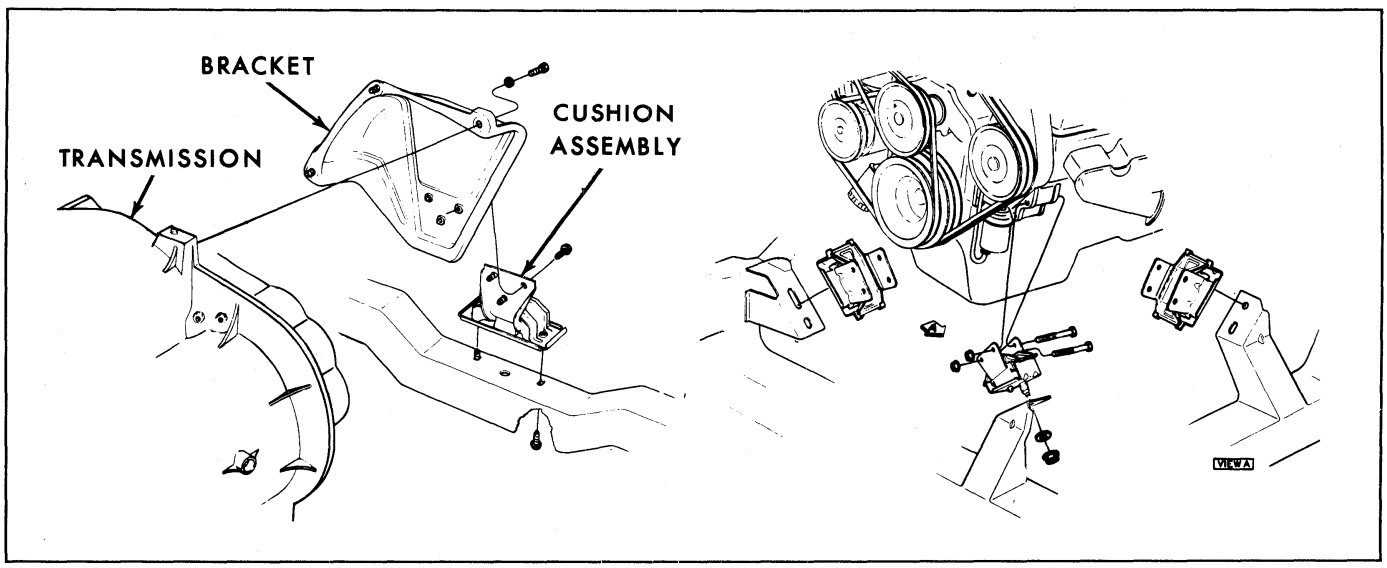


Fig. 6A-6 Engine and Transmission Mounts - Eldorado

to final drive bracket.

4. Remove screw securing top of steering gear flex coupling shroud to frame.

5. Remove nut from large through bolt securing top of engine mount and top of final drive bracket to engine.

6. Raise car and remove nut from lower engine mount through bolt.

NOTE: Attach box end wrench to nut, then use pry bar between wrench and engine.

7. Remove remaining screw securing flex coupling shroud to frame and remove shroud.

8. Remove cross bar bolt, nut, and two washers securing bottom of final drive bracket to final drive. Remove bracket by tipping back and to left of car.

9. Using block of wood and jack stand, lift engine from frame at crankshaft pulley to relieve load on engine mount bolts and remove both bolts from mount.

10. Loosen, but do not remove, nut and washer from right engine mount stud.

11. Raise engine sufficiently to remove mount from car. Work mount down and forward between fuel pump and frame.

NOTE: If interference from fan is encountered, rotate fan blades to a slightly different position.

b. Left Front Engine Mount Installation

1. Work mount up between frame and fuel pump, engaging mount stud and locating knob in holes in frame.

2. Install lower through bolt from rear of engine mount. Install nut but do not torque at this time.

3. Position final drive bracket and install upper through bolt from rear of engine mount, making sure through bolt properly secures final drive bracket to mount. Install nut but do not torque at this time.

4. Lower engine to normal ride position, making sure stud and locator knob on each mount enter holes in frame.

5. Install bolt, nut, and two washers securing bottom of final drive bracket to final drive, tightening to 65 foot-pounds.

6. Torque nuts on both through bolts to 20 foot-pounds.

7. Torque nut and washer securing right engine mount to frame to 52 foot-pounds.

8. Install nut and washer securing left engine mount to frame, tightening to 52 foot-pounds.

9. Secure transmission cooler lines to final drive bracket with one screw and clip.

10. Position flex coupling shroud on frame and install lower screw.

11. Lower car.

12. Install upper flex coupling shroud mounting screw.

13. Install radiator cover. Connect negative battery cable, tightening to 70 inch-pounds.

c. Right Front Engine Mount Removal

1. Remove six screws securing radiator cover to radiator cradle and one screw securing upper radiator hose bracket to cover and remove cover.

2. Remove nut and washer securing left engine mount to frame.

3. Raise car.

4. Remove nut and washer securing right engine mount to frame.

5. Reach between right engine mount and oil pump to attach open end wrench to nut on lower bolt securing engine mount to engine block. Holding this wrench in place, remove lower mounting bolt from rear, using ratchet, U-joint socket, and about 18″ of extension.

6. Work end wrench up between oil pump and crankshaft pulley and position wrench in a straight vertical position to engage nut on upper mounting bolt. Holding wrench in place, use same tools as in Step 5 to remove upper mounting bolt.

NOTE: If nut is impossible to engage, an alternative is to first perform Step 7, then use a 5″ extension and a 9/16″ crowfoot adapter and engage tool on nut by slipping between oil pump and A.I.R. pump.

7. Place jackstand under crankshaft pulley and, using wood block to avoid damage to pulley, either raise engine or lower chassis enough to remove mount.

CAUTION: *When separating engine and chassis, observe relative position of frame rail and right drive axle tri-pot housing. Interference between these parts requires removal of right drive axle before mount can be removed. Furthermore, if tri-pot housing does clear the frame, vertical*

movement is limited by presence of fuel lines. Do not allow tri-pot housing to contact fuel lines.

8. Work mount free and pull rearward over tri-pot housing to remove from car.

d. Right Front Engine Mount Installation

1. Position mount between engine and frame.
2. Install upper mounting bolt and nut securing engine mount to engine.
3. Install lower mounting bolt and nut securing mount to engine.
4. Torque upper and lower mounting bolts and nuts to 20 foot-pounds.
5. Lower engine into chassis, making sure each mount stud and locater engages its mounting hole in frame.
6. Install nut and washer securing right mount to frame, tightening to 52 foot-pounds.
7. Lower car.
8. Install nut and washer securing left mount to frame, tightening to 52 foot-pounds.
9. Secure radiator cover with six screws and install upper radiator hose and bracket on radiator cover.

e. Transmission Mount Removal (Fig. 6A-6)

1. Raise car on hoist.
2. Remove two screws securing transmission mount to frame cross bar, Fig. 6A-6.
3. Place jack stand under transmission pan. Use a block of wood to protect pan.
4. Lower chassis slightly to relieve vertical load on mount.
5. Remove three screws securing mount to transmission bracket and remove mount.

f. Transmission Mount Installation

1. Position mount against rear of transmission bracket and secure with three screws, tightening to 25 foot-pounds.

NOTE: While performing this step observe alignment of holes in mount and holes in frame to make sure installation of screws will be possible.

2. Raise chassis so that transmission is in normal ride position and transmission mount assumes normal load.
3. Install two screws securing transmission mount to frame cross bar, tightening to 25 foot-pounds.
4. Remove jack stand and wood block from under transmission pan and lower car.

INTAKE MANIFOLD EXCEPT E.F.I.

a. Removal

1. Disconnect negative battery cable.
2. Remove air cleaner, disconnecting the vacuum hose, heat tube, and crankcase ventilating breather.
3. Disconnect HEI connector.
4. Disconnect carburetor and Cruise Control linkage at throttle adapter plate.
5. Disconnect R.H. spark plug wires at spark plugs and position out of way.
6. Disconnect two orange wires from downshift switch and one white wire from choke.
7. Remove throttle return spring and downshift switch bracket.
8. Disconnect power brake vacuum line and vacuum modulator line from rear of carburetor on all cars except Eldorado. Position brake line out of way.
9. Disconnect double connector from compressor clutch.
10. Disconnect air conditioning system vacuum and TVS vacuum hoses from rear of manifold.
11. Disconnect fuel line at carburetor and move slightly out of way.
12. Disconnect canister purge hose at carburetor and position out of way.
13. Disconnect distributor vacuum advance hose at intake manifold and position out of way.
14. Partially remove compressor as described in Section 1.
15. Disconnect PCV valve from right rocker arm cover and Automatic Level Control vacuum hose if so equipped.
16. Remove ten screws and two screw/studs securing manifold to cylinder heads and remove manifold.
17. Remove sheet metal manifold shield and gasket.
18. Remove front and rear manifold to cylinder block rubber seals.

b. Installation

1. Coat ends of rubber seals with gasket cement and place over rails at front and rear of cylinder block. Tabs on seals should be positioned in holes in rails and beveled ends of gasket tucked under edge of cylinder head.
2. Coat upper and lower surfaces of port area of sheet metal gasket (do not coat ends). Place on engine and engage over dowel pins on cylinder heads.
3. Carefully position manifold on cylinder heads by lowering straight down. Start all manifold screws in their proper location. Center manifold on engine, by tightening the third screw from front on both sides evenly. Tighten all screws to 30 foot-pounds.
4. Connect P.C.V. valve to right rocker arm cover, and Automatic Level Control vacuum hose if so equipped.
5. Install compressor as described in Section 1.
6. Connect distributor vacuum advance and canister purge hoses.
7. Install ignition wires on spark plugs and clips.
8. Install fuel line at carburetor.
9. Connect power brake vacuum line to fitting on rear of carburetor on all cars except Eldorado.
10. Connect vacuum modulator line to fitting at rear of carburetor.
11. Connect double connector to compressor clutch.
12. Connect single connector green wire to temperature sender.
13. Connect HEI connector.
14. Install orange/black and orange/white wires to downshift switch.
15. Connect Cruise Control and throttle linkage at throttle adapter plate.
16. Install air cleaner bottom making sure heat tube engages heat shield on exhaust manifold and thermac vacuum hose is connected.
17. Carefully install crankcase ventilating breather. Install and tighten air cleaner cover.
18. Install Automatic Level Control, hose to air cleaner.
19. Check routing of all hoses around carburetor to make sure they do not interfere with the proper operation of the throttle linkage.
20. Connect negative battery cable.
21. Start engine and inspect for leaks.

Intake Manifold - EFI ONLY

a. Removal

1. Disconnect negative battery cable, remove air cleaner and crankcase filter.

2. Disconnect throttle cable and cruise control linkage at throttle body. Remove cable from bracket and position out of way.

3. Working on left side of engine, disconnect coolant temperature tell-tale switch (green wire), HEI lead wire, speed sensor connector and injector wires. Disconnect harness from fuel rail brackets and position harness out of way.

4. Disconnect two vacuum hoses from throttle body to TVS switch, California cars only.

5. Disconnect vacuum hoses and power brake pipe from rear of throttle body. Use a back-up wrench on power brake fitting.

6. Disconnect fuel line from fuel rail. Use a back-up wrench on fuel rail.

WARNING: DO NOT LOOSEN FITTINGS UNTIL THE PRECAUTIONS DESCRIBED ON PAGE 6C-97 HAVE BEEN TAKEN TO RELIEVE PRESSURE. FUEL IN SYSTEM MAY BE UNDER HIGH PRESSURE WHICH COULD SPRAY OUT AND RESULT IN A FIRE HAZARD AND POSSIBLE PERSONAL INJURY.

7. Working on right side of engine, disconnect injector wires, EGR solenoid leads, air temperature sensor connector and MAP sensor hose, also ground wires on all except Eldorado.

8. Disconnect electrical harness from fuel rail brackets and position out of way.

9. Remove PCV valve from rocker cover and position out of way.

10. Remove spark plug leads and distributor cap.

11. Remove front fuel rail as described on page 6C-104.

12. Partially remove air conditioning compressor as described in Section 1.

13. Remove fuel return hose from pressure regulator.

14. Remove twelve mounting screws and remove manifold. Do not pry against or lift manifold by the fuel rails or their mounting brackets.

15. Remove manifold gaskets.

b. Installation

1. Place rubber intake manifold seals over rails at front and rear of cylinder block. Tabs on gasket should be positioned in holes in rails and beveled ends of gasket tucked under edge of cylinder head.

2. Coat upper and lower surfaces of port area of sheet metal gasket (do not coat ends). Place on engine and engage over dowel pins on cylinder heads.

3. Carefully position manifold on cylinder heads by lowering straight down. Start all manifold screws in their proper location. Center manifold on engine, by tightening the third screw from front on both sides evenly. Tighten all screws to 30 foot-pounds.

4. Install air conditioning compressor as described in Section 1.

5. Install front fuel rail as described on page 00.

6. Install distributor cap and spark plug leads. Refer to Fig. 6 for wire routing.

7. Connect fuel return line to pressure regulator using a new hose clamp.

8. Working on right side of engine, secure wiring harness to injector brackets and make the following connections: Red-black injector leads to cylinders 1 and 7; white-black injector leads to cylinders 3 and 5; dark blue/black leads to fast idle valve (install grommet in throttle body); brown-black leads to EGR solenoid and black/pink-black/red lead to air temperature sensor.

9. Connect vacuum hoses to front and rear of throttle body. Actual hose routing is shown in Fig. 6C-14 and 15.

10. Install PCV valve in rocker cover.

11. Working on left side of engine, secure wiring harness to injector brackets and make the following connections: Red-black injector leads to cylinders 2 and 8; white-black injector leads to cylinders 4 and 6; green wire to coolant tell-tale switch; HEI lead wire and module connector; speed sensor connector (distributor trigger); downshift switch.

12. Connect fuel line to fuel rail using **a back-up wrench on the fuel rail** while tightening. Do **not** use teflon tape on flare nut.

13. Position throttle cable to bracket and secure throttle cable and cruise control cable to throttle body with clips.

14. Connect battery cable.

15. Turn ignition switch ON and OFF several times to build up fuel rail pressure and check for fuel leaks.

16. Start engine, check for leaks and for proper operation.

17. Install air cleaner and crankcase breather.

EXHAUST MANIFOLD (RIGHT OR LEFT)

a. Removal

1. If working on left manifold, remove carburetor air cleaner and heat duct. Remove nuts from #2 and #8 cylinder (#2 and #6 on Eldorado only) manifold studs and heat shroud from around manifold.

2. Remove two nuts securing header pipe to exhaust manifold at side being worked on. If working on right side remove two studs holding EFE valve to right hand manifold and remove EFE valve. EFI cars have a spacer in place of the EFE valve.

3. Remove eight screws securing exhaust manifold to cylinder head. If working on left manifold on an Eldorado, also remove clip securing dipstick tube.

4. Bend lock tabs, where necessary, from screw heads.
NOTE: Fifth screw from front may not be removable due to frame interference. If so, back screw off all the way and remove with manifold in Step 5.

5. Remove exhaust manifold from position in engine compartment.

b. Installation

1. Lubricate cylinder head mounting surfaces of the exhaust manifold with a thin coat of a moly-based lubricant (graphite).

2. Insert fifth screw from front in manifold and position manifold in location on cylinder head.
NOTE: Install screws in same order as removed.

3. Install remaining screws with tabs as required. If

working on left manifold, install screw/stud in front attaching hole of #2 cylinder and rear attaching hole of #8 cylinder (front hole of #2 and #6 on Eldorado only). Torque all long screws to 35 foot-pounds and all short screws to 12 foot-pounds.

NOTE: If working on Eldorado left manifold secure dipstick tube retaining clip under one screw.

4. Bend lock tabs, where necessary, against screw heads.

5. If working on left manifold, install heat shroud to exhaust manifold and secure with two nuts. If working on right side position EFE valve (spacer on EFI cars) to right hand exhaust manifold with actuator towards engine block. Secure with two stud-bolts, tighten to 35 ft. lbs.

6. Move exhaust pipe into position at manifold and secure with two nuts.

7. If working on left manifold, install carburetor air cleaner making sure heat duct engages heat shroud on manifold.

Rocker Arm Covers

a. Removal

1. If working on left side, remove air cleaner, heat duct, crankcase ventilating breather and cruise control servo.

2. If working on right side, remove PCV valve and elbow from cover. Remove generator wiring harness from clips.

3. Remove spark plug cable clips from studs, Fig. 6-185, and position out of way.

4. Remove screws holding cover to head and remove cover.

NOTE: If cover removal is difficult, use hammer and block of wood to loosen. Do not pry on rocker arm cover.

b. Installation

1. Using a new gasket or silicone sealer, position cover on cylinder head and secure with nine screws. Screw/studs should be installed in locations shown in Fig. 6A-7. Tighten screws to 30 inch-pounds.

2. Position spark plug cable clips on studs, Fig. 6A-7.

3. If working on right side, install PCV valve and elbow. Reposition generator wiring harness under clips.

4. If working on left side, install crankcase ventilating breather and air cleaner, making sure heat duct engages heat shroud on exhaust manifold.

Valve Train Diagnosis

Poor engine performance or noisy engine operation may be caused by worn or damaged parts in the valve train. If valve problems are indicated such as by a compression test, camshaft speed engine noise, excessive oil consumption, etc. remove rocker arm covers and inspect the following valve train components.

1. Valve spring
2. Valve spring retainer and oil shedder.
3. Rocker arm, retainer and support.
4. Pushrod
5. Valve stem
6. Valve guide

Noisy operation of valve lifters may be due to:

a. Incorrect Engine Oil Level

Oil level should be between the "Add" and "Full" mark on indicator when measured while hot. If level is too high, foaming may result, if too low, air may enter pump inlet. In either case, noisy valve action may result.

b. Improper Oil Pressure

If valve action is noisy after the oil is hot, it may be due to low oil pressure.

Low pressure usually results from an external leak in the engine lubrication system, a stuck or improperly operating oil pressure relief valve, scored parts, worn bearings, worn oil pump gears, clogged oil intake strainer screen assembly, or poor operation of oil pump.

c. Rusty or Varnished Valve Stems or Valve Guides

This condition may be associated with short trip operation, poor quality engine oil, or failure to change oil regularly.

d. Weak Valve Lifter Springs

These can cause noisy valve operation by causing sluggish plunger movements in the cylinder. To check these springs, disassemble plunger assembly, clean thoroughly and reassemble. Check pressure to compress spring with lifter dry.

If pressure required to compress spring 11/32 inch is less than 6-1/4 pounds, the assembly should be replaced.

e. Dirty, Worn, or Scored Valve Lifter Parts

A recurring tap or click synchronized with valve action, indicates trouble in a single lifter assembly, which should be disassembled and checked for:

1. Dirt or foreign particles, which can be removed after disassembly by wiping with a soft cloth and washing in kerosene.

2. Varnish or heavy sludge material, which can be removed with solvent.

NOTE: The engine oil pan should always be removed and cleaned when dirt has been responsible for sticking lifters. The oil passages from the header to the lifter bores should also be cleaned thoroughly by blowing out with kerosene and air.

3. Pitting and scoring of surfaces, which may result from gritty particles, excessive wear, poor grade oil, or damage during installation. This condition requires replacement of the complete unit.

4. Incorrect clearance between cylinder and plunger, usually caused by mismating of parts. These parts are selectively fitted in manufacturing and are not interchangeable.

f. Lifters That Do Not Turn In Their Bores

Scoring, surface flaking, cupping, or excessive wear on the bottom of the lifter may prevent the lifters from turning in their bores.

g. Other Causes

Excessive wear on either end of rocker arm or at rocker arm support; worn valve stems; worn or bent push rods; worn camshaft lobe; air in suction side of oil pump system.

Valve Lifter Leak-Down Rate Checking

The Valve Lifter Leak-Down Rate Tester, J-3074, is used to obtain a comparison of leak-down rates of hydraulic valve lifters without removing them from the engine. With this tool, a feeler gage of a given thickness is placed between the rocker arm and the valve stem, causing valve spring pressure to force oil out of the lifter. A spring, attached to the tool and compressed against the valve spring retainer, ejects the feeler gage when the lifter has leaked down enough to allow the valve to seat. By observing the length of time required by each lifter to leak-down the thickness of the feeler

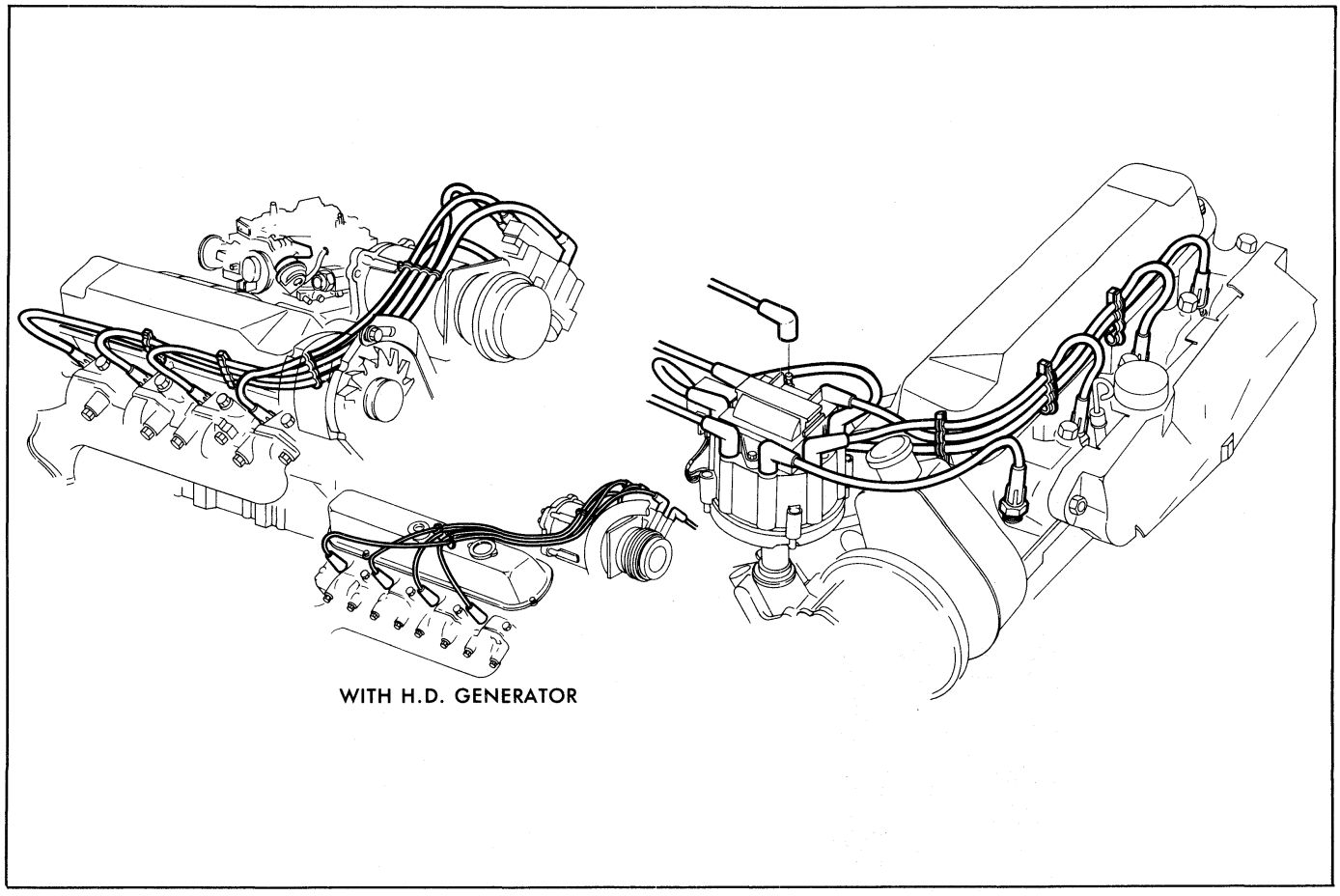


Fig. 6A-7 Spark Plug Wire Routing

gage, a faulty lifter or lifters can be easily located.

Use the following procedure:

1. Operate engine to allow lifters to fill with oil.
2. Turn off engine. Remove distributor cap and rotate crankshaft so that rotor is at No. 1 firing position.
3. Remove carburetor air cleaner.
4. Disconnect negative battery cable.
5. Disconnect spark plug wires at plugs and remove wiring from tabs on rocker arm covers, but leave wiring connected.
6. Remove rocker arm covers as described on page 6A-12.
7. Check each lifter listed in following table as shown in Fig. 6A-9.

Rotor at No. 1 firing position.

Check:	
1 Intake	1 Exhaust
2 Intake	2 Exhaust
5 Intake	3 Exhaust
7 Intake	4 Exhaust
8 Intake	8 Exhaust

8. Insert feeler gage of tool between valve stem and rocker arm and at the same time, compress tool "popout" spring to its stock against valve spring retainer, Fig. 6A-9.

NOTE: Install tool as quickly as possible to eliminate any unnecessary lifter leak-down.

9. Note interval of time during which tool is held in place by valve spring pressure. The noisy lifter or lifters will have the shortest leak-down time.
10. Connect negative battery cable, install distributor cap, connect spark plug wires, and operate engine to allow lifters again to fill up with oil.
11. Turn off engine, remove distributor cap and rotate crankshaft so that rotor is at No. 4 firing position. Disconnect spark plug wires and negative battery cable.
12. Check each lifter listed in the following table:

Rotor at No. 4 firing position.

Check:	
3 Intake	2 Exhaust
4 Intake	4 Exhaust
6 Intake	7 Exhaust

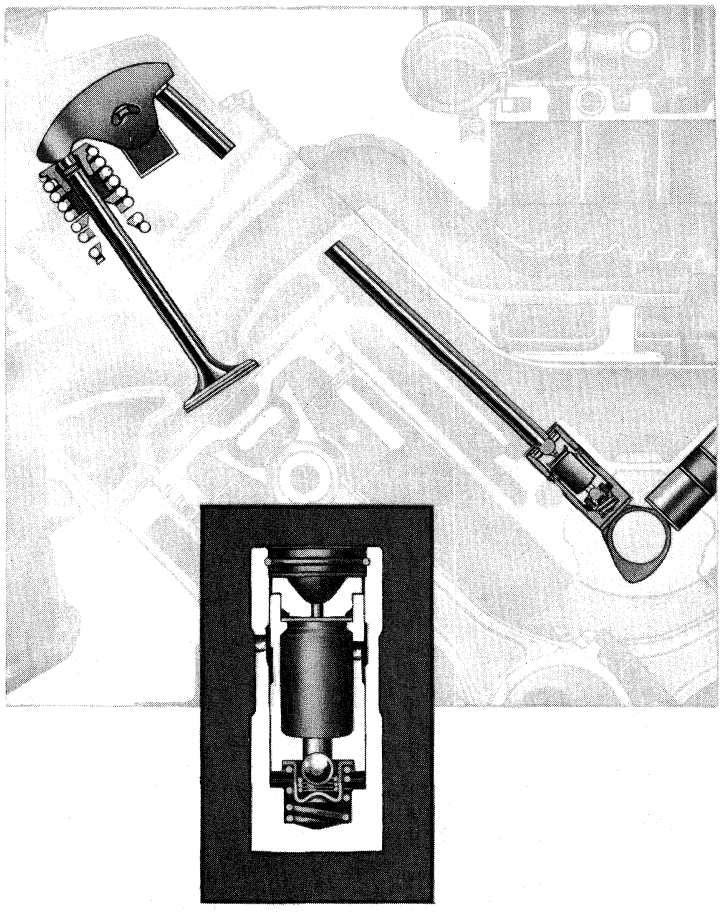
13. Install rocker arm covers as described on page 6A-12.
14. Install distributor cap.
15. Install carburetor air cleaner.
16. Connect negative battery cable.
17. Operate engine to obtain operating temperature and torque rocker arm cover screws to 30 inch-pounds.

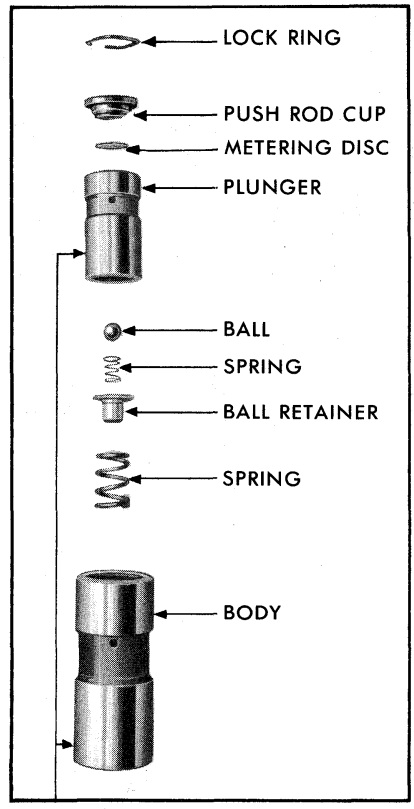
Valve Lifter

Removal

1. Remove intake manifold as described on page 6A-10.
2. Remove rocker arm covers as described on page 6A-12.
3. Remove screws securing rocker arm supports to cylinder heads.
4. Remove rocker arm assemblies. Store rocker arm assemblies so that they can be reinstalled in same location.
5. Remove push rods.
6. Using a small screwdriver, or pointed tool, remove lifters from engine. Keep them in order so they can be

ARRANGEMENT OF VALVES AND VALVE LIFTERS





PLUNGER AND BODY ARE FITTED PAIRS AND MUST NOT BE MISMATED.

OPERATION OF VALVE LIFTER MECHANISM

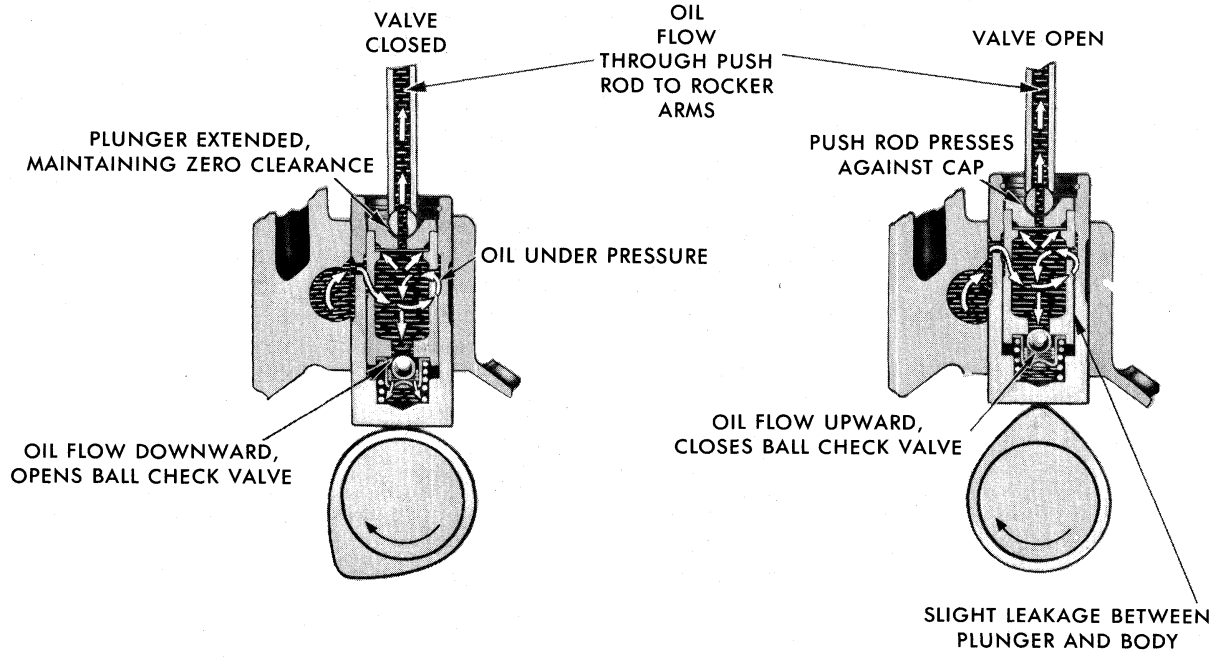


Fig. 6A-8 Valve Lifter Mechanism

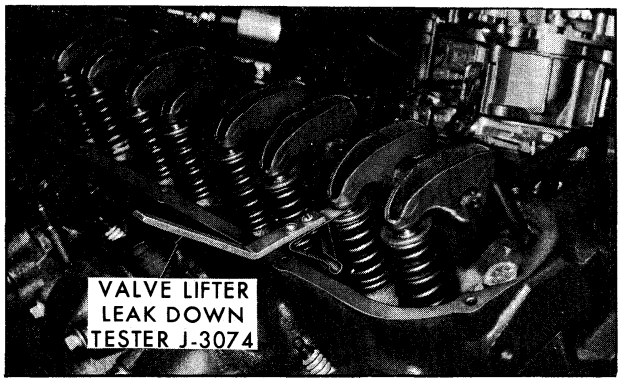


Fig. 6A-9 Checking Valve Lifter Leak-Down Rate

reinstalled in same bores from which they were removed. Use Valve Lifter Remover, J-3049, to remove any lifters that are stuck, rotating lifter back and forth while lifting, Fig. 6A-10.

b. Installation

1. Apply a small amount of rear axle lubricant to foot of each lifter.

2. Install valve lifters in same bores from which they were removed.

3. Install push rods through openings in cylinder heads. Bottoms of push rods must be seated in hydraulic valve lifter cups.

4. Install rocker arm assemblies on cylinder heads securing with screws. Tighten screws to 60 foot-pounds.

5. Position new rocker arm cover gaskets on cylinder heads.

6. Install rocker arm covers as described on page 6A-12.

7. Install intake manifold as described on page 6A-10.

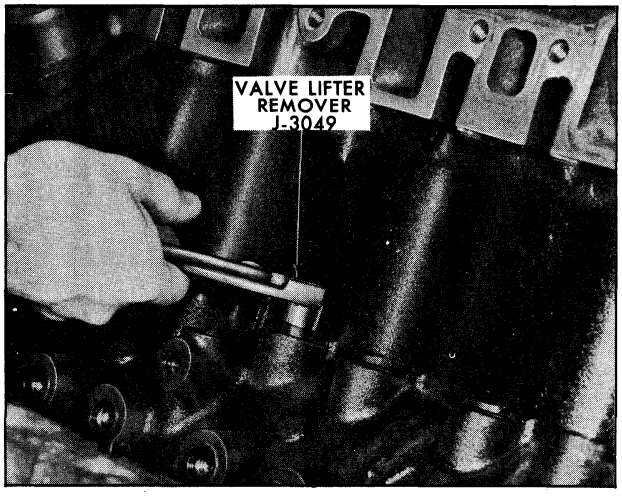


Fig. 6A-10 Removing Valve Lifters

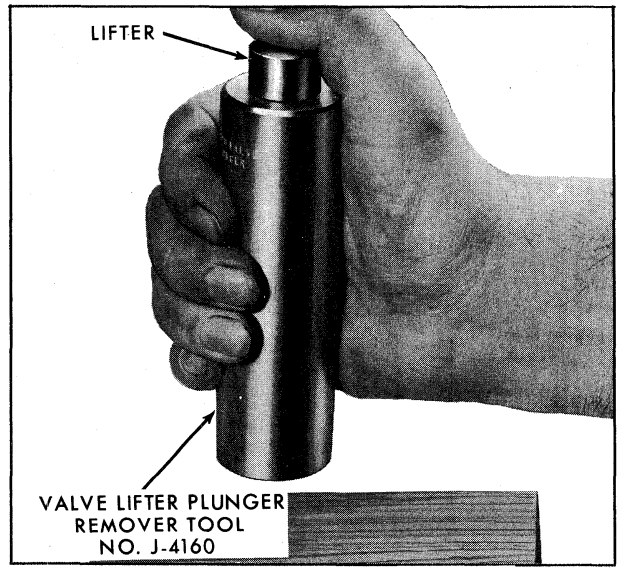


Fig. 6A-11 Removing Stuck Plunger from Body

Valve Lifter Disassembly and Assembly

a. Disassembly

NOTE: Valve plungers and bodies are matched in pairs and are not interchangeable with one another. In order to fit properly, they must be reassembled to their original matching pairs.

1. Press down on center of valve lifter push rod cup.

2. Using a pointed tool, remove lock ring from groove while holding cup down.

3. Invert lifter and slide out push rod cup, metering disc, plunger, ball, small spring, ball retainer, and spring.

If plunger is stuck in lifter body, place lifter, push rod end down, in Valve Lifter Plunger Remover, J-4160, Fig. 6A-11. Holding tool firmly in hand with thumb over lifter body, strike tool sharply on block of wood or wooden bench until plunger falls out of body.

b. Assembly

1. Place ball on its seat in lower end of plunger while holding plunger upside down. Place small spring on ball.

2. Position ball retainer over small spring and ball and snap into recess in plunger.

3. Place spring over ball retainer.

4. Lower lifter body over plunger assembly on an angle to seat spring.

5. Turn assembly right side up and fill plunger with clean engine oil.

6. Jiggle ball with small piece of wire until oil drains out of plunger into body and trapped air is released from body.

7. Refill plunger with oil, place oil metering disc and push rod cup on plunger, and position lock ring over cup.

8. Press lock ring into groove with Valve Lifter Lock Ring Installer, J-2730, Fig. 6A-12.

Valve Spring or Oil Shedder Replacement

a. Removal

1. Remove air cleaner.
2. Remove rocker arm cover as described on page 6A-12.
3. Remove rocker arm assembly from cylinder head.
4. Remove push rods.
5. Remove spark plug.

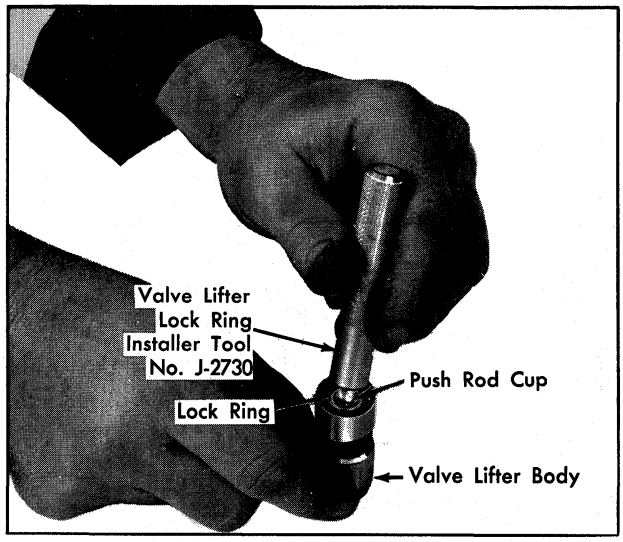


Fig. 6A-12 Lock Ring Installation

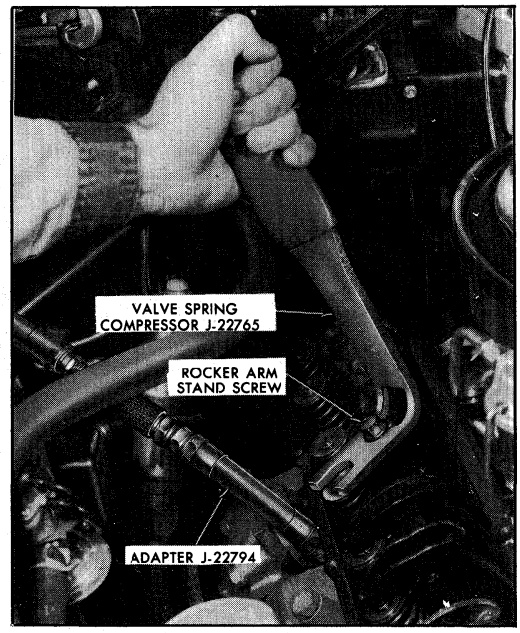


Fig. 6A-13 Compressing Valve Spring

6. Connect air hose to Adapter J-22794 and supply air to cylinder.

7. Install rocker arm support screw.

8. Install Valve Spring Compressor, J-22765, over rocker arm stand screw, Fig. 6A-13.

9. Compress valve spring and remove locks from valve stem.

NOTE: A sharp blow on a socket placed on top of the retainer will help break loose any stuck locks.

10. Lift out spring retainer with nylon shedder and spring, Fig. 6A-14. Discard retainer-shedder.

11. Clean gasket material off cylinder head and rocker arm cover.

b. Installation

1. Install valve spring and new retainer-shedder assembly, Fig. 6A-14.

2. Using Valve Spring Compressor, J-22765, compress valve spring and install locks, Fig. 6A-14.

3. Bleed air out of cylinder and remove air hose and Adapter, J-22794.

4. Install spark plug.

5. Remove rocker arm support screw.

6. Install push rods.

7. Position rocker arms on rocker arm support. Fig. 6A-15.

8. Position retainer on rocker arm supports.

9. Position rocker arm assembly on cylinder head and secure with screws. Tighten screws to 60 foot-pounds.

10. Position new rocker arm cover gasket on cover.

11. Install rocker arm cover as described on page 6A-12.

12. Install air cleaner, making sure heat duct engages heat shroud on exhaust manifold.

13. Run engine and check for oil leaks.

CYLINDER HEAD (Right or Left)

a. Removal

1. Drain Cooling system.

2. Remove intake and exhaust manifolds as described on Page 6A-10 and 6A-11 respectively.

3. Remove rocker arm covers as described on Page 6A-00.

4. Disconnect electrical and ground connections from cylinder head.

5. Partially remove power steering pump as described in Section 3B, if working on left cylinder head.

6. If working on right head, remove heater hose from rear of head. Remove generator as described on Page 6D-12, and remove A.I.R. pump, if so equipped, as described on Page 6E-12.

7. Remove screws securing rocker arm supports to cylinder head.

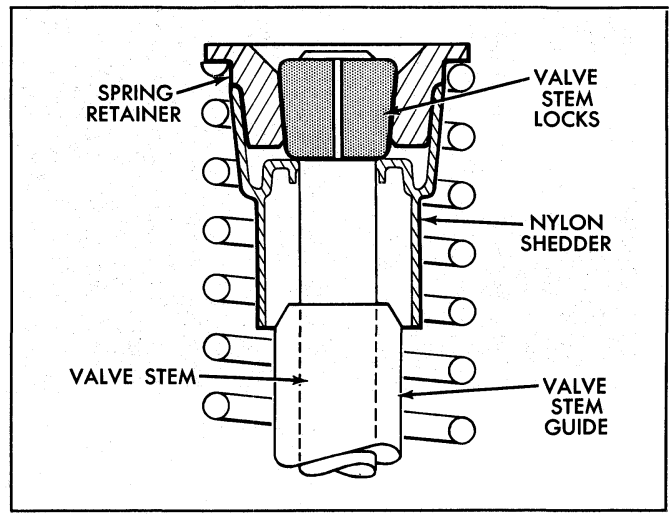


Fig. 6A-14 Valve Spring Retainer

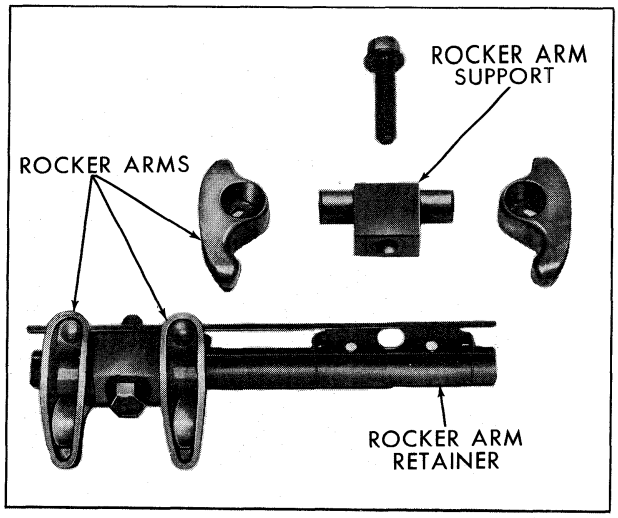


Fig. 6A-15 Rocker Arms Disassembled

8. Remove rocker arm assemblies. Store assemblies so that they can be reinstalled in same location.

9. Remove push rods.

10. Install two 7/16-14 x 6" screws, to be used as lifting handles, in two of the rocker arm support screw holes.

11. Remove ten cylinder head screws and lift head from block.

NOTE: Bottom rear screw is trapped due to clearance. It will be necessary to suspend the bolt Fig. 6A-16 to facilitate removal.

12. Carefully remove all gasket material from mating surface of cylinder head and cylinder block and cylinder head and rocker arm cover mating surfaces.

b. Installation

1. Use extreme caution to insure that all mating surfaces of cylinder head and cylinder block are clean.

2. Position cylinder head gasket over dowels on cylinder block.

NOTE: Bottom rear screw must be installed prior to positioning of cylinder head and suspended Fig. 6A-16.

3. Position cylinder head on cylinder block.

4. Install ten cylinder head screws finger tight in locations as indicated in Fig. 6A-17.

5. Tighten cylinder head screws to 95 foot-pounds starting from center of cylinder head and working toward both ends.

6. Remove two 7/16-14 x 6" screws used for lifting handles.

7. Install push rods through openings in cylinder head. Bottom of push rod must be seated in hydraulic valve lifter cup.

8. Position rocker arm assemblies on cylinder heads in same positions as found on disassembly and secure with screws. Tighten screws to 60 foot-pounds, Fig. 6A-17.

9. Install rocker arm cover as described on Page 6A-12.

10. Install exhaust and intake manifolds as described on Page 6A-10 and 6A-11 respectively.

11. If working on left cylinder head, install power steering pump as described in Section 3B. Connect high temperature warning wiring connector at rear of head.

12. If working on right cylinder head, install A.I.R. pump, if so equipped, as described on Page 6E-12, install generator as described on Page 6D-12, and connect heater hose at rear of head.

13. Refill cooling system.

14. Start engine and allow it to reach normal operating temperature. Check torque on rocker arm cover screws. Check for coolant and oil leaks.

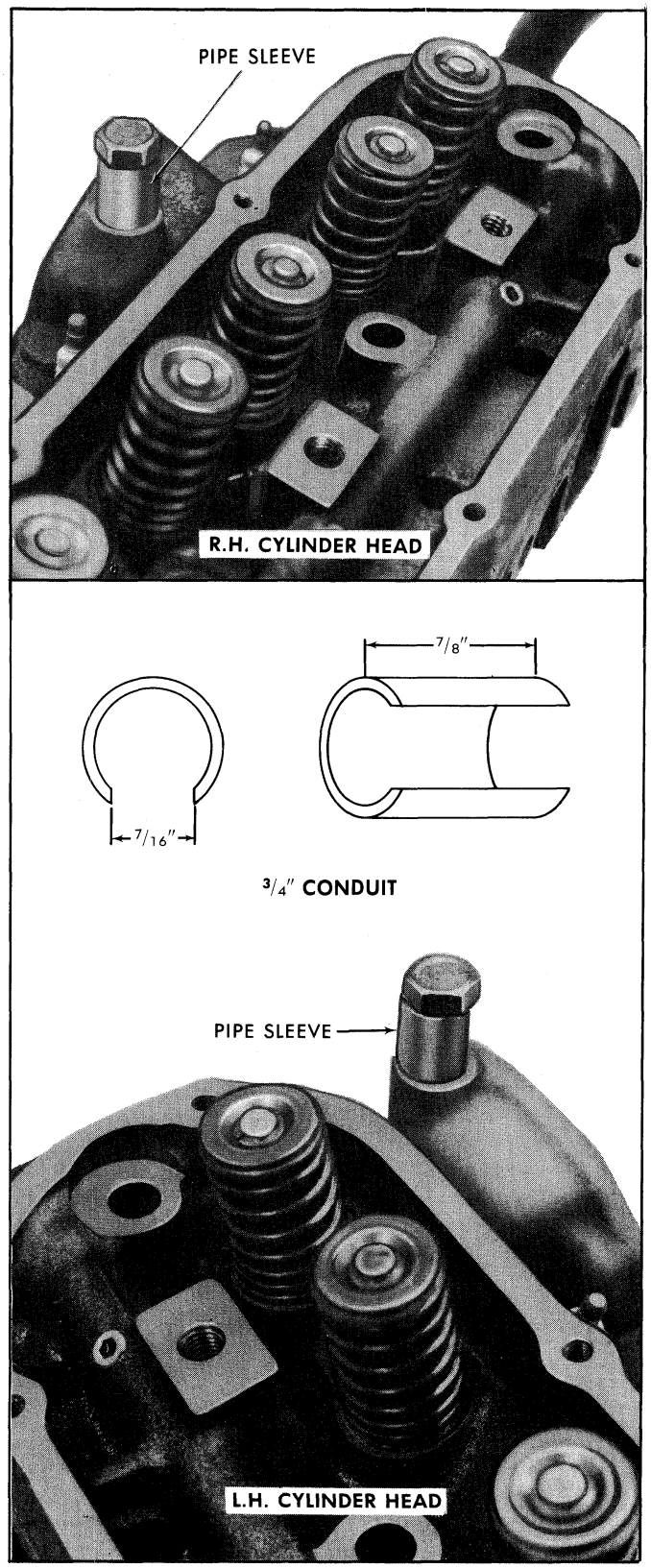


Fig. 6A-16 Cylinder Head Removal and Installation

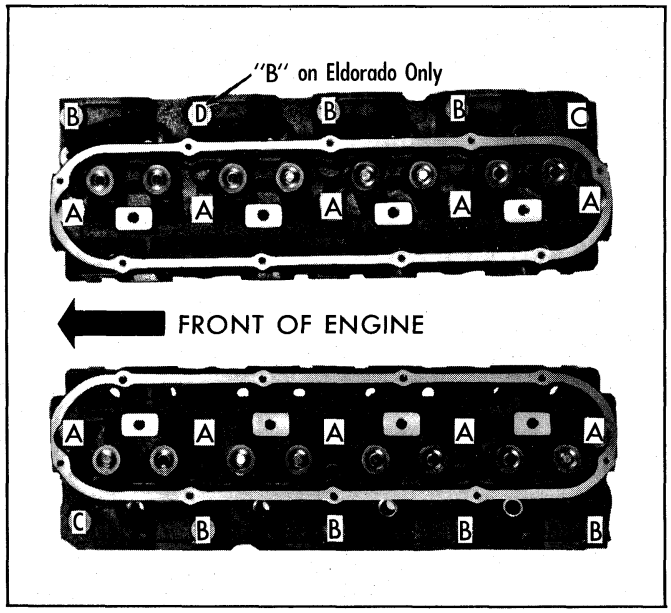


Fig. 6A-17 Cylinder Head Screws

Bolt Location	Length
A (Bolt)	4.36" (Medium)
B (Bolt)	4.77" (Long)
C (Bolt)	3.02" (Short)
D (Bolt/stud)	4.77" (Long)

Valve (Intake or Exhaust)

a. Removal

1. Remove cylinder head as described on page 6A-16.
2. Set cylinder head on clean work bench. Position cylinder head on intake manifold surface.
3. Position valve spring compressor over valve, Fig. 6A-18 and compress valve spring.
4. Remove valve locks.
5. Slowly release tension on valve spring compressor and remove compressor.
6. Remove valve spring retainer with nylon shedder and spring, from cylinder head. Discard valve spring retainer-shedder assembly.
7. Remove valve from cylinder head.
8. Repeat Steps 3 through 7 for remaining valves to be serviced.

b. Installation

1. Position valve and spring onto cylinder head.
2. Position new valve spring retainer-shedder assembly on valve stem.
3. Engage valve and retainer with valve spring compressor, Fig. 6A-18, and compress valve spring.
4. Install valve locks on valve stems.
5. Slowly release tension on valve spring compressor and remove valve spring compressor.
6. Repeat Steps 1 through 5 for remainder of valves to be installed.
7. Install cylinder head on engine as described on page 6A-17.

Valve and Seat Reconditioning

Valve reconditioning is normally required less frequently in engines having hydraulic valve lifters. When this work is done, the close limits given in the engine specifications, Pages 6A-31 and 6A-32 must be maintained.

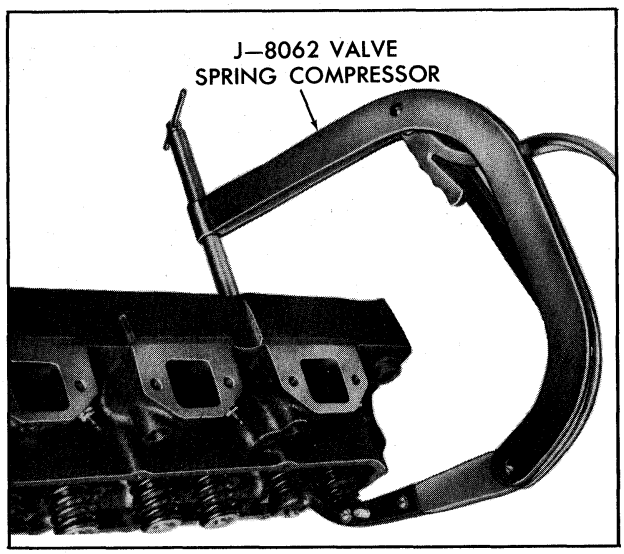


Fig. 6A-18 Removing Valve

Check valve stem to guide clearance using a hole gage and an outside micrometer. Measure valve guide inside diameter with hole gage, crossways to engine, at both top and bottom of guide, measuring gage each time with micrometer. A standard size valve guide is .343" in diameter.

Measure valve stem diameter with micrometer and subtract from greater of two guide measurements to obtain maximum clearance. If clearance is greater than .005 inch, guide should be reamed to oversize to prevent excessive oil consumption and improper seating of valves.

An alternate method of checking valve stem to guide clearance, if a hole gage is not available, is by using a 1/16 inch wide strip of .005 inch brass shim stock on a "no-go" basis.

Bend end of shim and hang in end of valve guide, with tip extending towards push rod side of head. Shim should not extend more than 1/4 inch into guide. If valve stem will enter guide, clearance is excessive and guide should be reamed to oversize.

Service valves are available in standard (.343") and +.003", +.006", +.013" sizes. If clearance is found to be excessive as described above, guide should be reamed to the next oversize using the appropriate reamer, and a valve having a corresponding oversize stem should be installed.

The following tools are recommended for the reaming operation:

Size	Tool Number
(346")	J-5830-1
(349")	J-5830-6
(356")	J-5830-7

Valves with a .003" oversize diameter and .003" oversize valve guides are installed at the factory on some engines. Engines so fitted will be marked by a "3" stamped on the cylinder head gasket surface in line with the oversize valve.

All oversize service valves will be so marked on the valve head so that they may be easily identified when part numbers are not available.

When an oversize valve is installed, be sure to stamp the oversize marking on the cylinder head gasket surface, as explained above, for future reference.

Check concentricity of all valve seats. This should be within .004 inch total, as measured with dial indicator and a solid, slightly tapered pilot which has a slight bind in the valve guide when installed.

CAUTION: *A pilot of the correct size must be used. Do not attempt to drive pilot into guide. Pilots with adjustable diameters to fit various sized guides are not recommended as valve guide damage could result.*

Grind valve seats to within .002 inch indicator reading when new valves are being installed, or if concentricity, seat width, or full contact of valves is not as specified.

Check seat width and location on valve to insure proper heat dissipation and prevent build up of carbon on seats. Condition valve seat to a width of 3/64 to 1/16 inch. This seat width will insure good idle stability.

Valve seats should be cut on a 45° angle so that the seat is 1/16 inch smaller in diameter than the valve head, Fig. 6A-19, to allow heat to escape and to provide maximum life for newly ground valves. The diameter of the seat can be checked by placing valve in position and then rotating to get a contact pattern with the seat.

New valves have a face angle of 44° to provide a line contact between the head of the valve and the valve seat in the cylinder head, which assures good seating of the valve and less chance of burning the valve head due to exhaust gas leakage. When reconditioning valves, always grind valve face angle to 44°.

Service valves should not have more than 1/16 inch wide contact with valve seats (due to 1° difference in angle) and should not be ground as they are ready to use as received. Grinding of valves by hand with grinding compound or lapping to seat them is not recommended. Use only precision equipment for valve and seat reconditioning, and follow equipment manufacturer's instructions.

ENGINE OIL PAN (Except Eldorado)

a. Removal

1. Disconnect negative battery cable.
2. Remove two screws each side securing, radiator cover to strut, support rods and loosen two screws at strut. Position support rods out of way.
3. Remove two screws securing upper fan shroud to radiator and one screw securing upper radiator hose clamp to shroud. Drill out six rivets securing upper fan shroud to lower shroud and remove shroud.
4. Loosen belt tensions and remove crankshaft pulleys.
5. Raise car on hoist.
6. Drain engine oil.
7. Remove exhaust "Y" pipe at exhaust manifold and converter as assembly.
8. Remove through bolts on motor mounts.
9. Remove starter motor as described on Page 6D-40.
10. Remove transmission lower cover.
11. Using a block of wood and a suitable jack raise the jack so the wood makes contact with the crankshaft hub. Continue to raise engine to gain clearance for pan removal.

CAUTION: *Observe clearance at cylinder heads to throttle linkage and A/C heater case. Avoid damage by contact in these areas.*

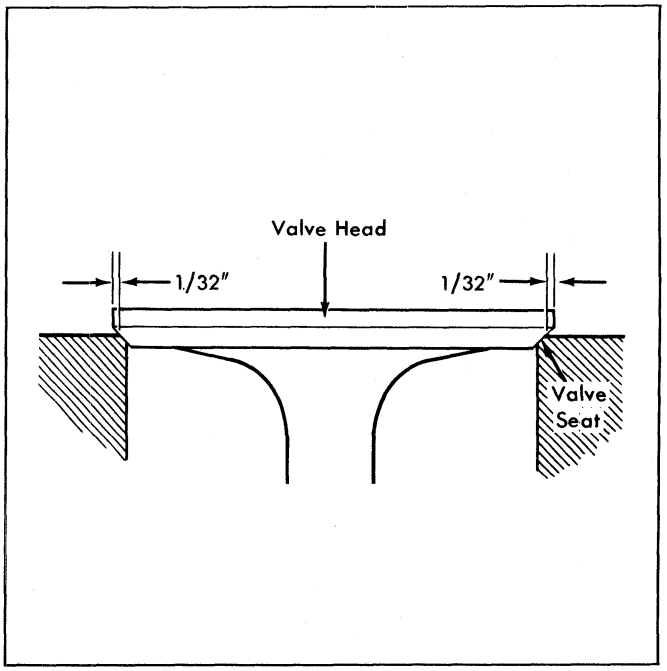


Fig. 6A-19 Valve Seat Grinding

12. Remove nuts and cap screws that hold oil pan to cylinder block and remove oil pan.
13. Remove side gaskets and rubber front and rear seals from oil pan, and discard.

b. Installation

1. Cement new gasket to both sides of oil pan with gasket cement or use RTV, lining up holes in gaskets with holes in oil pan flange.
2. Thoroughly clean front and rear seal surfaces of oil pan, and install new oil pan front and rear seals by pulling locating tangs on seals through locating holes in seal flange. Make sure seals are firmly positioned on flange surfaces with ends of each seal properly located in cut-out notches in side gaskets.
3. Seal all four corner notch openings with a coating of R.T.V.
4. Clean out notches in block where ends of oil pan rear seal fit. Fill this rectangular cavity with R.T.V.
5. Position oil pan on bottom surface of cylinder block and install cap screws and nuts tightening to 10 ft. lbs.
6. Lower engine and remove jack.
7. Install transmission lower cover and secure with four cap screws. Tighten screws to 20 ft. lbs.
8. Secure starter motor to cylinder block as described on Page 6D-40.
9. Install exhaust "Y" pipe and converter assembly.
10. Install motor mount through bolts.
11. Lower car.
12. Install crankshaft pulleys.
13. Install drive belts and adjust as described on Page 6B-12.
14. Position upper fan shroud and secure to lower shroud with nine screws and "J" nuts.
15. Install two screws securing upper shroud to radiator cover and one screw securing upper radiator hose to shroud.

16. Position, radiator cover to strut, support rods and secure with two screws each side. Tighten screws at strut.

17. Add four quarts engine oil to crankscase. Use five quarts on Eldorado. Check oil dipstick for proper oil level.

18. Connect negative battery cable.

19. Run engine and check for leaks at all connections.

Oil Pump Servicing

a. Removal

1. Raise car.

2. Remove oil filter.

3. Remove five screws securing oil pump to engine, Fig. 6A-20. The screw nearest the pressure regulator should be removed last, allowing the pump to come down with screw. Always discard oil pump to crankcase gasket.

4. Remove pump drive shaft.

b. Disassembly

1. Slide drive shaft, drive gear, and driven gear out of pump housing.

2. Using a 5/16 inch hex head wrench, remove plug from pump housing assembly, and remove oil pressure regulator valve and spring from bore in housing assembly.

c. Inspection

1. Inspect oil pressure regulator valve for nicks and burrs that might cause a leak or binding condition in bore of pump housing.

2. Check free length of regulator valve spring. It should be approximately 2.57 inches to 2.69 inches in length. A force of 9.3 to 10.5 pounds should be required to compress the spring to 1.46 inches.

3. Inspect drive gear and driven gear for nicks and burrs.

4. Inspect pump housing for wear and score marks.

5. Check pump mating surfaces on engine block for wear and score marks.

d. Assembly

1. Install oil pressure regulator valve and spring in bore of pump housing assembly.

2. Using a 5/16 inch hex head wrench, install plug in housing assembly and tighten plug to 30 foot-pounds.

3. Install pump drive gear over lower shaft in pump housing.

4. Slide driven gear over remaining shaft in pump housing, meshing driven gear with drive gear.

NOTE: The hex markings on both gears should be installed upwards toward the crankcase.

e. Installation

1. Pack pump with petrolatum.

NOTE: Recheck mating surface on crankcase to be sure old gasket was discarded.

2. Position new gasket on pump housing.

3. Engage pump drive shaft with distributor drive and guide into oil pump drive gear.

4. Install pump to engine by allowing it to ride up as screw nearest pressure regulator is turned in.

5. Install remaining four screws. Tighten all five screws to 15 foot-pounds.

6. Install oil filter and add 1 quart engine oil to crankcase.

7. Run engine (oil pressure light should go out) and check for leaks in pump area.

8. Lower car.

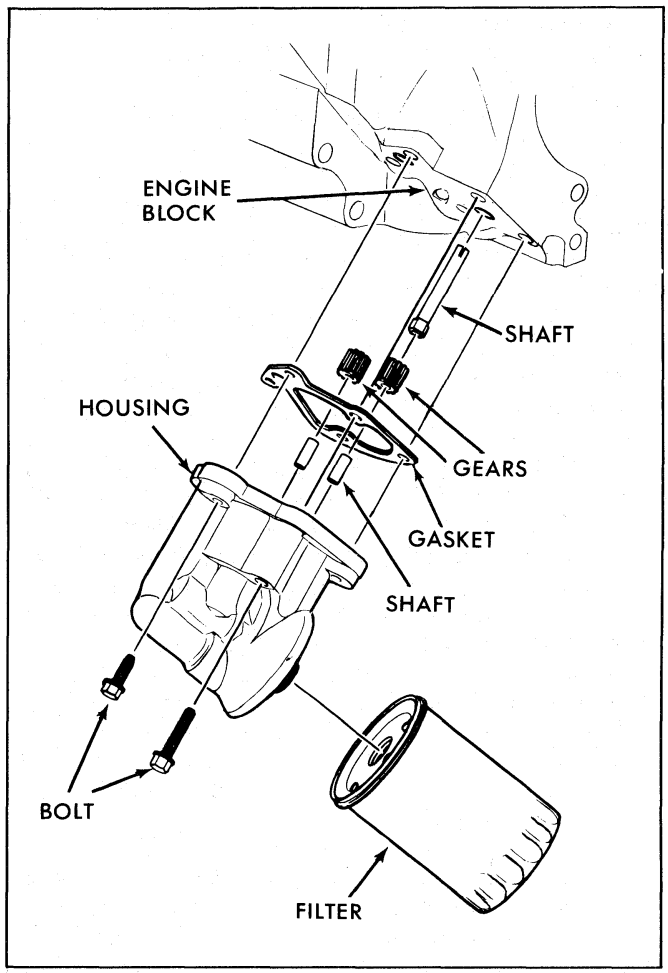


Fig. 6A-20 Oil Pump Disassembled

Rear Main Bearing Oil Seal Replacement

Rear main bearing seal installation can be properly accomplished by using a simple, easily made tool, Fig. 6A-21. Make the tool out of a metal banding strap or shim stock. The tool will act as a "shoehorn" to protect the backbone or outer diameter of the seal from scraping against the sharp edge of the cylinder block. Replacement procedure is as follows:

1. Disconnect spark plug wires and remove spark plugs.

2. Raise car.

3. Remove oil pan as described on Page 6A-19.

4. Loosen two screws that hold rear main bearing cap to cylinder block and remove cap with screws.

5. Remove lower seal half from bearing cap and discard.

6. Rotate upper seal half by pushing on one end with sharp object, and remove upper seal half from cylinder block.

7. Inspect grooves in bearing cap and cylinder block to be sure they are clean, dry, and free from burrs.

NOTE: The two seal halves are identical and can be used in either the lower or upper location. Both seal halves are pre-lubricated with a film of wax for break-in. Do not remove or damage this film.

8. To install lower half of seal into the bearing cap, slide either end of seal into position at one end of bearing cap and place tool in groove at other end of bearing, Fig. 6A-22. Make sure the seal is positioned in the groove and the lip of the seal is facing forward (car position).

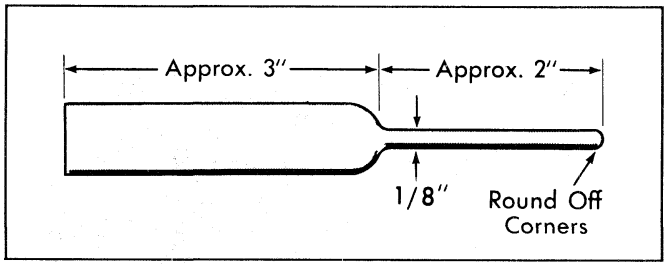


Fig. 6A-21 Main Bearing Oil Seal Tool

9. Hold thumb or finger over end of seal that is flush with split line to prevent it from slipping upward, and push seal into seated position by applying pressure to the other end.

10. Make sure seal is pressed down firmly and is flush on each side to avoid possibility of a leak at the seal split line. Avoid pressing on lip as damage to sealing edge could result.

11. To install upper half of seal in cylinder block (with crankshaft in car), position "shoehorn" in groove of block. Lubricate seal and start into groove in block with lip facing forward. Rotate seal into position, using care not to distort it, Fig. 6A-22.

12. Do not press on lip or sealing edge of seal may be damaged. Also, both ends of seal should be flush at the seal split line to avoid leaks.

13. If necessary, Lubriplate, or its equivalent, may be used to facilitate installation of both lower and upper half of seal. Do not use silicone or an oil leak may result.

14. Install bearing cap and secure with attaching screws. Tighten screws to 95 foot-pounds.

15. Rotate crankshaft 360° to make sure crankshaft is not binding.

16. Install oil pan as described on Page 6A-19.

17. Install spark plugs and tighten 59 25 foot-pounds. Connect spark plug wires.

18. Run engine and check for oil leaks.

19. Lower car.

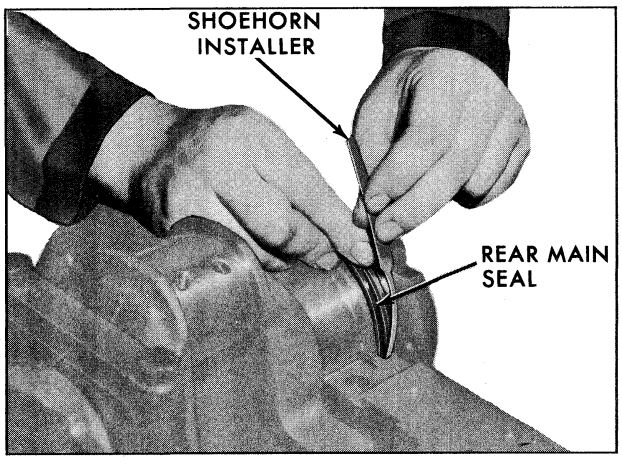


Fig. 6A-22 Installing Rear Main Oil Seal

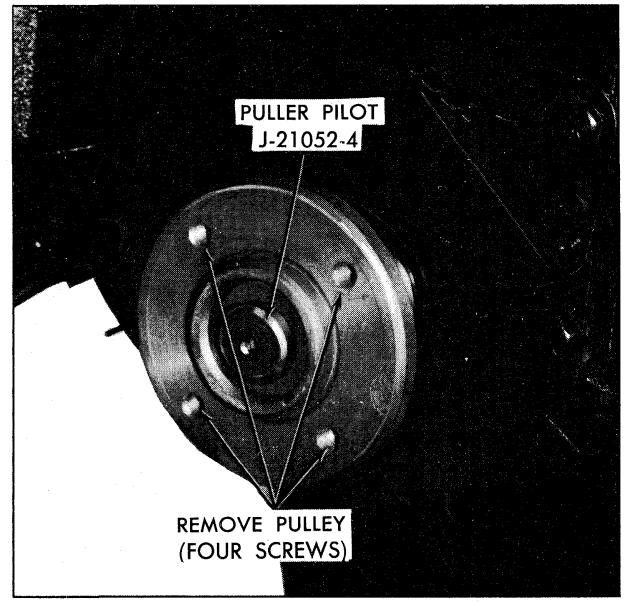


Fig. 6A-23 Installing Balancer Hub Pilot

Crankshaft Pulley and Hub

a. Removal

1. Disconnect negative battery cable.

2. Drain coolant from radiator.

3. Loosen hose clamp at radiator inlet (top) and remove one screw securing hose to radiator cover. Position upper radiator hose out of way.

4. Remove fan blade assembly as described on Page 6B-8 or 6B-17.

5. Remove generator belt and power steering pump belt.

6. Remove four cap screws that hold crankshaft pulley and remove pulley.

7. Remove plug from end of crankshaft.

8. Install Puller Pilot, J-21052-4, in bore in end of crankshaft, Fig. 6A-23.

9. install Holding Base, J-21052-1, on front of hub, lining up holes on base with screw holes in hub, and install four holding screws with washers finger tight, Fig. 6A-24. Do not use a wrench to tighten screws.

NOTE: The base will bolt to the hub in only one position. Do not install screws if they must be slanted.

10. Thread Puller Screw, J-21052-2, into base until screw contacts pilot.

11. Using a wrench, remove hub from crankshaft by tightening screw, Fig. 6A-24.

NOTE: Use of shop air pressure to hold one piston within its compression stroke may be necessary to remove hub without turning the crankshaft. Remove a spark plug, install Adapter J-22794, in spark plug port, and apply air pressure to hold piston within its compression stroke.

12. Remove pilot from end of crankshaft and remove Puller from hub.

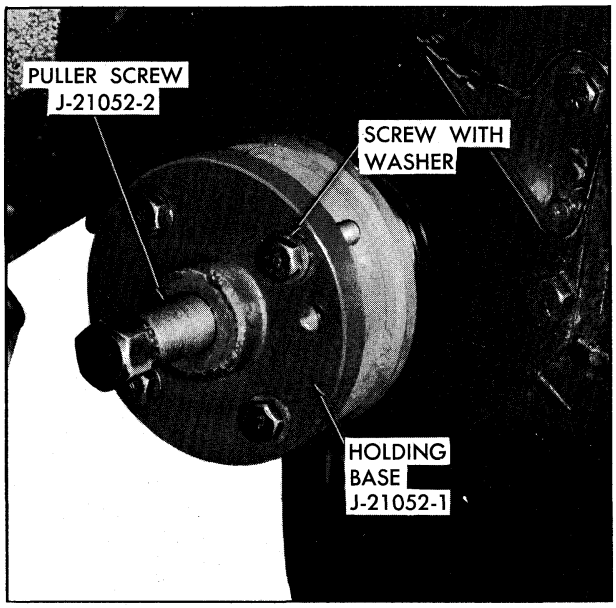


Fig. 6A-24 Removing Balancer Hub Pilot

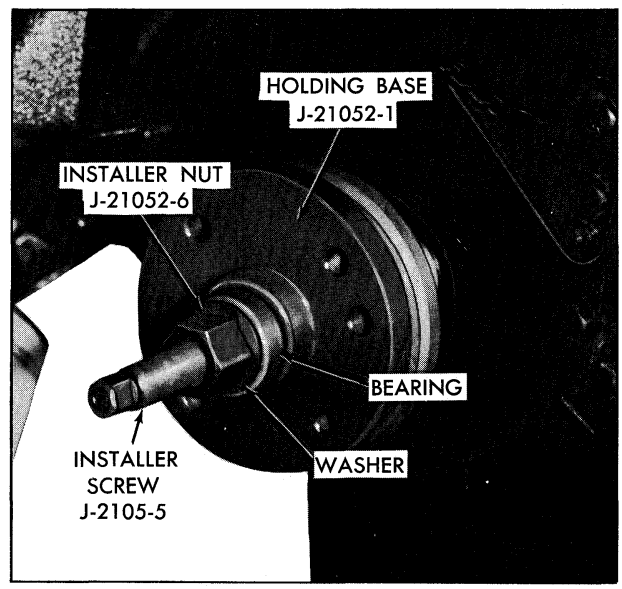


Fig. 6A-25 Installing Balancer Hub

b. Installation

1. Lubricate bore of hub and seal with E.P. lubricant to prevent seizure to crankshaft.

2. Position hub on crankshaft, lining up to key slot in hub with key on crankshaft.

3. Place Holding Base, J-21052-1, against front face of pulley and thread Installer Screw, J-21052-5, into end of crankshaft. Position thrust bearing with inner race forward, washer next, and Installer Nut, J-21052-6, last, Fig. 6A-25.

4. Using a wrench, install hub on crankshaft by tightening screw.

NOTE: Use of shop air pressure, as explained in removal procedure, may be necessary to install hub assembly without turning crankshaft.

5. Install crankshaft pulley to hub and secure with four screws. Tighten all four screws to 15 foot pounds.

6. Exhaust air pressure from cylinder, remove Adapter, J-22794, and install spark plug.

7. Install pulley and fan blade assembly on water pump as described on Page 6B-8.

8. Install power steering pump belt and generator drive belt on pulleys.

9. Adjust all belts as described on Page 6B-12.

10. Connect upper radiator hose at radiator inlet pipe and secure with hose clamp. Secure hose to radiator cover with one screw.

11. Lower car.

12. Refill cooling system with coolant.

13. Reconnect negative battery cable.

14. Run Engine to check for coolant and oil leaks.

Engine Front Cover

Engine operations requiring removal of the front cover (such as camshaft replacement) may use the following procedure which eliminates the necessity of removing the oil pan. Close adherence to the procedure is required to avoid oil leaks.

a. Removal

1. Remove crankshaft pulley hub as described on Page 6A-21.

2. Loosen starter sufficiently to gain access to oil pan screws.

3. Loosen oil pan nuts and screws and lower front of oil pan.

4. Loosen hose clamp at water pump inlet and remove lower radiator hose from water pump.

5. Remove 10 screws that hold front cover to cylinder block and remove cover with water pump attached. Discard gasket.

b. Installation

1. Inspect oil pan front seal to make sure that it was not damaged during removal of cover. If damaged, seal should be replaced. If seal is in satisfactory condition, remove any oil from seal and coat sealing surface with gasket cement.

2. Position new front cover gasket over locating dowels on cylinder block.

NOTE: Apply a small amount of gasket cement to hold gasket in place.

3. Work front cover over end of crankshaft and down into position over oil pan lip. Align dowel holes in cover with locating dowels on cylinder block. Secure with attaching screws. Refer to Fig. 6A-26 for proper screw location and torque specifications.

4. Install crankshaft pulley hub as described on Page 6A-22.

5. Tighten oil pan nuts and screws to 10 ft. lbs. and tighten starter motor mounting screws to 45 ft. lbs.

6. Install lower radiator hose to water pump inlet and secure with hose clamp.

7. Refill cooling system and add engine oil.

8. Run engine and check for leaks.

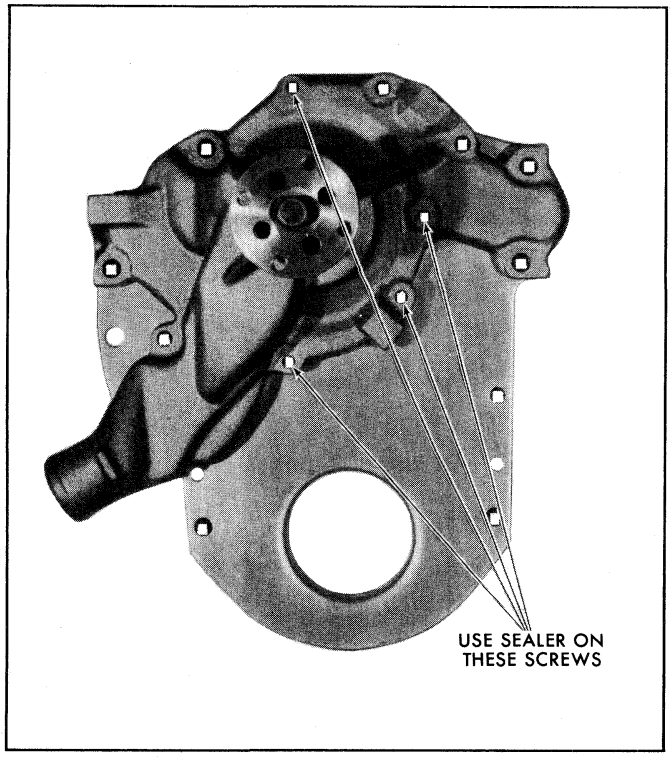


Fig. 6A-26 Front Cover Attaching Screw



Fig. 6A-27 Installing Front Cover Oil Seal

Key	(No.)	Size	Torque
A	(4)	3/8-16 x 1-3/8	22 Foot-Pounds
C	(3)	5/16-18 x 1-1/4	10 Foot-Pounds
D	(1)	5/16-18 x 5/8	10 Foot-Pounds
E	(2)	3/8-16 x 5/8	22 Foot-Pounds

Front Cover Oil Seal Replacement (Fig. 6A-27)

Removal

1. Remove crankshaft pulley and hub as described on Page 6A-21.

2. With thin-bladed screwdriver or similar tool, pry out front cover oil seal. Discard seal.

b. Installation

1. Lubricate new oil seal by filling the cavity between the lips with wheel bearing grease. Position seal on end of crankshaft with garter spring side toward engine.

2. Using Seal Installer, J-22770, and hammer, drive seal into front cover until it bottoms against front cover, Fig. 6A-27.

3. Install crankshaft pulley and hub as described on Page 6A-22

Camshaft

Removal

1. Remove radiator as described on page 6B-9.

2. Remove engine front cover as described on Page 6A-22.

3. Remove ignition distributor as described on Page 6D-33.

4. Remove oil pump as described on Page 6A-20.

5. Remove oil slinger from crankshaft.

6. Remove fuel pump as described on Page 6C-30.

7. Remove screw securing fuel pump eccentric to camshaft and remove eccentric.

8. Remove two screws securing camshaft sprocket to camshaft.

9. Remove camshaft sprocket with chain attached.

10. Remove valve lifters as described on Page 6A-13.

11. Slide camshaft forward carefully until it is out of engine.

CAUTION: *Extreme care must be exercised to keep cam lobes from scratching camshaft bearings.*

b. Inspection

The camshaft is made of alloy cast iron. It must be handled with particular care to avoid damage.

Whenever camshaft has been removed from engine, or faulty camshaft action is suspected in diagnosing engine conditions, the camshaft lobes should be visually checked for wear. This may be done with camshaft installed in engine by removing hydraulic lifters and noting condition of camshaft lobes. Excessive wear, scoring, or flaking of the lifter will usually denote camshaft wear. Excessive camshaft wear is evidenced by grooves, scoring, or flaking. Camshaft should be replaced if any of these conditions exist.

Bearing journals should not be scored or burned. Camshaft bearings should be visually inspected in their bores for excessive wear.

c. Installation

1. Apply a thin coat of rear axle lubricant to all camshaft lobes and bearing journals.

2. Guide camshaft carefully into cylinder block.

CAUTION: *Extreme care must be exercised to avoid nicking or scratching camshaft bearings.*

3. Install valve lifters as described on Page 6A-15.

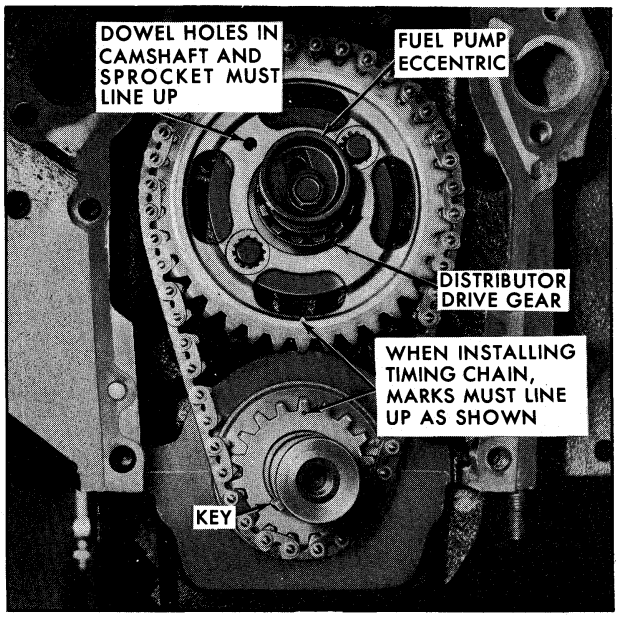


Fig. 6A-28 Timing Sprockets

4. Install camshaft sprocket in timing chain with timing mark toward front.

5. Place chain over crankshaft sprocket and line up timing marks on both sprockets, Fig. 6A-28.

NOTE: Engine is being timed so that cylinder #4 is in the firing position.

6. Hold camshaft sprocket in position against end of camshaft and press sprocket on camshaft by hand, being sure index hole in camshaft is lined up with index hole in sprocket.

7. Install two screws and lockwashers securing camshaft sprocket to camshaft. Tighten screws to 18 foot-pounds.

8. Install fuel pump eccentric on camshaft and secure with screw. Tighten screw to 35 foot-pounds.

9. Install fuel pump as described on Page 6C-30.

10. Install oil slinger on crankshaft with smaller end of slinger against crankshaft sprocket.

11. Install engine front cover as described on Page 6A-22.

12. Install ignition distributor as described on Page 6D-33.

NOTE: Engine timing has been set so that cylinder #4 is in the firing position. When installing the distributor, either set the rotor so that cylinder #4 is firing or crank the engine 360° as observed at crankshaft and set ignition timing on cylinder #1.

13. Install oil pump as described on Page 6A-20

14. Install radiator as described on Page 6B-9.

Camshaft Bearing Replacement

Babbitt type camshaft bearings are used on all engines. Whenever camshaft has been removed from engine for inspection, these bearings should be visually inspected in their bores for excessive wear. If excessive wear is evident, all five bearings should be replaced. A precision pre-machined camshaft bearing, interchangeable bore to bore, is available for field replacement.

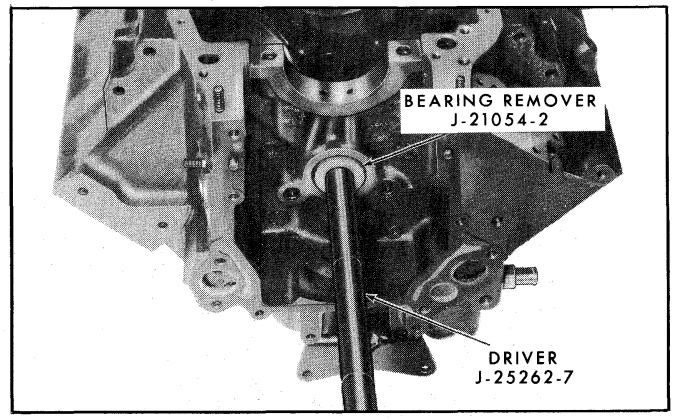


Fig. 6A-29 Removing Camshaft Bearings

a. Removal

1. Remove camshaft as described on Page 6A-23.

2. Thread Arbor, J-21054-2 on end of Drive Shaft, J-25262-7, and position shoulder of arbor against front face of No. 1 bearing, Fig. 6A-29.

3. Using a hammer, drive out No. 1 bearing through rear face of bearing bore. Remove bearing from arbor and discard.

4. Place Pilot J-25262-6 on Handle J-25262-7 and position pilot in No. 1 cam bearing journal in block.

5. Position Arbor J-21054-2 to No. 2 cam bearing and drive bearing out of block.

6. Remove remaining three bearings in same manner. When removing No. 5 bearing, drive out rear cup plug, located behind No. 5 bearing, along with bearing.

b. Installation

1. Install new cup plug in rear of No. 5 bearing bore and seal plug with a permanent type sealer.

2. Locate center oil passage in each bearing bore and scribe a reference mark on front face of each bore, Fig. 6A-30.

3. Slide Drive Shaft, J-25262-7, with Arbor, J-21054-2, through No. 1, 2, 3, and 4 bearing bores until arbor is positioned between No. 4 and No. 5 bores.

4. Slide Pilot J-25262-6 in position in No. 1 cam bearing

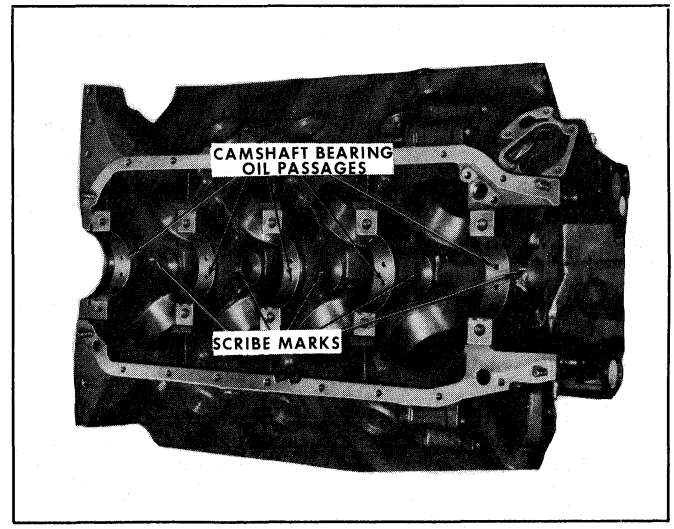


Fig. 6A-30 Camshaft Bearing Oil Passages.

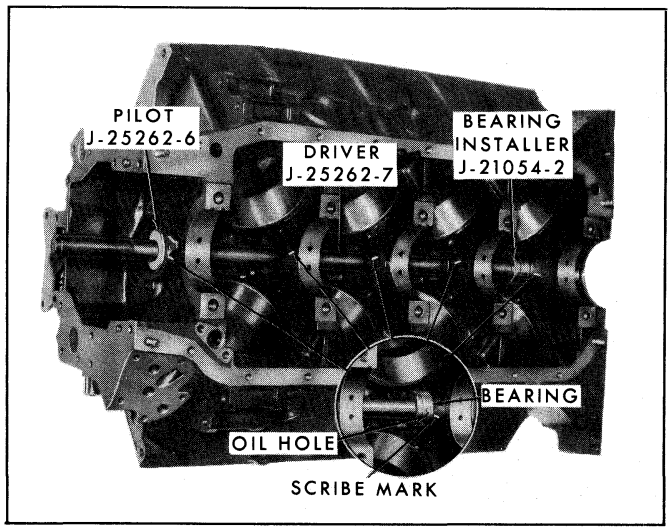


Fig. 6A-31 Installing Camshaft Bearings

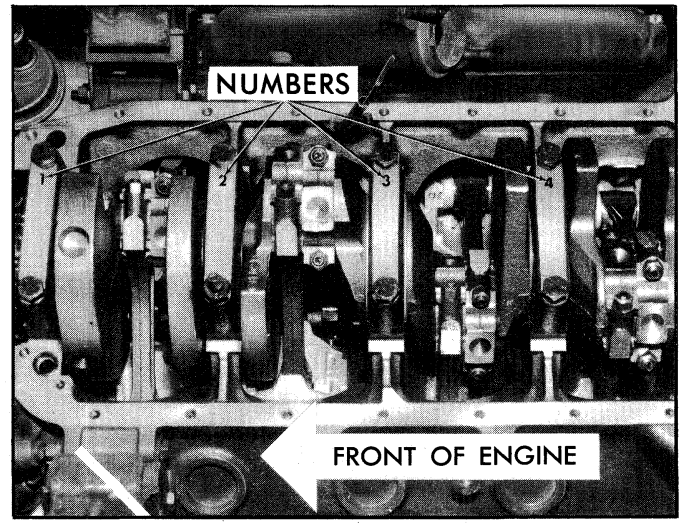


Fig. 6A-32 Main Bearing Caps

journal.

5. Place new bearing on Arbor and position in No. 5 bearing bore, lining up oil hole in bearing with scribe mark on front face of bore, Fig. 6A-31.

6. Using a hammer, install bearing in bore until the last white line on the Driver J-25262-7 is flush with the front face of Pilot J-25262-6.

NOTE: Use only line labeled 500.

7. Place No. 4 bearing on Arbor J-21054-2, align oil hole and drive in until next white line is flush with pilot.

NOTE: Use only lines labeled 500.

8. Following the same procedure install No. 3 and No. 2 bearings.

9. Install No. 1 bearing using only Driver J-25262-7 and Arbor J-21054-2.

10. Check alignment of bearing oil holes by looking down oil hole.

11. Install camshaft as described on Page 6A-23.

Crankshaft

Removal

1. If working on Eldorado, remove engine from vehicle chassis as described on Page 6A-7. Proceed to Step 3.

2. Raise car.

3. Remove oil pan as described on Page 6A-19.

4. Remove timing chain and sprockets as described on page 6A-23. Steps 1 through 9.

5. Remove screws and nut securing oil pick-up tube and strainer assembly to cylinder block and remove intake screen assembly. Discard O-ring.

6. On all cars except Eldorado remove transmission as described in Section 7.

7. Remove six screws that hold flywheel to crankshaft and remove flywheel.

8. Remove spark plugs.

9. Disconnect connecting rods and, using Connecting Rod Guide Set, J-3224, to protect journals, push pistons up into cylinders so that crankshaft can be removed without interference.

10. Remove front and rear main bearing caps.

11. Support crankshaft at front and rear and remove three intermediate bearing caps.

12. Remove crankshaft from engine.

b. Installation

1. Place crankshaft in position and support in place while installing main bearing caps as described on Page 6A-30. Use a new rear main bearing oil seal as described on Page 6A-20.

NOTE: Each bearing cap has a number (1, 2, 3, 4) machined on bottom starting from the front of the engine as shown in Fig. 6A-32. Do not mismatch these caps or turn them around because they are individually matched as the cylinder block is machined.

2. Lubricate crankpins with engine oil and pull connecting rods down toward crankshaft. Use Connecting Rod Guide Set, J-3224, to protect journals.

3. Install connecting rods on crankshaft as described on Page 6A-25.

4. Install oil pick-up tube and strainer assembly with new O-ring on cylinder block and secure with two screws and nut. Tighten to 18 foot-pounds.

5. Install flywheel and secure with six screws. Tighten screws to 75 foot-pounds.

6. On all cars except Eldorado, install transmission as described in Section 7.

7. Install spark plugs. Tighten to 25 foot-pounds.

8. Install timing chain and sprockets as described on Page 6A-23.

9. Install oil pan as described on Page 6A-19.

10. Lower Car.

11. If working on Eldorado, install engine in vehicle chassis as described on Page 6A-7.

Connecting Rod and Piston

a. Removal

1. If working on Eldorado, remove engine from vehicle chassis as described on Page 6A-7.

2. Remove cylinder heads as described on Page 6A-16.

3. Clean carbon from top of cylinder bore. Ream upper ridges if necessary to prevent breakage or distortion of piston ring lands due to rings catching in the ridge. Pack cylinder bore with cloth to catch shavings.

4. Remove oil pan as described on Page 6A-19.

5. Remove two cap screws and nut that hold oil pick-up tube and strainer assembly to cylinder block. Discard O-ring.

6. Remove connecting rod cap by removing connecting

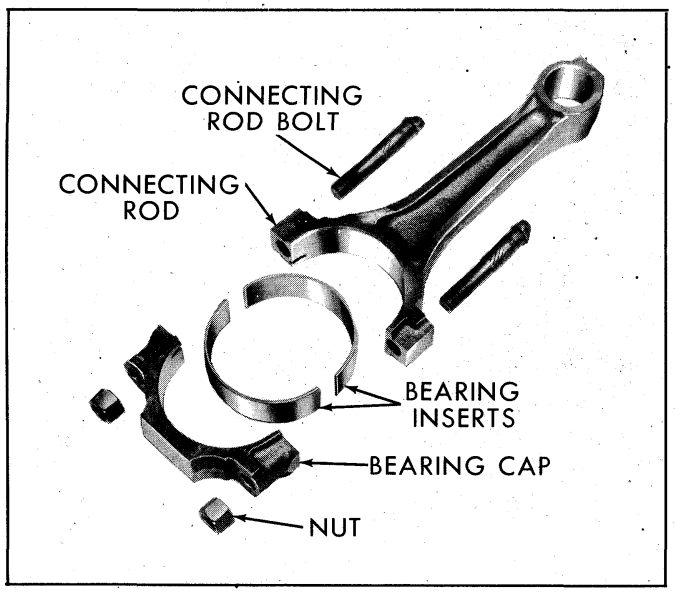


Fig. 6A-33 Connecting Rod and Bearing

rod nuts and sliding cap down off connecting rod bolts, Fig. 6A-33.

7. Install Connecting Rod Guide Set, J-3224, on connecting rod bolts.

CAUTION: *Be careful not to damage crankshaft or cylinder bore when removing piston and rod assembly.*

8. Push connecting rod and piston assembly up until piston rings are out of bore, and remove piston and connecting rod assembly from engine.

CAUTION: *Be careful not to nick lower edge of bore when pushing rod up.*

Remove remaining seven piston and connecting rod assemblies in same manner.

b. Installation

1. Removing connecting rod cap from connecting rod and install bearing inserts in both cap and rod, being careful to locate bearing tangs in locating notches.

2. Install Connecting Rod Guide Set, J-3224, on rod bolts to protect crankpin journals.

3. Using Piston Ring Compressor, J-22666, position capless rod and piston in cylinder bore with notch toward front of engine (letter "R" on piston toward rear) as shown in Fig. 6A-34.

4. Using wood hammer handle, tap piston and connecting rod down into position on crankpin, Fig. 6A-35 and remove Connecting Rod Guide Set, J-3224.

CAUTION: *Extreme care must be exercised when installing pistons and rods to be sure rod is lined up with crankshaft journals and does not stick or bind on counterweights.*

5. Install connecting rod cap with bearing in place over connecting rod bolts, making sure numbered side of cap is on same side as numbered side of rod.

6. Install remaining seven piston and connecting rod assemblies in the same manner.

NOTE: Recheck to see that numbered sides of connecting rods on Nos. 1, 3, 5, and 7 rods are on right side of engine and Nos. 2, 4, 6, and 8 are on left side of engine, and that rods are on proper crankpin.

7. Install rod cap nuts and tighten to 40 foot-pounds.

8. Check connecting rod end play on crankpin by tapping the two rods apart at crankpin and checking with feeler gage. Endplay should be at least .011" but not more than .021".

9. Install oil pick-up tube and strainer assembly on cylinder block, using new O-ring. Tighten screws and nut to 18 foot-pounds.

10. Install oil pan as described on Page 6A-19.

11. Install cylinder heads as described on Page 6A-16.

12. If working on Eldorado, install engine in vehicle chassis as described on Page 6A-7.

Connecting Rod Bearing Clearance Checking and Replacement

Worn bearings can be replaced without removing the rod and piston assembly by removing the cap and replacing the upper and lower halves. The clearance between the connecting rod bearing and the crankshaft can be measured with the aid of plastic gauging material, as follows:

1. Remove bearing cap and wipe oil from crankshaft journal and bearing insert.

2. With crankpin at approximate bottom dead center, place a piece of plastic gauging material in center of cap.

NOTE: When using plastic gauging material, plastic material and part being measured must both be at room temperature. If parts are excessively warm, an incorrect reading may result. Fresh plastic gauging material is recommended for greatest accuracy.

3. Reinstall bearing cap. Tighten screws to 40 foot-pounds.

NOTE: It is extremely important to position tangs on bearings in notches in rod and cap.

4. Remove bearing cap and determine clearance by comparing width of flattened plastic gauging material, at its widest point, with graduations on plastic gauging material container. Number within matching graduation on envelope indicates clearance in thousandths of an inch. Fig. 6A-36.

If clearance is greater than .0035 inch, replace bearing. If new bearings do not reduce clearance to less than .0035 inch, crankshaft must be replaced to obtain specified limits. If both new bearings and new crankshaft are installed, clearance should be from .0005 inch to .0028 inch.

Piston Ring Replacement

Each piston has two compression rings and a side-seal type oil ring that incorporates a steel expander and two identical chrome plated steel rails. The top compression ring is molybdenum filled cast iron. The second compression ring is coated cast iron.

When replacing piston rings, install only re-ring sets that have molybdenum filler upper compression ring, and multi-piece oil rings.

The compression rings are chamfered on the lower inner face. There is a locating "dimple" on both rings near the end for easy identification on the top side. Install with top side "dimple" facing up.

1. Place ring in area of cylinder where piston ring will travel. Be sure ring is square with cylinder bore by positioning ring with piston head.

2. Gap between compression ring ends should be .013 inch to .025 inch.

3. Gap between oil ring ends should be .015 inch to .055 inch.

4. With compression ring on piston, clearance between

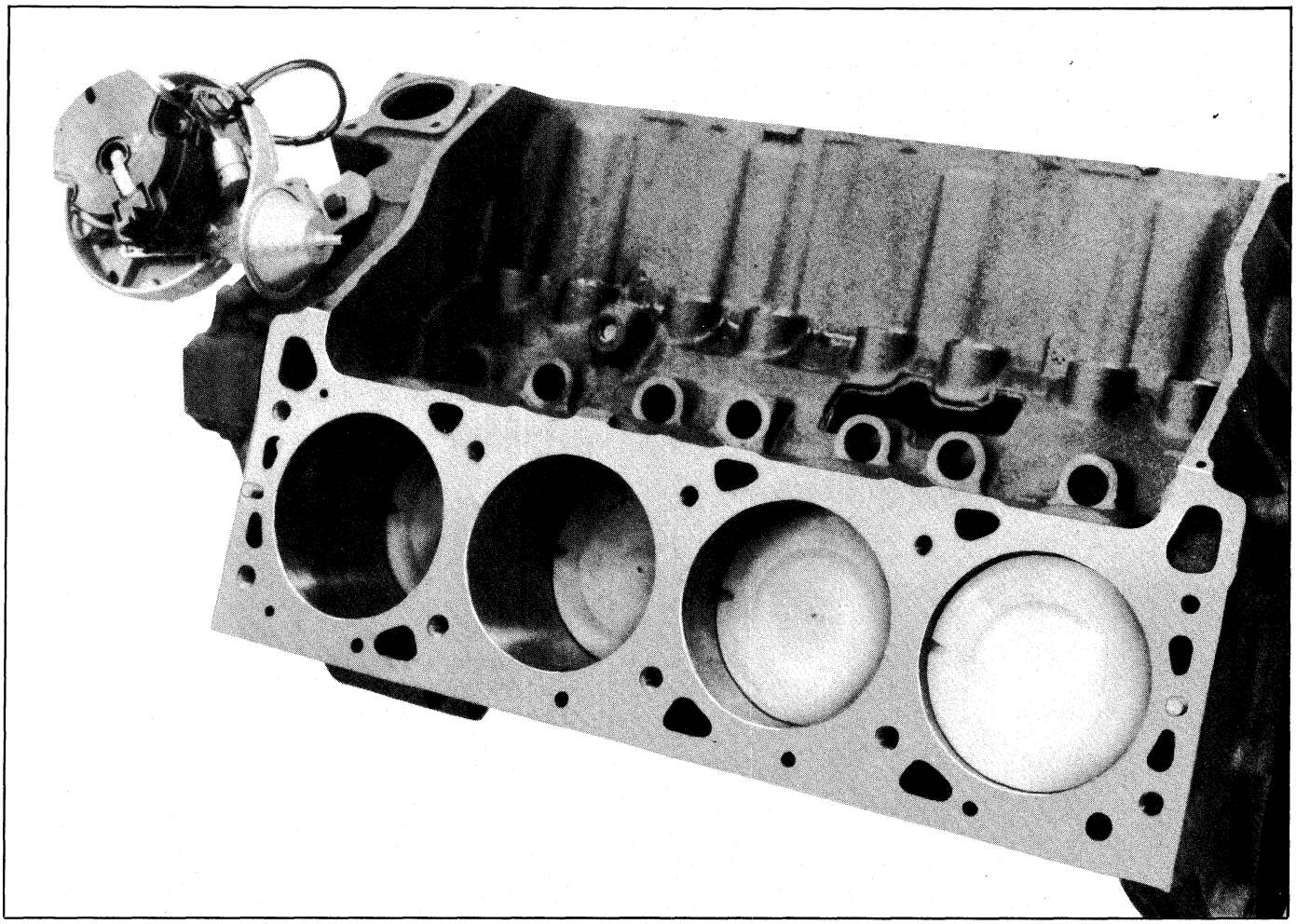


Fig. 6A-34 Engine Partially Disassembled (Typical)

top surface of piston ring and ring land should be no greater than .005 inch. If clearance is greater, replace the ring. If the new ring does not reduce the clearance to .005 inch or less, new pistons should also be installed.

Clearance on new rings and new pistons should be .0017 inch to .0040 inch. This can be checked with a .0015 inch and .005 inch feeler gage on a "go-no-go" basis. The .0015 inch feeler gage should always enter; the .005 inch feeler gage should never enter. When installing rings on piston, gaps in piston rings should be staggered by approximately 120°.

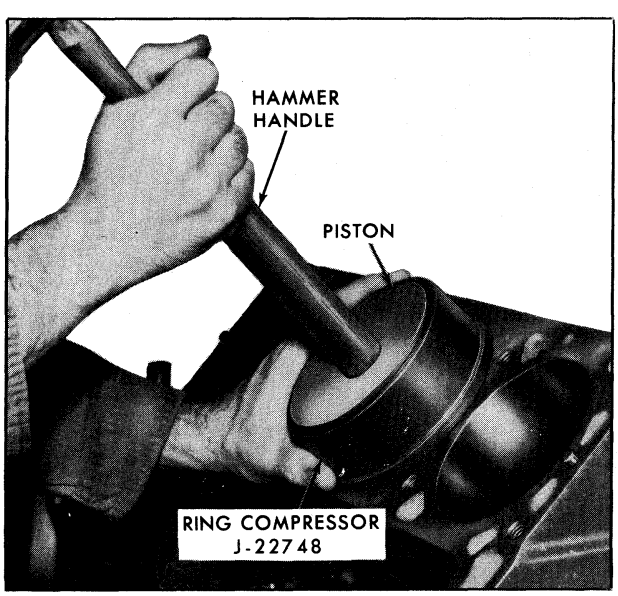


Fig. 6A-35 Installing Piston in Cylinder Block

Piston Pin

a. Removal

1. Position the support fork of Tool J-24086-11 between the connecting rod and piston, Fig. 6A-37.

2. Install removal arbor, Tool J-24086-8, through the alignment hole in the tool base, Fig. 6A-37.

CAUTION: *Center the piston, rod and pin assembly with the removal arbor. Press the piston pin out of the connecting rod.*

b. Installation

1. install pin guide J-24086-4 (red) through piston and into connecting rod. Hand tap pin guide into position for proper retention, Fig. 6A-38.

CAUTION: *The pin guide centers the connecting rod in the piston. When the piston, connecting rod, piston pin and pin guide assembly are positioned on*

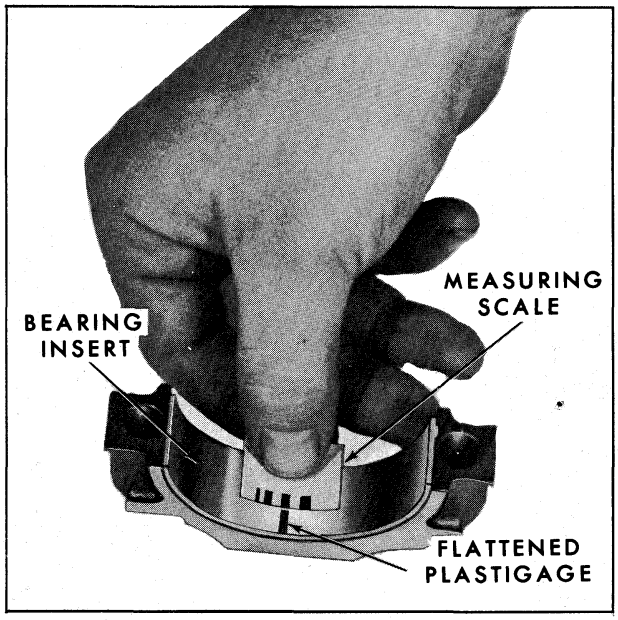


Fig. 6A-36 Checking Bearing Clearance

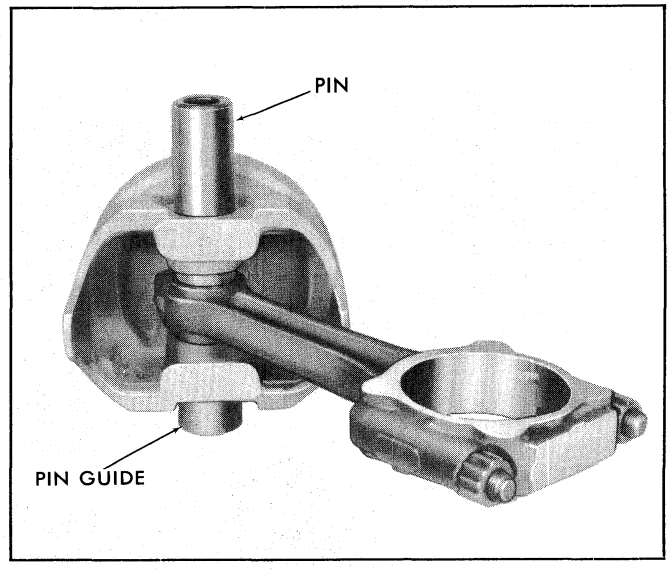


Fig. 6A-38 Installing Pin Guide

the fork of the tool, the pin guide will also center this assembly in the tool. If a pin guide that is too small is used, the piston assembly will not be located centrally in the tool, and damage may occur to the fork of the tool.

2. Install piston assembly into fork assembly of tool. Tool will support connecting rod at the piston pin. Be sure piston assembly slides onto the fork until the pin guide contacts the fork.

3. Adjust installing arbor, Tool J-24086-9, to G8 by turning the numbered sleeve on the lettered shaft. Turn knurled nut to lock numbered sleeve on shaft.

4. Insert the installing arbor through the hole in the arch of the tool, Fig. 6A-39.

Press piston pin into the connecting rod until the sleeve on the installing arbor contacts the top of the tool arch. The pin guide will fall out of the connecting rod as the piston pin is pressed in.

CAUTION: *Do not exceed 5000 pounds of force when stopping the installing arbor sleeve against the arch.*

NOTE: An alternate piston pin remover and installer Tool BT-7612 may be used using manufacturer's instructions.

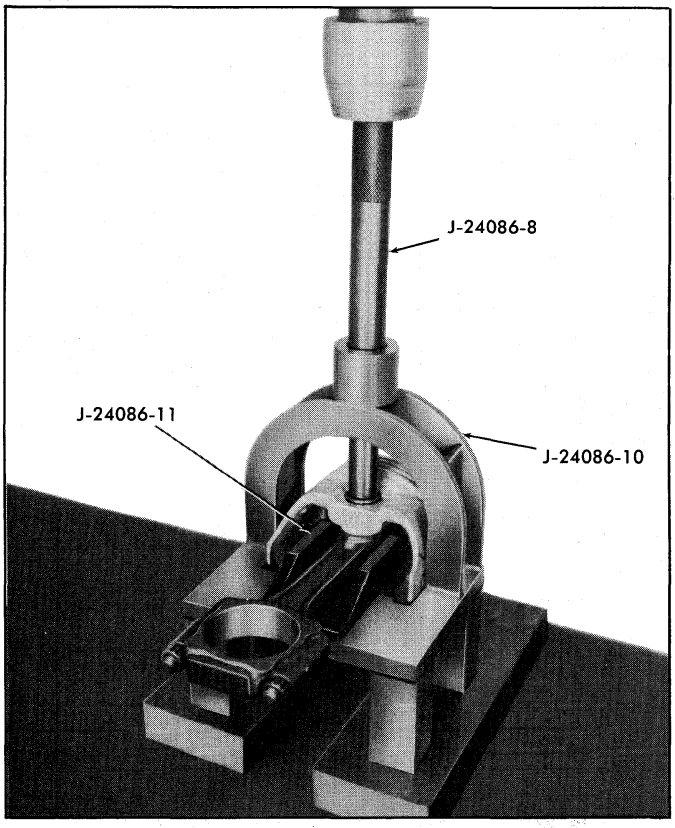


Fig. 6A-37 Removing Piston Pin

Piston Clearance

When measuring piston diameter, the micrometer should be placed 3/16 inch below the cross slot or 1/4 inch below the oil ring grove, Fig. 6A-40. Cylinders must be measured by placing the micrometer 1-1.8 inches from the top, and perpendicular to the centerline of the face.

An identification letter is stamped on the cylinder head face of the cylinder block. The letter is located directly below the cylinder bore. This letter denotes the cylinder-piston size as shown in the table on page 6A-29.

The table indicates five piston sizes ranging in steps of .0004 inch from 4.0810 inches to 4.0830 inches. This makes it possible to maintain the .006 to .0014 inch piston to cylinder wall clearance. The sizes shown apply to 70°F. (21.1°C.).

If double letters (such as AA, BB) appear on the cylinder

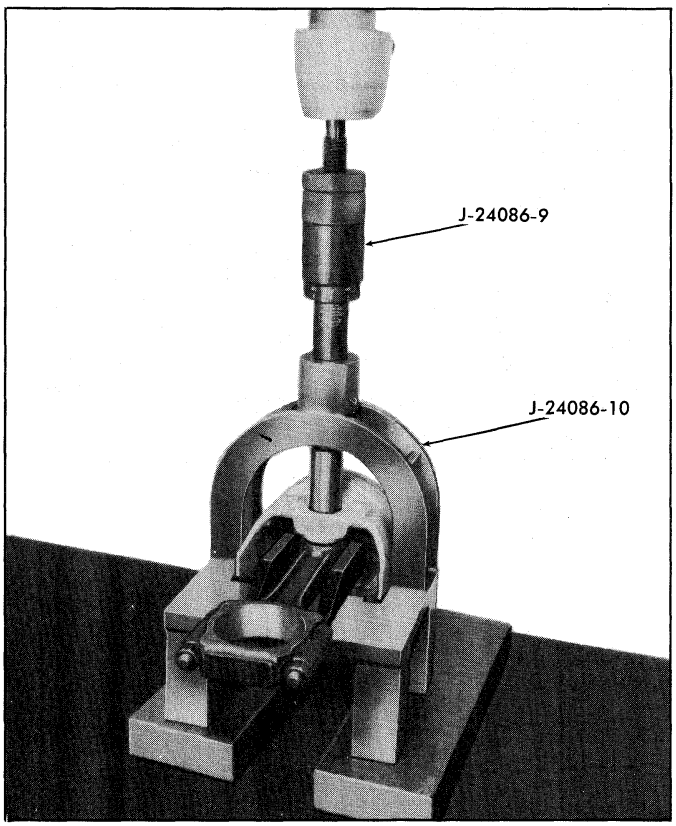


Fig. 6A-39 Installing Piston Pin

head face of the block just above the cylinder bore, it indicates that this particular cylinder has been bored to .010 inch over the diameter indicated by a single letter in the chart. For example, a cylinder with the letters CC stamped on the block would have a diameter of 4.0920 inches to 4.0964 inches; a matching piston for this size would have a diameter of 4.0910 inches to 4.0954.

Orders for service pistons will be filled in sizes C and E through the servicing parts warehouses.

Cylinder bores must not be reconditioned to more than .0100 inch oversize as pistons are not available over this range.

While the current model is in production, specific code size pistons A through E and AA through EE are available from the factory Parts Warehouse in Detroit on a special order basis.

NOTE: Before special ordering specific code size pistons, it is very important to check the sizes of the cylinder bores by actual measurement. Actual measurement at the time of replacement is the only certain way to avoid error in ordering.

An outside micrometer and an inside micrometer are required to determine piston clearance. The outside micrometer, used for measuring piston diameter, must be adjusted to turn freely so that it can be adjusted up to the piston with a very light turning effort on the screw. If it is adjusted to get a frictional feel over the piston, it will show several tenths of a thousandth smaller than its actual size. With practice, fractional thousandths can be checked accurately.

The inside micrometer for measuring the cylinders may be used with or without an extension handle. It should be adjusted so the screw turns sufficiently tight to retain its setting while checking the cylinder at the different points to be measured.

The direct readings shown on the inside micrometer should not be taken as the cylinder sizes. With one end of the micrometer contacting the cylinder wall and the other being oscillated, adjust the micrometer until it will just slip through the cylinder with a light drag. Remove the micrometer, obtaining the same feel as when measuring the piston.

By this method, even if the two micrometers do not agree in readings, no error will result in arriving at the actual clearance of the piston in the cylinder.

Letter	Cylinder Size (Diameter in Inches)	Piston Size (Diameter in Inches)
A	4.0820 - 4.0824	4.0810 - 4.0814
B	4.0824 - 4.0828	4.0814 - 4.0818
C	4.0828 - 4.0832	4.0818 - 4.0822
D	4.0832 - 4.0836	4.0822 - 4.0826
E	4.0836 - 4.0840	4.0826 - 4.0830

Cylinder and Piston Diameter Chart

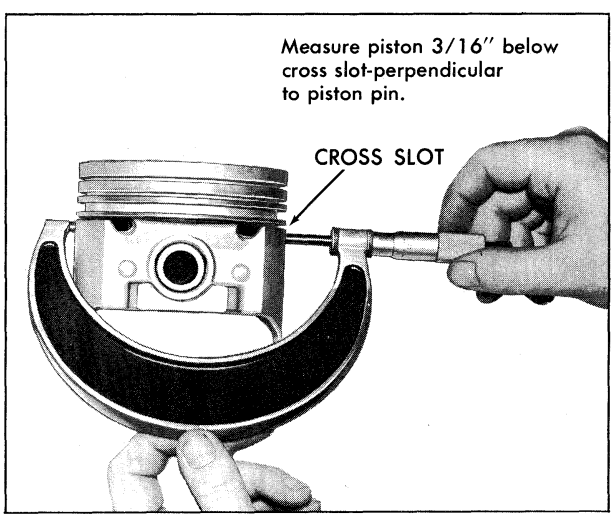


Fig. 6A-40 Measuring Piston Diameter

Connecting Rod Alignment

Connecting rods are carefully aligned at the factory and it is not necessary to check their alignment in the field. Only in cases of damage will they become misaligned. If this condition does exist, the piston, pin, and rod assembly should be replaced. Do not attempt to straighten connecting rods.

Main Bearing Replacement and Clearance Checking

Shell type main bearings of steel-backed aluminum and steel-backed babbitt are used in all engines. Proper location for these bearings is shown in Fig. 6A-41. No. 1 upper and lower bearings halves are interchangeable. No. 2 and 4 upper bearing halves are interchangeable. No. 2 and 4 lower bearing halves are interchangeable. No. 3 upper and lower bearing

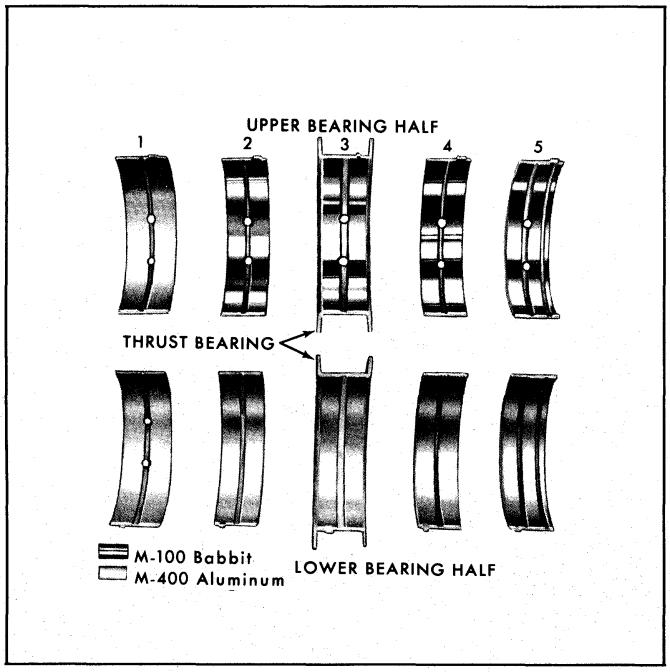


Fig. 6A-41 Main Bearing Location

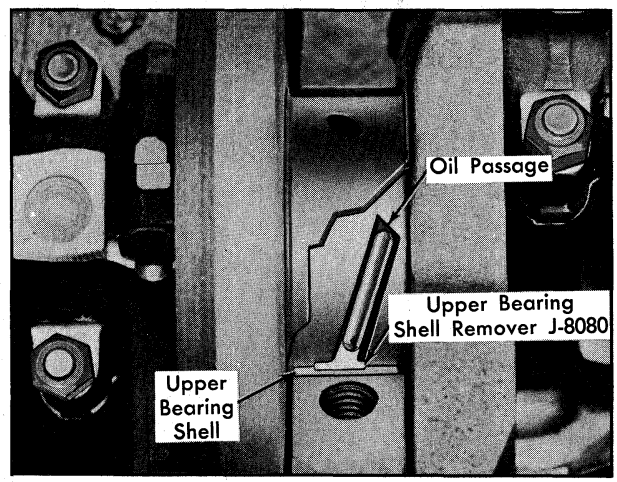


Fig. 6A-42 Removing Upper Bearing Shell

halves are not interchangeable.

The crankshaft end thrust is taken by the center main bearing. The worn limit for crankshaft end play is .015 inch.

a. To Check a Main Bearing

1. Remove bearing cap to be checked.

2. Measure bearing wear using the plastic gauging material method as described on Page 6A-26. Bearing cap must be tightened to 90 foot-pounds.

NOTE: If bearings are being measured with engine in chassis, crankshaft must be supported in order to take up clearance between upper bearing shell and crankshaft. This can be done by removing bearing caps adjacent to bearing being checked, and placing a strip of .005 inch brass shim stock between lower bearing shell and crankshaft bearing journal.

CAUTION: *When reinstalling bearing caps with shims lightly tighten attaching screws to avoid damaging bearing caps.*

3. If bearing is greater than .0045 inch, replace bearing.

4. If new bearings do not reduce the clearance to less than .0045 inch, crankshaft should be replaced.

If both new bearings and new crankshaft are installed, clearance should be .0003 inch to .0026 inch for all bearings except front bearing. Clearance for front bearing should be .0001 inch to .0024 inch.

b. Main Bearing Replacement

1. If working on Eldorado, remove engine from vehicle chassis as described on Page 6A-7.

2. Remove spark plugs.

3. Remove engine oil pan as described on Page 6A-19.

4. Remove two cap screws and nut that hold oil intake screen assembly to cylinder block and remove screen assembly. Discard O-ring.

5. Remove two screws that hold bearing cap to cylinder block and remove cap. Remove worn shell from cap and discard.

NOTE: Each bearing cap has a cast number (1, 2, 3, 4) on the bottom starting from the front of the engine, as shown in Fig. 6A-32. Do not mismatch these caps or turn them around because they are individually matched when the cylinder block is machined.

6. Install Upper Bearing Shell Remover, J-8080, into oil hole in crankshaft bearing journal, Fig. 6A-42.

7. Slowly rotate crankshaft clockwise (viewed from front of engine) until tool contacts and forces out upper shell.

8. Install new upper shell in place as far as possible by hand, with locating tang in correct position. Remover Tool, J-8080, may also be used to aid in installing new upper shell. Install tool in crankshaft oil passage so that tool bears against notched end of bearing shell. Rotate crankshaft counterclockwise to position bearing, then remove tool, Fig. 6A-42.

9. Install new lower shell in cap with locating tang in correct position.

NOTE: When replacing the rear main bearing, use a new oil seal as described on Page 6A-20.

10. Install cap on cylinder block and secure with two attaching screws. Tighten screws to 90 foot-pounds.

11. Replace four remaining bearings in same manner.

NOTE: When replacing center bearing it is necessary to line up bearing thrust surfaces. To do this, install bearing cap screws finger tight. Then, using a plastic hammer, tap crankshaft fore and aft the limit of its travel several times. Do not use hammer on connecting rods, tap on counterweights only.

12. Install oil intake screen assembly on cylinder block using new O-ring, and secure with attaching screws and nut. Tighten to 18 foot-pounds.

13. Install oil pan as described on Page 6A-19.

14. Install spark plugs and tighten to 25 foot-pounds. Connect spark plug wires at plugs.

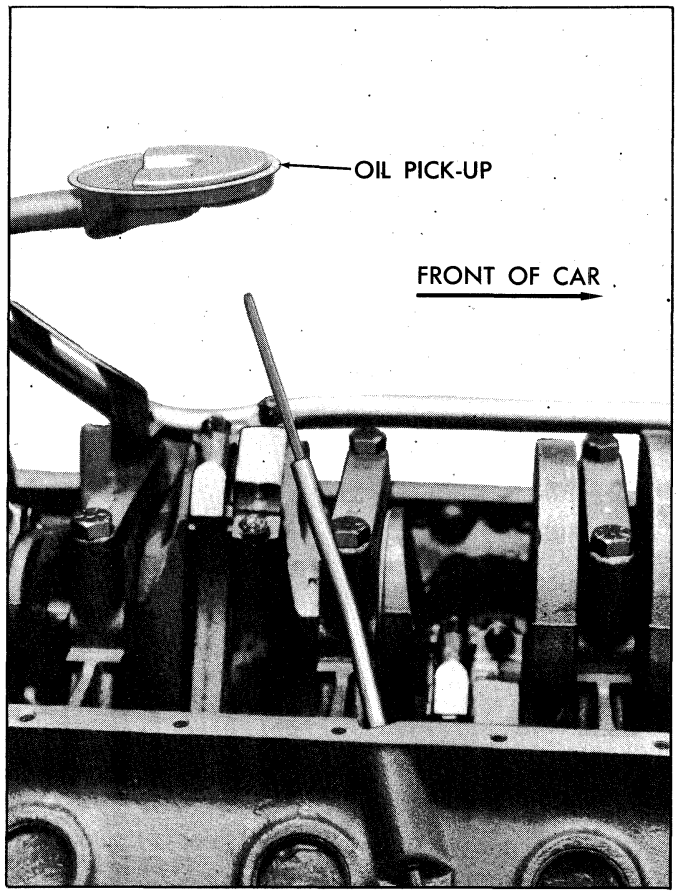


Fig. 6A-43 Dipstick Tube Position

15. If working on Eldorado, install engine in vehicle chassis as described on Page 6A-7.

Dipstick Tube Installation

When replacing engine block and pistons, it is necessary to fit the new assembly with a replacement dipstick tube. To avoid interference with moving parts and to assure proper reading on dipstick when installed, heed the following instructions.

1. Line up tube and tap in gently with hammer and block of wood until stop ring on tube contacts block.

3. Install 3/8" tubing bender on dipstick tube:

Put a shallow rearward bend in the tube so that tube misses No. 3 main bearing cap by 1/2". Tube should point to a spot just forward of center of oil pick up strainer, Fig. 6A-43.

SPECIFICATIONS

Items	All Series Unless Otherwise Noted
Bore	4.082
Stroke	4.060
Piston Displacement	425 Cu. In.
Compression Ratio	8.2:1
Compression Pressure	
At cranking speed	
(Throttle open)	140-165 psi
Points of Suspension	3
VALVES	Intake / Exhaust
Clearance between stem and guide New limits	.0010"-.0027"
Worn limits, not over	.005
Clearance between lifter body and crankcase	.0005"-.0020"
Head diameter, overall	.000" 1.625"
Lift	.457" .473"
Valve face angle	44°
Valve seat angle (in head)	45°
Seat width (in head)	1/16"
Seat eccentricity, not over (T.I.R.)	.004"
Stem diameter	.3413"-.3420"
Valve guide diameter (in head)	.343"
Rocker Arm Ratio	1.65:1

Items	All Series Unless Otherwise Noted
VALVE SPRINGS	
Free Length	2.250"
Pounds required to compress to 1.946" (Valve closed)	60-65
Pounds required to compress to 1.496" (Valve open)	155-165
CAMSHAFT	
Chain	
Type	Silent Chain
Adjustment	None
Length	24"
Number of links	48
Pitch	.500"
Width	750"
Bearing Clearance	
Number	5
New limits	.001"-.0022"
Worn limits, not over	.004"
Out-of-round, not over	.002"
Valve Timing (with ramp at .001" lift)	
Intake opens	21° B.T.D.C.
Intake closes	111° A.B.D.C.
Exhaust opens	73° B.B.D.C.
Exhaust closes	55° A.T.D.C.

SPECIFICATIONS (Cont'd.)

Items	All Series Unless Otherwise Noted
Valve Lift	
Intake	.457"
Exhaust	.473"
Duration	
Intake	312°
Exhaust	308°
Valve Overlap	76°
CONNECTING RODS	
Bearing Material	Aluminum
Clearance between bearing and shaft —	
New limits	.0005"-.0028"
Worn limits, not over	.0035"
Diameter lower end, without bearing	2.6243"-2.6250"
Length, center to center	6.75"
End play of rods on crank pin	.008"-.020"
PISTON RINGS	
Clearance between rings and sides of groove in piston —	
Compression rings	.0017"-.0040"
Oil rings	NONE - Side Sealing
Gap between ends	
compression rings	.013"-.023"
Oil rings	.015"-.055"
Number of compression rings	2
Number of oil rings	1
Width of compression ring groove	.0802"-.0810"
Width of oil ring groove	.188"-.189"
Diameter at bottom of groove	
Oil ring	3.263"-3.268"
Compression rings	3.620"-3.625"
PISTON PINS	
Clearance between pin and piston —	
New limits	.0002"-.0004"
Pin length	2.870"
Pin diameter	.9994"-.9999"
PISTONS AND CYLINDERS	
Cylinder bore out-of-round (new or reground limit)	
Not over	.0005"
Piston Taper, not over	.0005"-.002"
Piston Material	Aluminum Alloy
Piston skirt top clearance	.0006"-.0014"
Piston skirt bottom clearance	.0014"-+ .0009"

Cylinder and piston sizes (as indicated by letters stamped on the cylinder head gasket surface). The letters are in groups of two for adjacent cylinders (such as "E" and "B") midway between the two cylinders. The letters denote the cylinder piston sizes as shown on page 6-00.

Items	All Series Unless Otherwise Noted

Letter	Cylinder Size (Diameter in Inches)	Piston Size (Diameter in Inches)
A	4.0820-4.0824	4.0810-4.0814
B	4.0824-4.0828	4.0814-4.0818
C	4.0828-4.0832	4.0818-4.0822
D	4.0832-4.0836	4.0822-4.0826
E	4.0836-4.0840	4.0826-4.0830

OIL PUMP	
Oil pump type	Spur Gear
Backlash between drive gears	.001"-.013"
Clearance between pump body and gears —	
New limits	.001"-.004"
Worn limits, not over	.005"
No. of teeth on each gear	9
CRANKSHAFT AND MAIN BEARINGS	
Clearance, main bearings —	
New limits	.0001"-.0026"
Worn limits, not over	.0045"
Main bearing caps —	
Screw thread diameter	1/2"
Main bearing journal, diameter	3.250"
Main bearing journals, out-of-round not over	.00025"
Main bearing journal length —	
No. 1 and No. 5	1.1925"
No. 2 and No. 4	1.0595"
No. 3	1.0670"
Main bearings material	AT-20 Aluminum and M-100 Babbitt
Crankpin diameter	2.500"
Crankpin out-of-round not over	.00025"
End play in crankshaft —	
New limits	.002"-.012"
Worn limits	.015"
OIL PRESSURE REGULATOR	
Clearance between valve plunger and housing —	
New limits	.0020"-.0035"
Worn limits, not over	.005"
Normal pressure at 30 mph	
Minimum	35 psi
Idle (average)	10 psi
Spring	
Free length	2.57"-2.69"
Lbs. required to compress to 1.460 inches	9.3-10.5
Valve opens at	35 - 40 psi

TORQUE SPECIFICATIONS

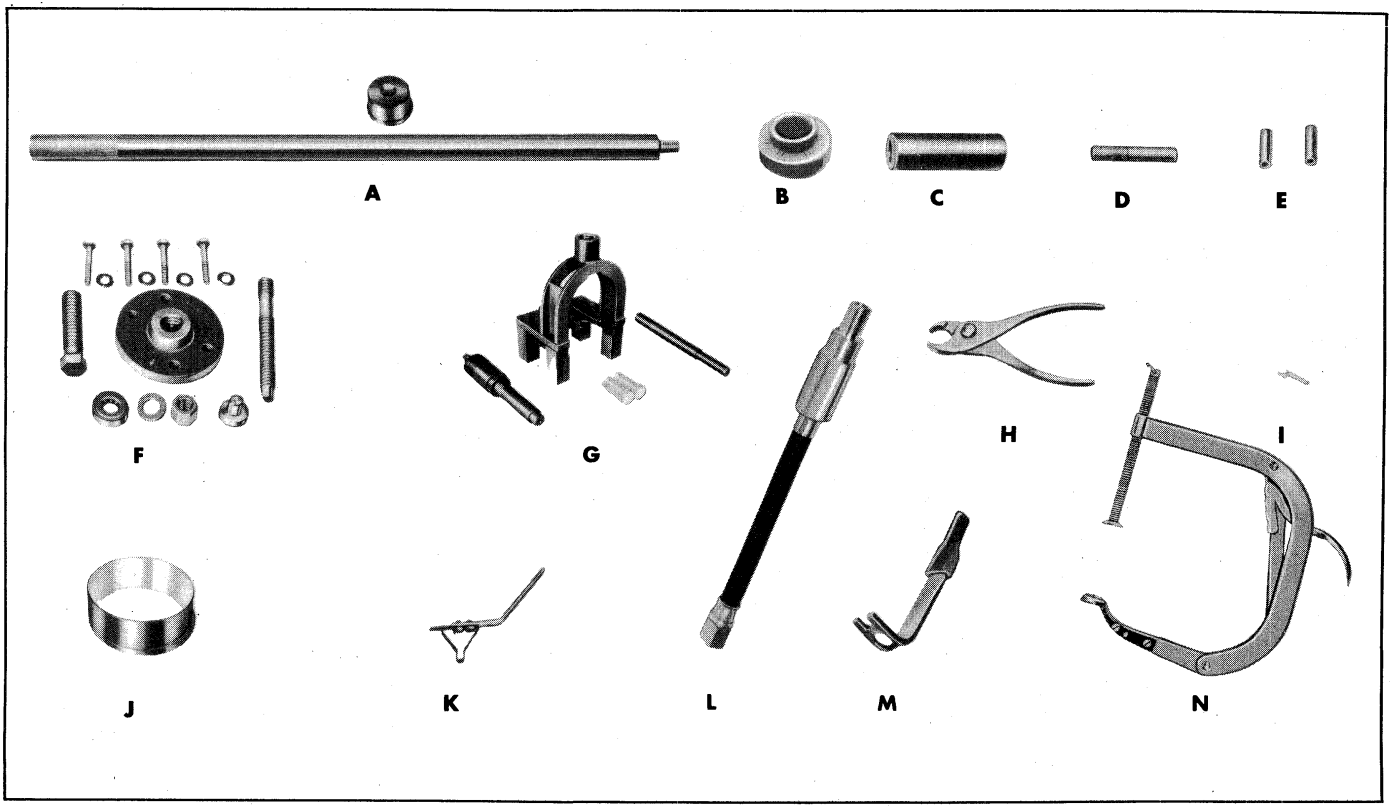
Material No.	Application	Thread Size	Torque
280-M	Camshaft Sprocket to Camshaft Screws	5/16-18	18 ft. lbs.
260-M	Carburetor to Intake Manifold Screw (Front)	5/16-18	11 ft. lbs.
280-M	Carburetor to Intake Manifold Screw (Rear)	5/16-18	15 ft. lbs.
1038	Connecting Rod Nut	3/8-24	40 ft. lbs.
300-M	Cylinder Head to Cylinder Block Screw (All-Special) Oiled	1/2-13	95 ft. lbs.
Special	Cylinder Head Temperature Switch	3/8-24	6 ft. lbs.
286-M	Distributor Clamp Nut	5/16-24	15 ft. lbs.
286-M	Engine Front Support Mount to Cylinder Block Nut	3/8-24	21 ft. lbs.
286-M	Engine Front Support Mount to Frame Nut	3/8-16	30 ft. lbs.
300-M	Engine Front Support Mount Through Bolt	1/2-13	30 ft. lbs.
300-M	Engine Rear Support Mount to Rear Support Cross Member Bolt	3/8-16	45 ft. lbs.
280-M	Engine Rear Support Cross Member to Frame Bolt	5/16-18	20 ft. lbs.
500-M	Engine Rear Support Mount to Transmission Extension Housing Bolt	M10 x 1.5	30 ft. lbs.
286-M	Eldorado Engine Front Mounting Support Bracket to Crankcase Nut	3/8-24	21 ft. lbs.
286-M	Eldorado Engine Front Support Cushion to Frame Nut	7/16-14	35 ft. lbs.
300-M	Eldorado Engine Front Support Cushion to Engine Mounting Bracket Nut	7/16-20	57 ft. lbs.
280-M	Eldorado Engine Rear Support Bracket to Transmission Bolt	7/16-14	50 ft. lbs.
280-M	Eldorado Engine Rear Support Assembly to Bracket	7/16-14	46 ft. lbs.
280-M	Eldorado Engine Rear Support Assembly to Frame (Bolt or Nut)	1/2-13	52 ft. lbs.
280-M	Exhaust Manifold to Cylinder Head Screw (Long Screw)	3/8-16	35 ft. lbs.
	(Short Screw)	3/8-16	12 ft. lbs.
260-M	Fan Blade Assembly Mounting Screw	15/16-24	18 ft. lbs.
280-M	Flywheel to Converter Housing Screw	3/8-16	30 ft. lbs.
280-M	Flywheel to Crankshaft Screw (All)	7/16-20	75 ft. lbs.
280-M	*Front Cover to Cylinder Block Screw	5/16-18	10 ft. lbs.
280-M	*Front Cover to Cylinder Block Screw	3/8-16	22 ft. lbs.
280-M	Fuel Pump to Engine Screw	5/16-18	12 ft. lbs.
286-M	Fuel Pump to Engine Nut	5/16-14	12 ft. lbs.
280-M	Fuel Pump Eccentric	3/8-16	35 ft. lbs.
260-M	Generator Adjusting Link to Generator Screw	5/16-18	10 ft. lbs.
260-M	Generator Support Bracket Screw	3/8-16	17 ft. lbs.
1112	Generator Support Bracket Nut	3/8-24	17 ft. lbs.
1010	Heater Hose Clamps	10-24	14 ft. lbs.
260-M	Ignition Coil Mounting Screw	5/16-18	15 ft. lbs.
280-M	Intake Manifold to Cylinder Head Screw	3/8-16	30 ft. lbs.
300-M	Main Bearing Cap to Cylinder Block Screw	1/2-13	90 ft. lbs.
Special	Oil Pan Drain Plug	1/2-20	25 ft. lbs.
1010	Oil Pan to Cylinder Block Nut	5/16-24	10 ft. lbs.
1010	Oil Pan to Cylinder Block Screw	5/16-18	10 ft. lbs.
280-M	Oil Pick-up and Strainer to Cylinder Block Screw	5/16-18	15 ft. lbs.
286-M	Oil Pick-up Tube and Strainer Assembly to Main Bearing Bolt	3/8-24	35 ft. lbs.
Special	Oil Pressure Switch	1/4" Pipe	20 ft. lbs.
280-M	Oil Pump Assembly to Engine Screw	5/16-18	15 ft. lbs.
280-M	Pulley to Harmonic Balancer Screw	5/16-18	17 ft. lbs.
1010-M	**Rocker Arm Cover to Cylinder Head Screw/Washer	1/4-20	30 in. lbs.
300-M	Rocker Arm Support Bolt	7/16-14	70 ft. lbs.

TORQUE SPECIFICATIONS (Cont'd.)

Material No.	Application	Thread Size	Torque
1018	Starter Motor Brace Mounting Screw	5/16-18	12 ft. lbs.
1018	Starter Motor Brace Mounting Nut	1/4-20	70 in. lbs.
280-M	Starter Motor Mounting Screws	3/8-16	45 ft. lbs.
Special	Spark Plug	14mm	25 ft. lbs.
Special	Temperature Indicator Switch	1/2" Pipe	40 ft. lbs.
260-M	Thermostat Housing to Engine Screw	5/16-18	10 ft. lbs.
280-M	Transmission Housing to Cylinder Block	3/8-16	35 ft. lbs.
260-M	Water Pump to Front Cover Screw	1/4-20	70 in. lbs.
280-M	Water Pump to Cylinder Block Screw	5/16-18	10 ft. lbs.
280-M	Water Pump to Cylinder Block Screw	3/8-16	22 ft. lbs.

NOTE: Refer to back of manual for bolt and nut markings and steel classifications.

SPECIAL TOOLS



Key	Tool No.	Name	Key	Tool No.	Name
A	J-25262	Camshaft Bearing Remover and Installer Set	G	J-25270-90	Piston Pin Remover and Installer Set
B	J-22770	Front Cover Oil Seal Installer	H	J-3049	Valve Lifter Remover
C	J-4160	Hydraulic Valve Lifter Plunger Remover	I	J-8080	Main Bearing Upper Shell Remover
			J	J-22666	Piston Ring Compressor
D	J-2730	Valve Lifter Lock Ring Installer	K	J-3074	Valve Lifter Leak-Down Tester
E	J-3224	Connecting Rod Bolt Guide Set	L	J-22794	Adapter
F	J-21052	Crankshaft Hub Remover and Installer Set	M	J-22765	Valve Spring Compressor
			N	J-8062	Valve Spring Compressor

Fig. 6A-44 Special Tools Chart

ENGINE MECHANICAL — SEVILLE

TABLE OF CONTENTS

Balancer 6A-53
Camshaft 6A-56
Camshaft Bearings 6A-56
Crankshaft 6A-57
Main Bearings 6A-58
Rear Main Oil Seal 6A-60
Connecting Rod and Piston Assembly 6A-49
Rod Bearings 6A-49
Cylinder Head and Gasket 6A-45
Valve and Springs 6A-47
General Description 6A-36
Engine Assembly 6A-38
Engine Mounts 6A-40
Installation and Removal 6A-38
Front Cover 6A-53
Oil Seal 6A-54
Lubrication System 6A-37
Manifold
Intake 6A-41
Oil Pan 6A-48
Oil Pump 6A-48
Piston
Checking Cylinder Bore 6A-50
Cleaning Piston 6A-50
Measuring Piston 6A-50
Piston Pins 6A-
Rings
Piston Ring and Rail Gap 6A-50
Ring Tolerance 6A-50
Side Clearance 6A-50
Rocker Arm Assemblies 6A-42
Specifications 6A-62
Timing Chain and Gears 6A-55
Torque Specifications 6A-63
Tools 6A-64
Valve Covers 6A-42
Valves and Springs 6A-46
Valve Guides
Reaming Procedure 6A-46
Valve Lifters
Assembly 6A-42
Diagnosis 6A-44
Leak-Down Rate Checking 6A-45

GENERAL DESCRIPTION

The engine is of the overhead valve, 90° V-8 design. The cylinder bore diameter is 4.057 inches and the piston stroke is 3.385 inches, providing a piston displacement of 350 cubic inches. The engine has a compression ratio of 8.25:1. Three-quarter views of the engine are shown in Figs. 6A-45 and 6A-46.

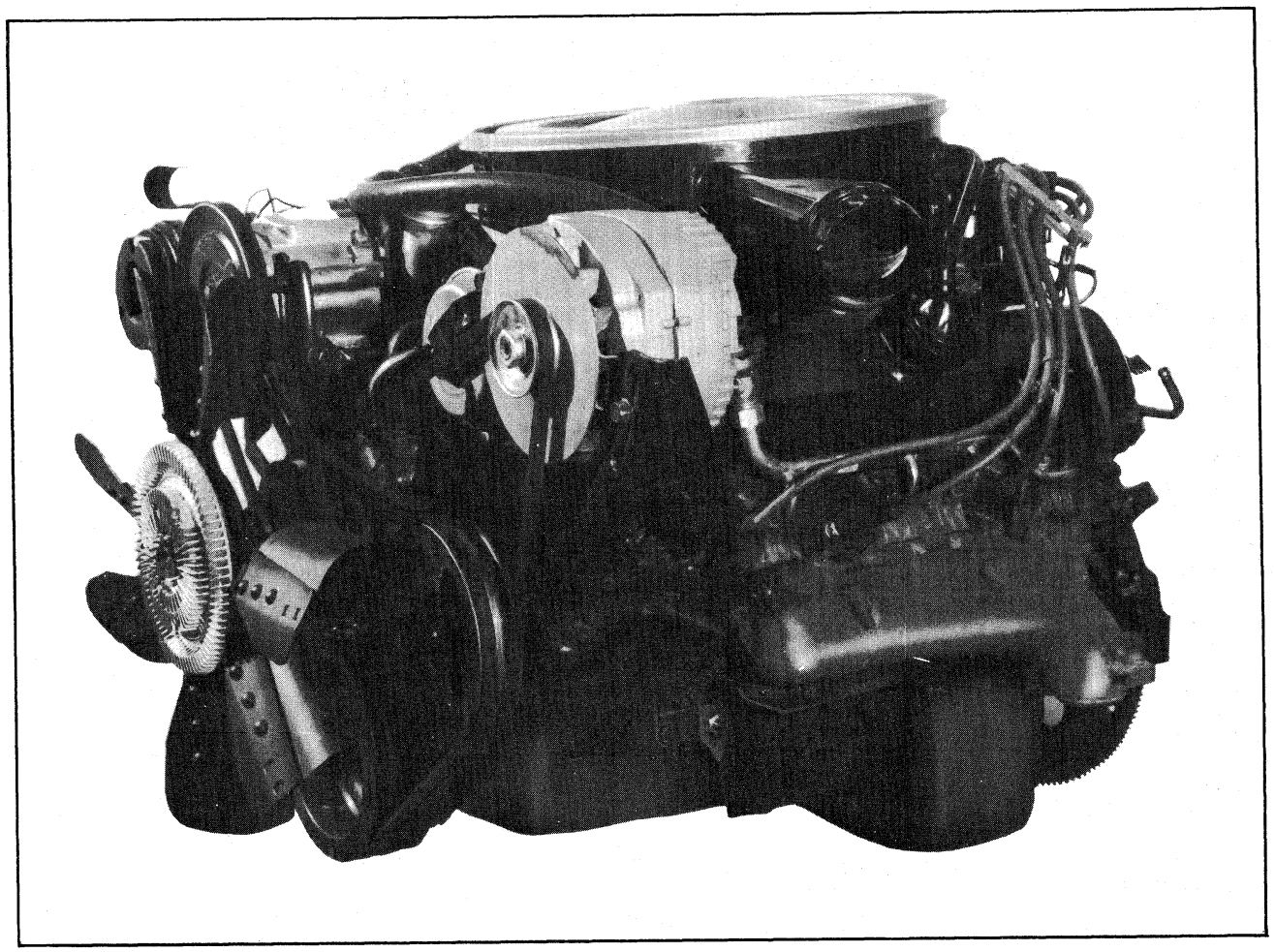


Fig. 6A-45 350 Cubic Inch Cadillac Engine

Design Features

The cast iron cylinder block is designed with two 90° cylinder banks having four cylinder bores in each bank.

Cylinder numbering is by cylinder arrangement. The left front cylinder is number one, and the right front is number two. Cylinders on the left bank have odd numbers (1, 3, 5, and 7) and those on the right bank have even numbers (2, 4, 6, and 8).

The firing order is 1-8-4-3-6-5-7-2.

The crankshaft is designed to provide a 3.385 inch stroke. The cast nodular iron crankshaft has 2.124" diameter connecting rod journals and incorporates five 2.50" diameter main bearing journals with shell-type inserts of steel-backed aluminum and steel-backed babbitt construction. End thrust of the crankshaft is taken by the center main bearing. Six counterweights are integral with the crankshaft with the harmonic balancer pressed on the front end of the crankshaft.

Connecting rods for pistons of opposite cylinders are carried side by side on the same crankpin. Shell type connecting rod bearings are steel-backed with a bearing material overlay.

The cast aluminum pistons use two compression rings and one oil ring. To provide a non-scuffing surface when the engine is new, the pistons are tin-plated.

Piston pins are press-fitted into the connecting rods. Broached groves in each piston pin bore direct oil from the cylinder wall to the piston pin to provide adequate lubrication.

The camshaft is supported by five steel-backed babbitt bearings. It is driven by the crankshaft through a timing chain at the front of the engine. Both the crankshaft and camshaft sprockets have locating marks to provide correct valve timing when the timing chain is installed. Wide camshaft lobe design assures minimum lobe wear.

A drive gear, cast as an integral part of the camshaft, meshes with the driven gear on the distributor drive shaft. The distributor drive shaft rotates in a counter clockwise direction when viewed from above. This shaft also drives the oil pump.

Hydraulic valve lifters are used to maintain zero operating clearance throughout the valve train. This arrangement assures quiet operation and eliminates the need for valve tappet adjustments. The lifters operate in guide holes bored in the cylinder block. The valve lifter plunger and lifter body are selectively fitted in matched pairs. The push rods ride in cups in the lifters and extend up through openings in the cylinder heads to the rocker arms.

A full flow type oil filter assembly incorporates a throw away type filter element and a spring loaded by-pass valve integral with the pump assembly, to assure that the engine oil supply is not interrupted if the element should become

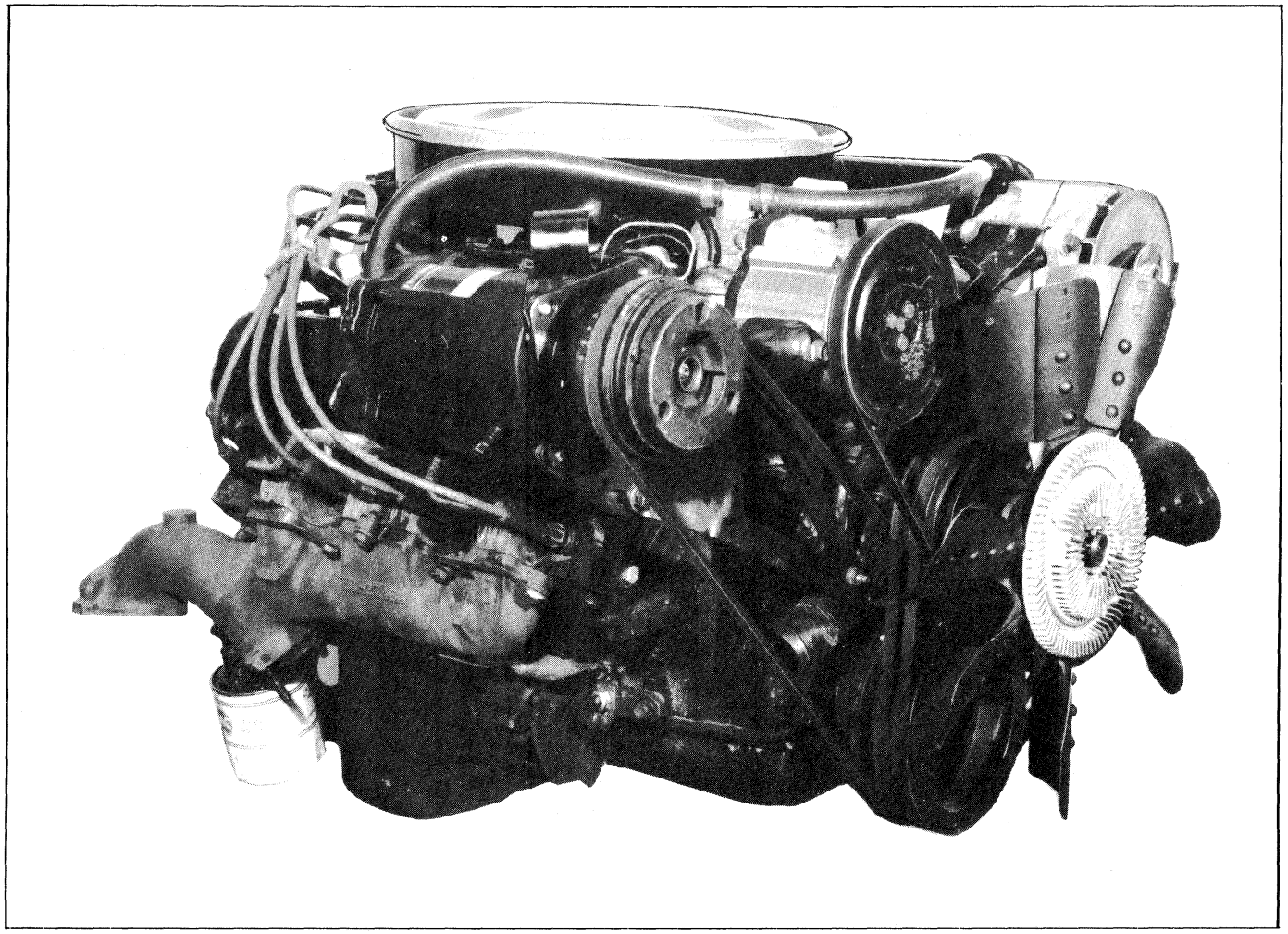


Fig. 6A-46 350 Cubic Inch Cadillac Engine

clogged.

Oil capacity of the engine crankcase is four quarts; five quarts should be added if the filter is changed.

Three engine support mounts are used; two in the front located on each side of the engine block, and one at the rear of the transmission. The front mounts are of a completely encapsulated design in that the rubber cushions in the mounts are always under compression.

The front mounts are seated on the main front cross member of the frame and secured by a nut and washer.

Engine Lubricating System (Fig. 6A-47)

The engine oil pan forms a reservoir for engine oil to provide lubrication and to operate the valve lifters. Oil pressure for lubrication is furnished by a gear type oil pump that is bolted to the rear main bearing cap and driven by the distributor through a hexagonal drive shaft.

Oil enters the pump through a screened inlet located near the bottom rear of the oil pan. The pressurized oil from the pump passes through the oil filter located on the right rear side of the engine block. The oil filter base has a by-pass valve which in the event of filter restriction will open at 5.3 to 6.3 psi. Oil then enters the right oil gallery where it is distributed to the five main bearings. The right bank valve lifters receive oil from this gallery from eight feed holes that intersect the gallery.

The five camshaft bearings are lubricated from vertical passages intersecting the main bearing oil passages. At the front main bearing a third passage connects the right main oil gallery to the left gallery which then feeds the left bank of valve lifters.

The engine oil pressure warning light switch is connected to the front of the left oil gallery. The switch is calibrated to turn on the instrument panel warning light when engine oil pressure is too low. The switch, normally closed, is set to open at 2-6 psi. The rear oil gallery plug has a .040" orifice to help purge contaminants from the gallery.

At the front end of the right gallery, a small orifice sprays oil to lubricate the timing chain.

The distributor drive gear is lubricated by oil from the left rear oil gallery.

The rocker arms and valve tips are lubricated through the hydraulic lifters and hollow push-rods. A disc valve in the lifter meters oil to the push rods.

The connecting rod bearings are oiled by constant oil flow from passages drilled through the crankshaft connecting the main journals to the rod journals. A groove around each main bearing furnishes oil to the drilled crankshaft passages.

Oil returns to the oil pan reservoir from the rocker arms through passages at each end of the cylinder heads. Oil from the valve lifter compartment returns through clearance holes in the lower portion of the compartment near the camshaft.

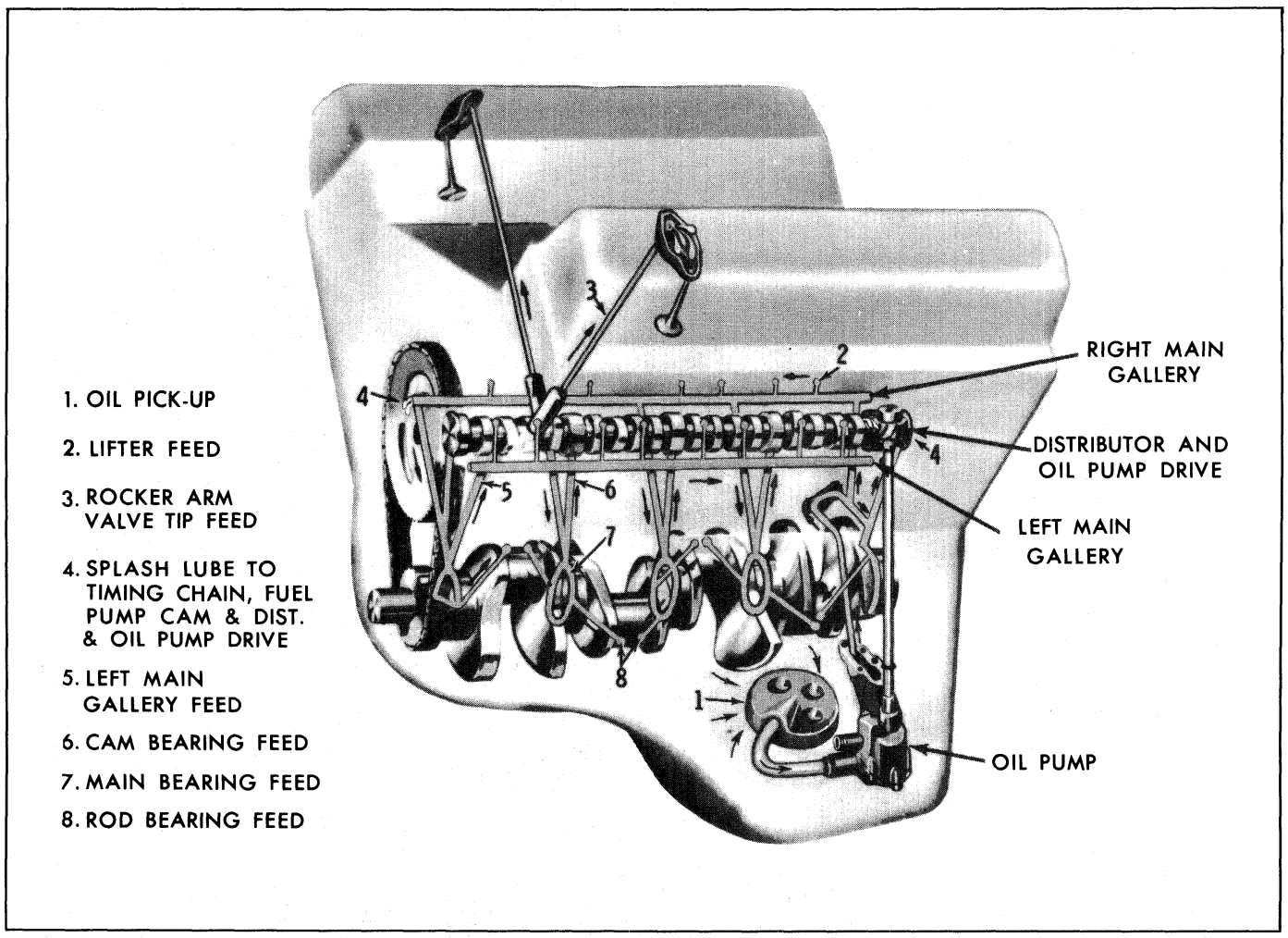


Fig. 6A-47 Engine Lubricating System

The timing chain compartment drains directly into the oil pan.

Oil is supplied to the valve lifters through a hole in the side of each lifter body which indexes with a groove and hole in the lifter plunger. Oil is then metered past the oil metering valve in the lifter, through the push-rods to the rocker arms.

When the lifter begins to ride up the cam lobe, the ball check is held against its seat in the plunger by the ball check spring which traps the oil in the base of the lifter body below the plunger. The plunger and lifter body then raise as a unit, pushing up the push-rod to open the valve. The force of the valve spring which is exerted on the plunger through the rocker arm and push-rod causes a slight amount of leakage between the plunger and lifter body. This "leak-down" allows a slow escape of trapped oil in the base of the lifter body. As the lifter rides down the other side of the cam lobe and reaches the base circle or "valve closed" position, the plunger spring quickly moves the plunger back (up) to its original position. This movement causes the ball check to open against the ball spring and oil from within the plunger is drawn into the base of the lifter. This restores the lifter to zero lash.

SERVICE PROCEDURES

Engine-Removal and Installation

a. Removal

1. Disconnect negative battery cable.
2. Raise rear of car approximately two feet, place drain pan under radiator and open petcock to drain radiator. Remove radiator cap.
3. Remove air cleaner assembly.
4. Remove hood as described in Section 2C.
5. Remove wheelhouse struts from both sides.
6. Remove three screws at top and two screws at rear securing radiator cover and remove cover.
7. Disconnect power brake hose at junction of steel line and rubber hose (rear of left cylinder head).
8. Disconnect left side branch of electrical harness at injectors, coolant sensor, oil pressure switch, HEI feed, heater turn-on switch, speed sensor, generator, etc. Position harness out of way.
9. Remove heater hose from nipple at rear of intake manifold.
10. Remove upper radiator hose and overflow hose.
11. Remove fan and clutch assembly as described on page 6B-17.
12. Remove lower radiator hose at radiator and drain hose into drain pan.

13. Remove distributor cap and secondary wiring.
14. Disconnect right side branch of electrical harness at injectors, throttle position switch, EGR solenoid, fast idle valve, air temp. sensor, compressor, MAP sensor, economy lite hose, etc.
15. Remove two ground wires from compressor bracket and position harness out of way.
16. Disconnect accelerator linkage at throttle body and position out of way. Disconnect vapor canister hose at throttle body.
17. Remove fuel inlet line from fuel rail using a back-up wrench on fuel rail and plug inlet line.

WARNING: DO NOT LOOSEN FITTINGS UNTIL THE PRECAUTIONS DESCRIBED ON PAGE 6C-97 HAVE BEEN TAKEN TO RELIEVE PRESSURE. FUEL IN SYSTEM MAY BE UNDER HIGH PRESSURE WHICH WOULD SPRAY OUT AND RESULT IN A FIRE HAZARD AND POSSIBLE PERSONAL INJURY.

18. Remove power steering hoses at steering gear and plug both hoses and gear. Secure hoses to engine.
19. Disconnect fuel return line from pressure regulator outlet fitting.
20. Partially remove air conditioning compressors as described in Section 1.
21. Raise car.
22. Remove 2 screws securing exhaust pipe to right manifold and remove pipe.
23. Remove four screws securing converter cover and remove cover.
24. Remove starter motor as described on page 6D-40.
25. Remove one screw and clip securing transmission cooler lines at oil pan.
26. Remove three screws securing flexplate to converter.
27. Remove thru bolt from each engine mount.
28. Remove exhaust crossover pipe - 2 screws at each manifold.
29. Remove screws securing engine to transmission housing.
30. Lower car.
31. Remove two screws securing heater water valve to evaporator and reposition valve out of way.
32. Install a suitable lifting fixture to engine.
33. Support transmission with a block of wood on floor jack and slowly raise engine off of mounts with chain fall. Reposition transmission support.
34. Raise engine carefully and pull forward to disengage transmission.
35. Raise engine and remove from car.

b. Installation

1. Raise transmission as high as possible using a floor jack and a block of wood.
2. Lower engine in chassis at an angle that matches transmission. Engage engine to transmission and loosely install two engine-to-transmission mounting bolts.

NOTE: During this operation use care not to damage any items in the engine compartment. Some twisting and maneuvering of the engine may be required.

3. Release the floor jack's support of the transmission.

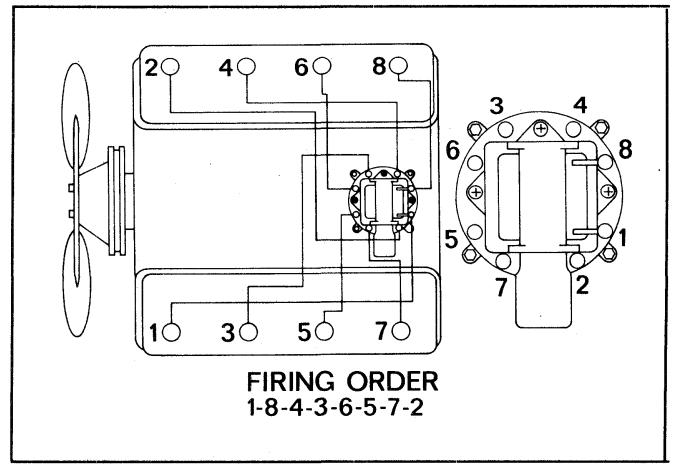


Fig. 6A-48 Cylinder Numbering

4. Lower the engine completely allowing it to seat on its mounts.
5. Remove lifting equipment.
6. Raise car on hoist.
7. Install remaining screws securing engine to transmission and tighten all screws.
8. Install engine mount thru bolts and torque to 30 ft.-lbs.
9. Install exhaust crossover pipe and secure with two screws at each manifold.
10. Install three screws securing converter to flexplate.
11. Position transmission cooler lines near oil pan and secure with one screw and clip.
12. Install starter motor as described on page 6D-40.
13. Position converter cover to transmission and secure with four screws.
14. Position exhaust pipe to right hand manifold and secure with two screws.
15. Lower car.
16. Position heater water valve to evaporator case and secure with two screws.
17. Install heater hose to fitting at rear of intake manifold.
18. Install air conditioning compressor as described in Section 1.
19. Install power steering hoses to gear.
20. Connect fuel return line to pressure regulator outlet fitting.
21. Connect accelerator linkage to throttle body and check for proper operation and for wide open throttle.
22. Install fuel inlet line to fuel rail. Using a back-up wrench, torque flare nut to 15-20 ft. lbs. refer to Page 6C-104, fuel line gaskets. Do not use teflon tape on flare nut.
23. Connect vapor hose to vapor canister.
24. Position electrical harness to engine and connect left branch to injectors, coolant sensor, oil pressure switch, speed sensor, heater turn-on switch, metal temp sensor, generator, etc.
25. Install distributor cap and secondary wiring. Refer to Fig. 6A-48 for wire routing. Connect HEI feed wire to cap.
26. Connect right side of electrical harness to injectors, throttle position switch, EGR solenoid, fast idle valve, air temp. sensor, compressor, MAP sensor, economy lite hose, etc.

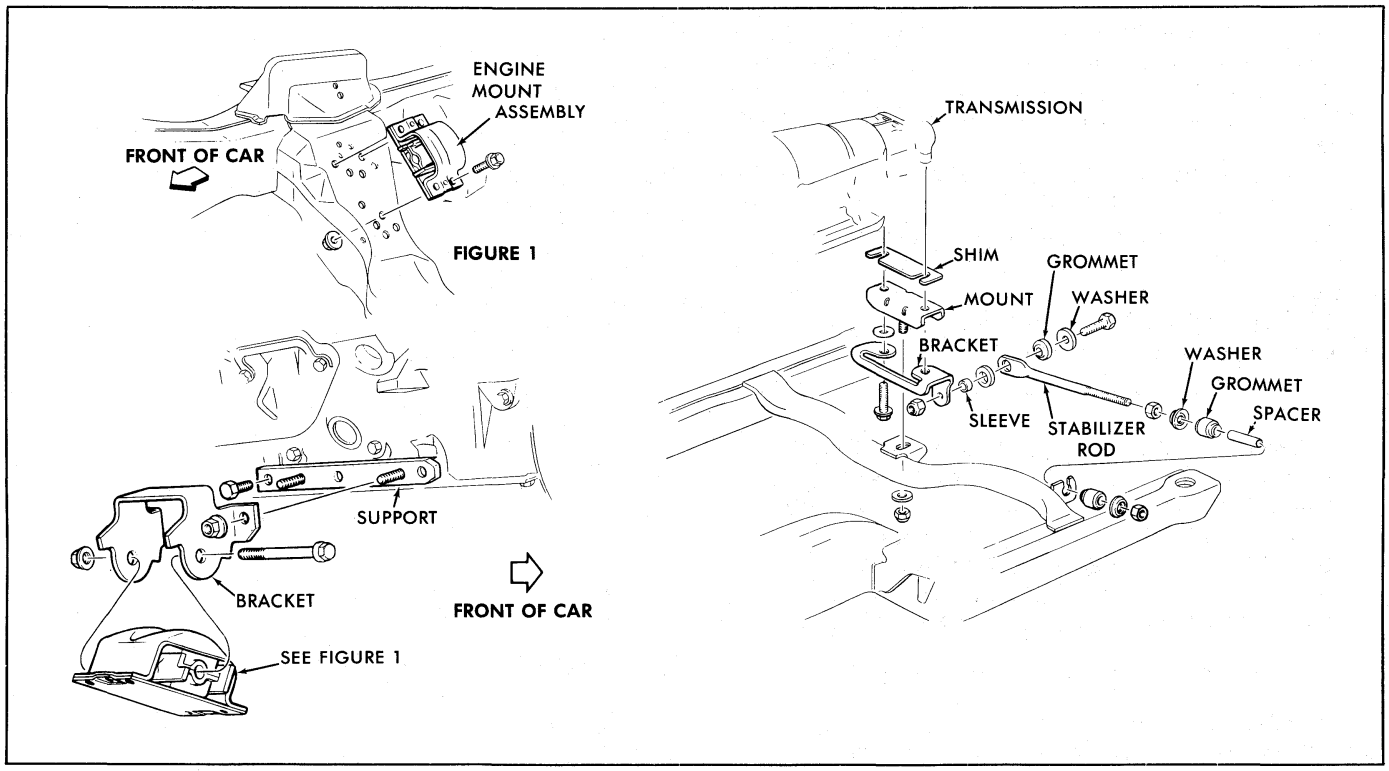


Fig. 6A-49 Engine Mounts

27. Install two ground wires to compressor bracket.
28. Position lower radiator hose to radiator and secure with new clamp.
29. Install fan and clutch assembly as described on page 6B-17.
30. Tension all drive belts as described on page 6B-18.
31. Install upper radiator hose and overflow hose.
32. Install radiator cover and secure with five screws.
33. Install power brake hose to steel tubing at rear of left cylinder head.
34. Install wheelhouse struts.
35. Install hood as described in Section 2C. Align hood.
36. Fill cooling system.
37. Connect negative battery cable.
38. Turn ignition switch ON and OFF several times to build pressure in the fuel system and check for leaks.
39. Start engine and check for proper operation.
40. Install air cleaner.

Engine Mount

a. Removal

1. Remove three screws at top and two screws at rear securing radiator cover and remove radiator cover.
2. Remove wheelhouse struts from both sides.
3. Raise car.
4. Remove exhaust crossover pipe.
5. Remove thru bolt from each engine mount.
6. Support car with stands at each front frame horn.
7. Apply pressure (hoist, jack, screw jack, etc.) to oil pan. Apply pressure over entire bottom of sump with no concentration of pressure due to bumps or knobs on lifting device.
8. Raise engine to a point where support assembly may be removed from block and remove support by removing 2 screws, Fig. 6A-49.
9. Working thru openings between lower control arm and frame, remove three nuts and bolts securing engine mount to frame and remove mount, Fig. 6A-49.

b. Installation

1. Position engine mount to frame as shown in Fig. 6A-49. Observe proper holes.
2. Install three bolts thru mount and frame.
3. Working thru openings between lower control arm and frame, install lock nuts over bolts installed in step 2.
4. Torque to 30 ft.-lbs.
5. Position support assembly to block and secure with two screws. Torque to 60-75 ft.-lbs.
6. Lower engine and install thru bolts. Torque to 30 ft.-lbs.
7. Install exhaust crossover pipe.
8. Lower car.
9. Install radiator cover and secure with five screws.
10. Install wheelhouse strut at each side.

Transmission Mount

a. Removal

1. Raise car on hoist.
2. Remove locknut securing transmission mount to crossmember, Fig. 6A-49.
3. Remove screw securing stabilizer rod to mount bracket, Fig. 6A-49.
4. Remove two screws securing transmission mount to transmission.
5. Raise transmission and remove mount.

b. Installation

1. With transmission high enough to install mount, position mount to crossmember.
2. Position stabilizer bracket between transmission mount and transmission, Fig. 6A-49.
3. Lower transmission and install two screws securing mount and bracket to transmission.
4. Install locknut securing mount to crossmember. Torque nut to 50 ft.-lbs.
5. Move stabilizer rod into position and secure with one screw.

Intake Manifold

a. Removal

1. Disconnect negative battery cable, remove air cleaner and crankcase filter.
2. Disconnect throttle cable and cruise control linkage at throttle body. Remove cable from bracket and position out of way.
3. Disconnect coolant temperature tell-tale switch, HEI lead wire, speed sensor connector and injector wires.
4. Disconnect injector wires, EGR solenoid leads, throttle position switch, fast idle valve, air temperature sensor connector and MAP sensor hose. Disconnect two ground wires from compressor bracket.
5. Disconnect electrical harness from fuel rail brackets and position out of way.
6. Disconnect two vacuum hoses from throttle body to TVS switch.
7. Disconnect vacuum hoses and power brake pipe from rear of throttle body. Use a back-up wrench on power brake fitting.
8. Disconnect fuel line from fuel rail. Use a back-up wrench on fuel rail.

WARNING: DO NOT LOOSEN FITTINGS UNTIL THE PRECAUTIONS DESCRIBED ON PAGE 6C-100 HAVE BEEN TAKEN TO RELIEVE PRESSURE. FUEL IN SYSTEM MAY BE UNDER HIGH PRESSURE WHICH WOULD SPRAY OUT AND RESULT IN A FIRE HAZARD AND POSSIBLE PERSONAL INJURY.

9. Remove PCV valve from rocker cover and position out of way.
10. Remove spark plug leads and position out of way.
11. Drain radiator and disconnect upper radiator hose, thermostat by-pass hose and heater hose at rear of manifold.
12. Partially remove air conditioning compressor as described in Section 1.
13. Remove fuel return hose from pressure regulator.
14. Remove mounting screws and remove manifold. Do not pry against or lift manifold by the fuel rails or their mounting brackets.
15. Remove manifold gaskets.

b. Installation

1. Coat both sides of gasket sealing surface that seal the intake manifold to the head with 1050026 Sealer or equivalent and position intake manifold gasket. Be careful not to use too much sealer near injector tips.
2. Install end seals, making sure that ends are positioned under cylinder heads as shown in Fig. 6A-50.

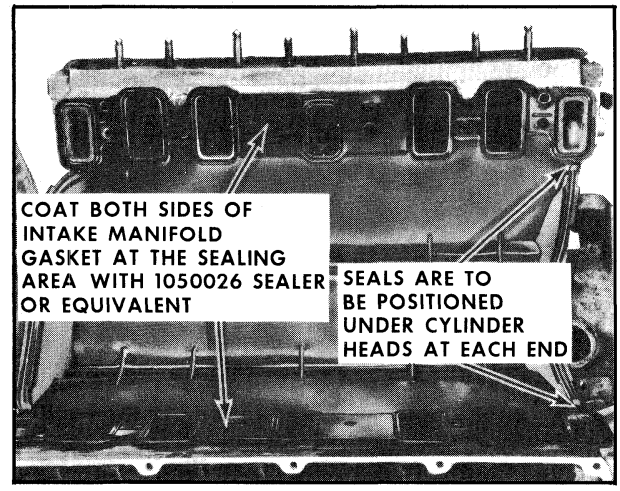


Fig. 6A-50 Intake Manifold Gasket

3. Position intake manifold on engine and connect thermostat bypass hose to water pump.
4. Install intake screws and torque to 15 ft.-lbs. Following sequence shown in Fig. 6A-51. Retorque in sequence to 40 ft.-lbs.
5. Install A/C compressor as described in section 1.
6. Install distributor cap and spark plug leads. Wire routing is shown in Fig. 6A-48.
7. Connect fuel return line to pressure regulator using a new hose clamp.
8. Secure wiring harness to injector brackets and make the following connections: Red-black injector leads to cylinders 1, 2, 7 and 8; white-black injector leads to cylinders 3, 4, 5 and 6; dark blue/black leads to fast idle valve (install grommet in throttle body); brown-black leads to EGR solenoid and orange-black/red lead to air temperature sensor. Connect throttle position switch connector.
9. Connect vacuum hoses to front and rear of throttle body as shown in Fig. 6C-14 and 15.
10. Install PCV valve in rocker cover.
11. Secure wiring harness to injector brackets and make the following connections: green wire to coolant tell-tale switch; HEI lead wire and module connector; speed sensor connector (distributor trigger); connect two ground wires to compressor bracket.
12. Connect fuel line to fuel rail using a back-up wrench on the fuel rail while tightening. Do not use teflon tape on flare nut. Refer to page 6C-104 for use of fuel fitting gaskets.
13. Position throttle cable to bracket and secure throttle cable and cruise control cable to throttle body with clips.
14. Secure upper radiator hose, thermostat bypass hose and heater hose at rear of manifold.
15. Refill cooling system.
16. Connect battery cable.
17. Turn ignition switch ON and OFF several times to build up fuel rail pressure and check for fuel leaks.
18. Start engine. Check for leaks and for proper operation.
19. Install air cleaner and crankcase breather.

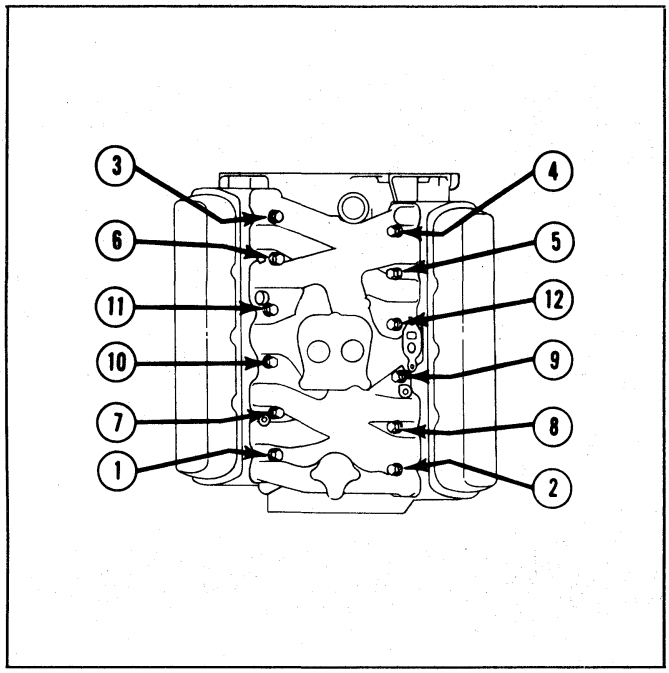


Fig. 6A-51 Intake Manifold Torque Sequence

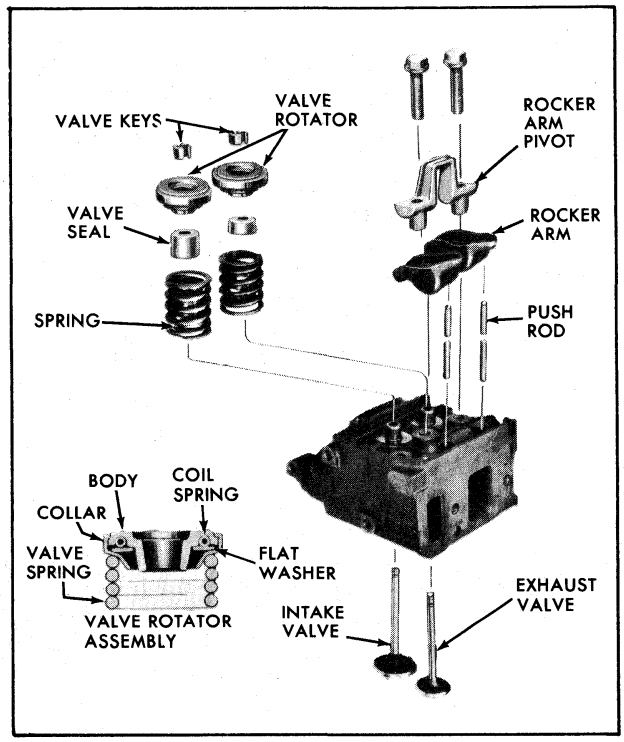


Fig. 6A-52 Cylinder Head-Exploded View

Valve Cover

Valve cover gaskets are not used in production of service on the 350 cubic inch engine. Sealer 1051435 or equivalent should be used.

Torque valve cover screws to 7 ft.

Rocker Arm Assemblies

a. Removal

1. Remove valve cover.
2. Remove rocker arm, flanged bolts, pivot and rocker arms, Fig. 6A-52.

NOTE: Remove each set (one set per cylinder) as a unit.

b. Installation

1. Position a set of rocker arms (for one cylinder) in the proper location.
2. Lubricate wear points with 1050169 Lubricant or equivalent and install the pivots.
3. Install the hardened flanged bolts and tighten alternately. Torque bolts to 25 ft. lbs.

Valve Lifters

a. Removal

NOTE: Valve lifters and push-rods should be kept in order so they can be reinstalled in their original position. Some engines will have both standard and .010" oversize valve lifters, the .010" oversize lifter is etched "O" on the side of the lifter. The cylinder block will also be marked if the oversize lifter is used. Fig. 6A-53.

1. Remove intake manifold and gasket as described on page 6A-41.
2. Remove valve covers, rocker arm assemblies and push-rods.
3. If lifters are varnished, apply carburetor cleaning solution to lifter body. Allow five minutes for solution to remove varnish.

CAUTION: *Carburetor cleaning solvent should be used in a well ventilated room. Avoid contact with skin and prolonged breathing of fumes.*

4. Remove lifters. Use of Tool J-3049 will aid in removal of varnished lifters (Fig. 6A-54).

b. Disassembly (Fig. 6A-55)

1. Remove retainer ring with small screwdriver.
2. Remove push-rod seat and oil metering valve.
3. Remove plunger and plunger spring. If plunger is stuck tight, allow lifter to soak in carburetor cleaning solvent for approximately five minutes, then remove.
4. Remove ball check retainer from plunger, then remove ball and spring.

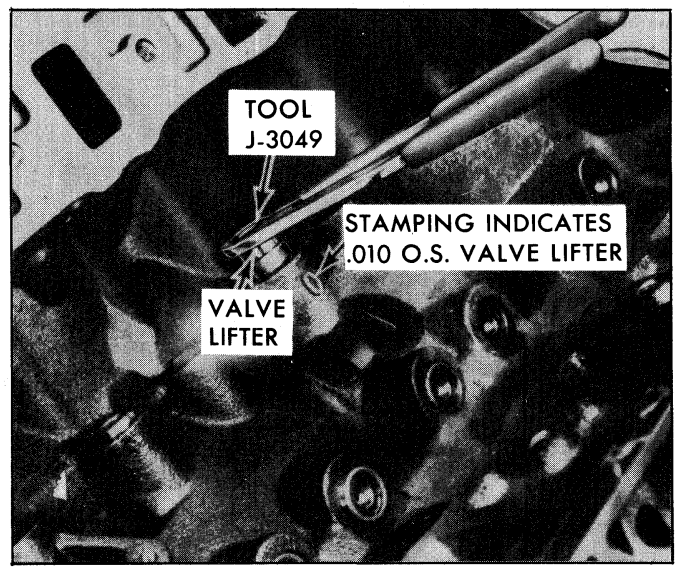


Fig. 6A-53 Removing Valve Lifter

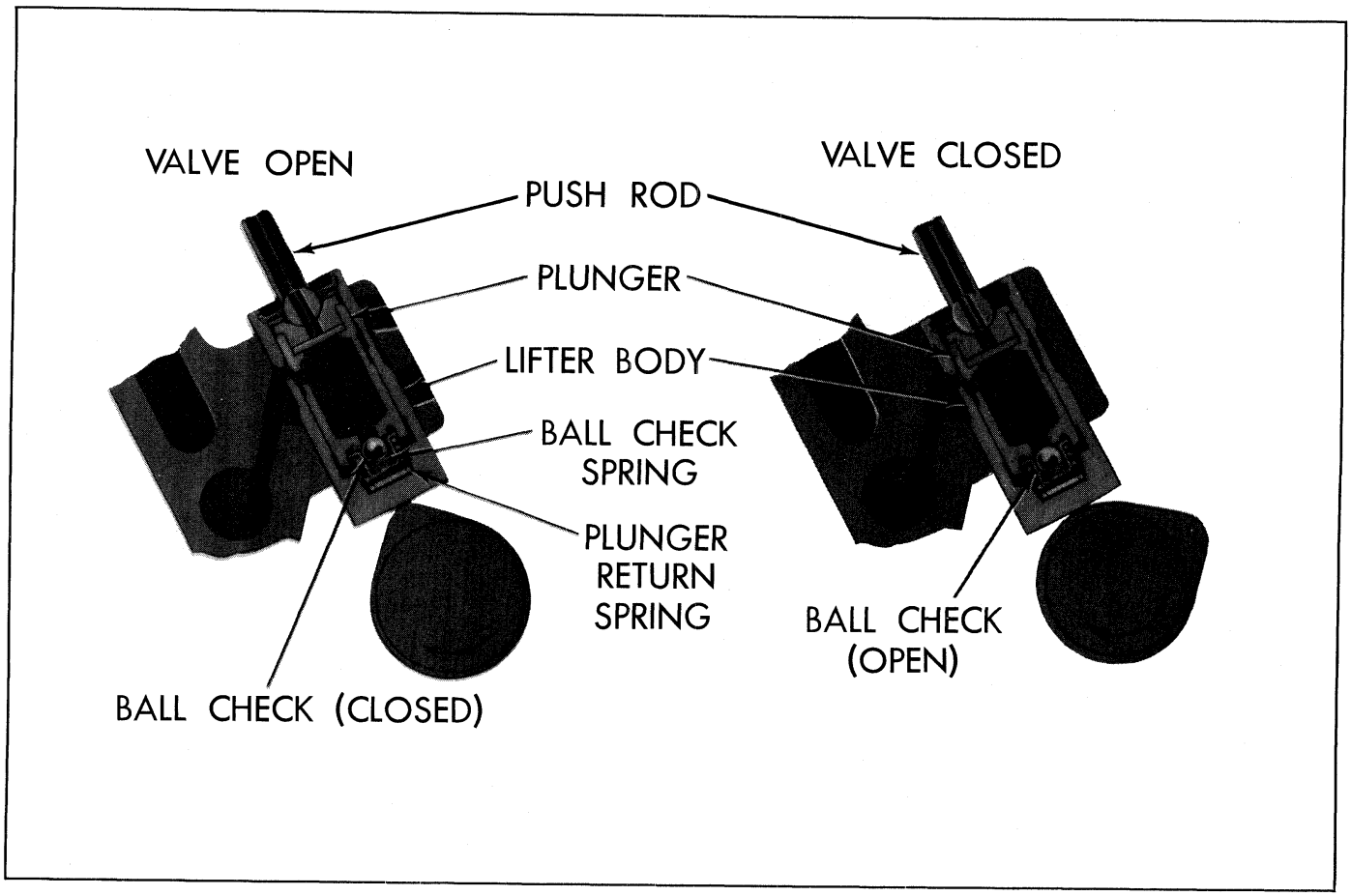


Fig. 6A-54 Valve Lifter Cutaway View

c. Cleaning and Inspection

After lifters are disassembled, all parts should be cleaned in clean solvent. A small particle of foreign material under the ball check valve will cause malfunctioning of the lifter. Close inspection should be made for nicks, burrs or scoring of parts. If either the body or plunger is defective, replace with a new lifter assembly.

Whenever lifters are removed, check the lifter foot for abnormal wear as follows:

1. Place a straight edge across the lifter foot.

NOTE: Lifter foot must be clean and dry.

2. While holding the lifter at eye level, check for light between the straight edge and lifter foot.

3. If light indicates a concave surface of the lifter foot, the lifter should be replaced and the camshaft inspected for wear. Wear at the CENTER of the cam base circle is NORMAL. The camshaft should be replaced ONLY when wear is present across FULL WIDTH of cam base circle. Full wear across the nose of the cam is normal.

d. Assembly

1. Assemble ball check, spring and retainer into plunger, (Fig. 6A-55). Make sure retainer flange is pressed tight against bottom of recess in plunger.

2. Install plunger spring over ball check retainer.

3. Hold plunger with spring up and insert into lifter body. Hold plunger vertically to prevent cocking spring.

4. Assemble oil metering valve and push rod seat and seat retaining ring in groove.

e. Installation

NOTE: Prime new lifters by working lifter plunger while submerged in new engine oil. Lifter could be damaged when starting engine if dry.

1. Install lifters and push-rods into original position in cylinder block. See note under Removal.

2. Install manifold gaskets and manifold as described on page 6A-41.

3. Position rocker arms, pivots and bolts on cylinder head shown in Fig. 6A-52.

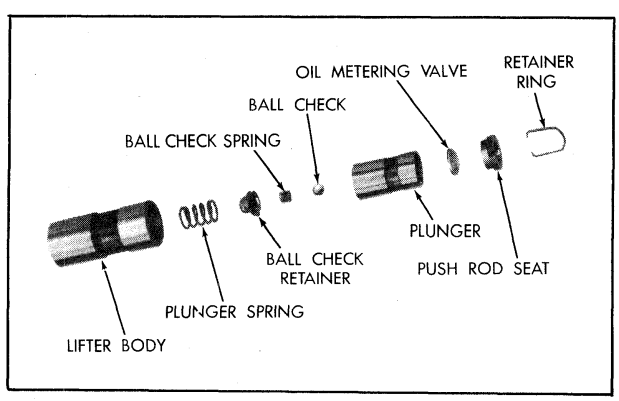


Fig. 6A-55 Valve Lifter - Exploded View

4. Install valve covers, connect spark plug wires and install air cleaner.

Valve Lifter Diagnosis

1. Momentarily Noisy When Car Is Started:

This condition is normal. Oil drains from the lifters which are holding the valves open when the engine is not running. It will take a few seconds for the lifter to fill after the engine is started.

2. Intermittently Noisy on Idle Only, Disappearing When Engine Speed is Increased:

Intermittent clicking may be an indication of a flat or pitted ball, or it may be caused by dirt.

Correction: Clean the lifter and inspect. If ball is defective, replace lifter.

3. Noisy At Slow Idle or With Hot Oil, Quiet With Cold Oil or As Engine Speed is Increased:

Insert a .015" feeler gauge between the rocker arm and valve stem. If noise momentarily disappears and then reappears after a few seconds with the feeler still inserted, it is an indication that the lifter leak-down rate is too fast.

Correction: The lifter must be replaced.

4. Noisy at High Car Speeds and Quiet at Low Speeds.

a. High oil level - Oil level above the "Full" mark allows crankshaft counterweights to churn the oil into foam. When foam is pumped into lifters, they will become noisy since a solid column of oil is required for proper operation.

Correction: Drain oil until proper level is obtained.

b. Low oil level - Oil level below the "Add" mark allows the pump to pump air at high speeds which results in noisy lifters.

Correction: Fill until proper oil level is obtained.

c. Oil pan bent on bottom or pump screen cocked, replace or repair as necessary.

5. Noisy at Idle Becoming Louder as Engine Speed is Increased to 1500 rpm. This noise is not connected with lifter malfunction. It becomes most noticeable in the car at 10 to 15 mph "L" range, or 30 to 35 mph "D" range and is best described as a harshy sound. At slow idle, it may be entirely gone or appear as a light ticking noise in one or more valves. It is caused by one or more of the following:

1. Badly worn or scuffed valve tip and rocker arm pad.
2. Excessive valve stem to guide clearance.
3. Excessive valve seat runout.
4. Off square valve spring.
5. Excessive valve face runout.
6. Valve spring damper clicking on rotator.

7. To correct this condition remove valve covers and while listening with a stethoscope, locate noisy valves by increasing engine speed slightly above idle, about 1500 rpm. With gloved hand, push side-ways on valve spring. Noise will change, either becoming louder or disappearing completely. Some noise will be present in all valve locations. It is necessary to determine which are actually responsible for the noise.

a. Occasionally this noise can be eliminated by rotating the valve spring and valve. Crank engine until noisy valve is off its seat. Rotate spring. This will also rotate valve. Repeat until valve becomes quiet. If correction is obtained, check for an off square valve spring. If spring is off square more than 1/16" in free position, replace spring. (Fig. 6A-56).

b. Check for excessive valve stem to guide clearance. If necessary, correct as required.

7. Valves Noisy Regardless of Engine Speed.

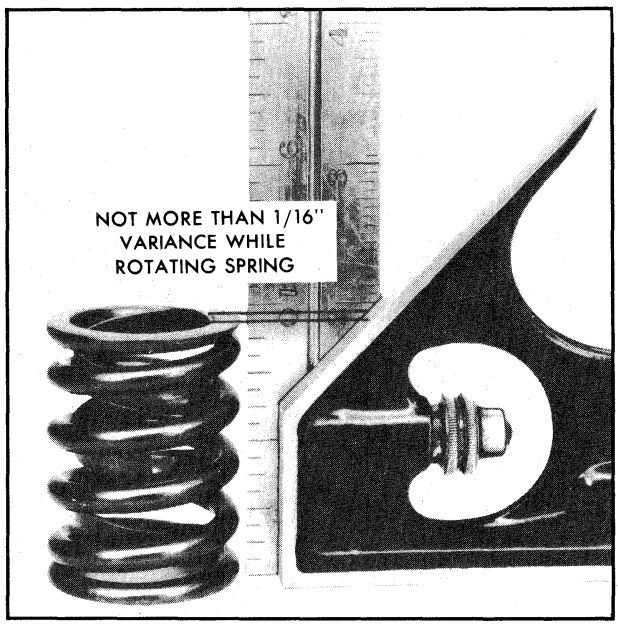


Fig. 6A-56 Checking Valve Spring

This condition can be caused by foreign particles or excessive valve lash.

8. To correct this condition:

a. With transmission in Park and parking brake on, run the engine at a moderate speed.

If this method does not quiet the lifter, strike the rocker arm above the push-rod with a mallet while the engine is idling. This method of correction has proven successful for dislodging a foreign particle which is preventing the ball from seating properly.

b. Check for valve lash by turning engine so the piston in that cylinder is on top dead center of firing stroke. If valve lash is present, the push-rod can be freely moved up and down a certain amount with rocker arm held against valve.

Valve lash indicates one of the following:

1. Worn push-rod.
2. Worn rocker arm.
3. Lifter plunger stuck in down position due to dirt or varnish.
4. Defective lifter.

Checking of the above four items:

1. Observe upper end of push-rod. Excessive wear of the spherical surface indicates one of the following conditions.

a. Improper hardness of the push-rod ball. The push-rod and rocker arm must be replaced.

b. Improper lubrication of the push-rod. The pushrod and rocker arm must be replaced. The oiling system to the push-rod should be checked.

2. If push-rod appears in good condition and has been properly lubricated, replace rocker arm and recheck valve lash.

3. If valve lash exists and push-rod and rocker arm are okay, trouble is in the lifter. Lifter should be replaced.

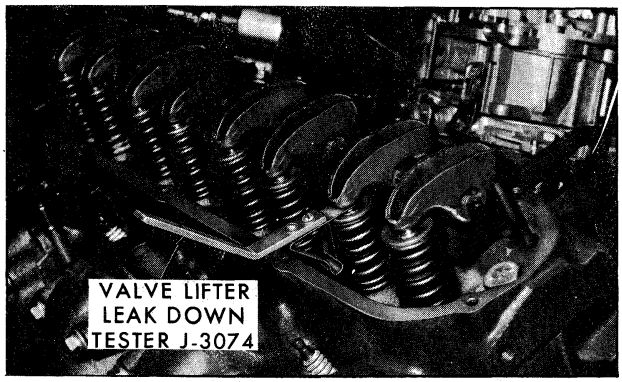


Fig. 6A-57 Checking Valve Lifter Leak-Down Rate - Typical

Valve Lifter Leak-Down Rate Checking

The valve Lifter Leak-Down Rate Tester, J-3074, is used to obtain a comparison of leak-down rates of hydraulic valve lifters without removing them from the engine. With this tool, a feeler gage of a given thickness is placed between the rocker arm and the valve stem, causing valve spring pressure to force oil out of the lifter. A spring, attached to the tool and compressed against the valve spring retainer ejects the feeler gage when the lifter has leaked down enough to allow the valve to seat. By observing the length of time required by each lifter to leak-down the thickness of the feeler gage, a faulty lifter or lifters can be easily located.

Use the following procedure:

1. Operate engine to allow lifters to fill with oil.
2. Turn off engine. Remove distributor cap and rotate crankshaft so that rotor is at No. 1 firing position.
3. Remove air cleaner.
4. Disconnect negative battery cable.
5. Disconnect spark plug wires at plugs and position out of way.
6. Remove rocker arm covers.
7. Check each lifter listed in following table as shown in Fig. 6A-57.

Rotor at No. 1 firing position.
Check:

Rotor at No. 1 firing position.
Check:

1 Intake	1 Exhaust
2 Intake	3 Exhaust
5 Intake	5 Exhaust
7 Intake	6 Exhaust
8 Intake	8 Exhaust

8. Insert feeler gage of tool between valve stem and rocker arm and at the same time, compress tool "popout" spring to its stock against valve spring retainer, Fig. 6A-52.

NOTE: Install tool as quickly as possible to eliminate any unnecessary lifter leak-down.

9. Note interval of time during which tool is held in place by valve spring pressure. The noisy lifter or lifters will have the shortest leak-down time.
10. Connect negative battery cable, install distributor cap, connect spark plug wires, and operate engine to allow lifters again to fill up with oil.
11. Turn off engine, remove distributor cap and rotate crankshaft so that rotor is at No. 6 firing position. Disconnect spark plug wires and negative battery cable.
12. Check each lifter listed in the following table:

Rotor at No. 6 firing position.
Check:

Rotor at No. 6 firing position.
Check:

3 Intake	5 Exhaust
4 Intake	6 Exhaust
6 Intake	7 Exhaust

13. Install rocker arm covers.
14. Install distributor cap.
15. Install air cleaner.
16. Connect negative battery cable.
17. Operate engine to obtain operating temperature and retorque rocker arm cover screws to 7 ft.lbs.

Cylinder Head

a. Removal

1. Drain radiator. By raising the rear wheels at least 24", the block will drain enough coolant to remove the heads.
2. Remove intake manifold as described on page 6A-41.
3. Remove exhaust manifold.
4. Remove valve cover.

NOTE: Loosen or remove any accessory brackets which interfere.

5. Remove rocker arm bolts, pivots, rocker arms and push rods.

NOTE: Scribe pivots and keep rocker arms separated so they can be installed in their original locations.

6. Remove cylinder head bolts and remove cylinder head.

b. Installation

1. Head gaskets are a special composition gasket that must be used WITHOUT a sealer. These gaskets are to be installed with the contrasting color stripe facing "up". Fig. 6A-58.
2. Clean and dip cylinder head bolts in engine oil, install bolts according to length as shown in Fig. 6A-59. Torque

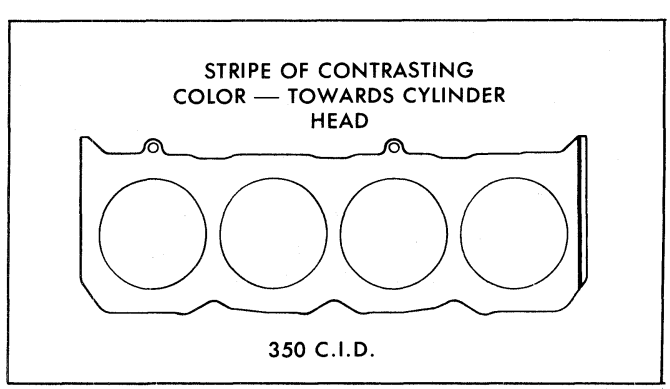
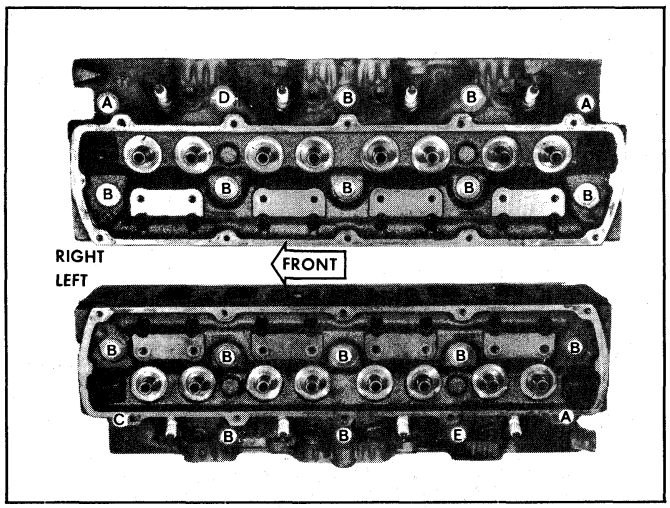


Fig. 6A-58 Cylinder Head Gasket



Bolt Location	Length
A (Bolt)	2.96 (Short)
B (Bolt)	4.16 (Long)
C (Bolt/Stud Head)	2.96 (Short)
D (Bolt/Stud Head)	4.16 (Long)
E (Bolt-Special)*	4.16 (Long)*

*This special bolt has an extra thick hex head which is drilled and tapped to accept the A/C blower turn-on switch.

Fig. 6A-59 Location of Cylinder Head Bolts

bolts to 100 ft.lbs. in sequence shown, then re-torque in sequence to 130 ft.lbs. Fig. 6A-60.

Valves and Springs with Head Removed

a. Removal

1. Remove valve keys by compressing valve spring with a tool such as J-8062.

2. Remove valve spring rotators or retainers and springs.

3. Remove oil seals from valve stems.

4. Remove valves. Keep valves separated so they can be installed in their original locations.

b. Installation

1. Install valves in their respective guides.

2. Install new oil seals over valve stem. Position seals down as far as possible on valve stem. The seals will correctly position themselves when the engine is started.

***Letter located on underside of valve head. The paint code is used for production identification and may or may not be found depending upon car mileage. All valves are aluminized.**

3. Position valve springs over valve stems.

4. Install valve rotators then compress springs with tool J-8062 and install valve stem keys.

5. Check valve springs and keys to be sure they are properly seated.

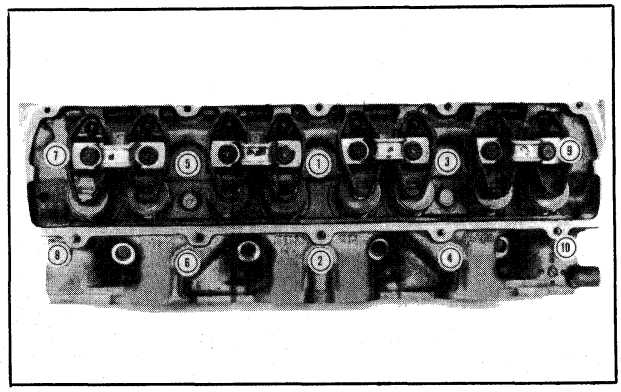


Fig. 6A-60 Cylinder Head Torque Sequence

Reconditioning Valves

When reconditioning valves and valve seats, clean carbon from cylinder heads and valves using care not to gouge or scratch machined surfaces. A soft wire brush is suitable for this purpose. Whenever valves are replaced or new valves installed, the valve seats must be reconditioned, Fig. 6A-61.

Narrow the valve seats to the specified width.

NOTE: This operation is done by grinding the portside with a 30° stone to lower the seat and a 60° stone to raise the seat.

See "engine specification" chart for valve seat width.

NOTE: Exhaust valve seats are induction hardened and must be ground, not cut.

If valve guide bores are worn excessively, they can be reamed oversize. This will require replacement of the valves with oversize stems. The guide bores should be reamed before grinding the valve seats. Valve clearance in guide bore should be .001" to .004". The following reamers are available:

If a standard valve guide bore is being reamed, use the

VALVE SEAL IDENTIFICATION

Intake	
Std. - .005" O.S.	Gray Colored
.010" - .013" O.S.	Orange Colored
Exhaust	
Std. - .005" O.S.	Ivory Colored
.010" - .013" O.S.	Blue Colored

(NOTE: Inspect seal for cracks after installation.)

TYPE	PAINT CODE	*FORGED LETTER	DIAMETER HEAD	VALVE FACE ANGLE
Intake	Yellow	O9A S9A	1.875"	44°
Exhaust	None	E7A T7A	1.622"	30°

*Letter located on underside of valve head. The paint code is used for production identification and may or may not be found depending upon car mileage. All valves are aluminized.

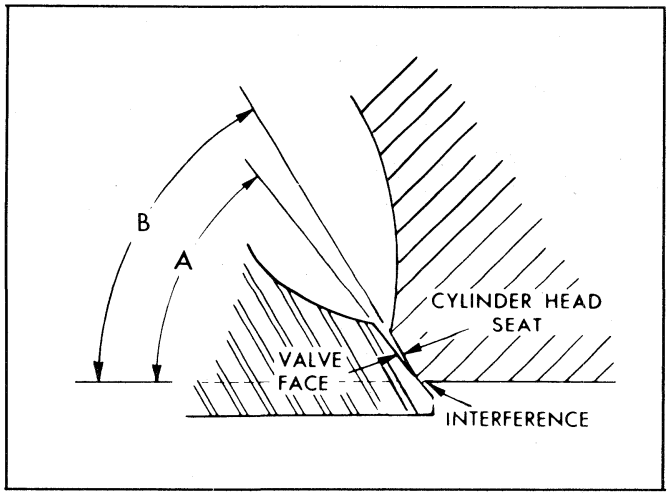


Fig. 6A-61 Relation of Valve and Seat Angles

.003" or .005" oversize reamer. For the .010" oversize valve guide bore, use the .013" oversize reamer. If too large a reamer is used and the spiraling is removing, it is probable that the valve will not receive the proper lubrication.

Occasionally a valve guide bore will be oversize as manufactured. These are marked on the inboard side of the cylinder heads on the machined surface just above the intake manifold surface, Fig. 6A-62. The markings are visible without removing any parts other than the air cleaner assembly. Before removing the cylinder heads to perform service to either the valves or valve guide bores, the cylinder heads should be inspected to determine if these markings are present. If no markings are present, the guide bores are standard. If oversize markings are present, any valve replacement will require an oversize valve. If the oversize marking is present, only that particular bore would be oversize, not all bores in that cylinder head. Service valves are available in five different stem diameters: Standard, .003" oversize, .005" oversize, .010" oversize, and .013" oversize. Oversize valve stems require the use of oversize valve stem oil seals, refer to page 6A-46.

Before attempting to ream the valve guide bores they should be cleaned.

This procedure to ream valve guide bores using Tool is shown in Fig. 6A-63. Use care to hold reamer straight in

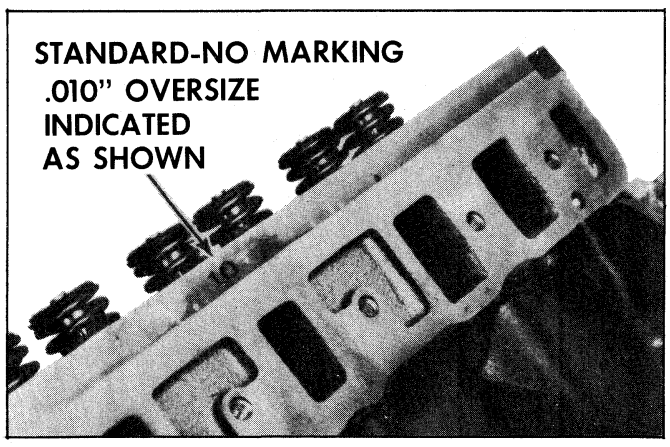


Fig. 6A-62 Valve Guide Bore Marking

Size	Tool Number
+.003" (.346")	J-5830-1
+.005" (.348")	J-6621
+.013" (.356")	J-5830-7

valve guide bore.

Replacing Valve Spring (Head On Engine)

To replace a worn or broken valve spring without removing the cylinder head proceed as follows:

a. Removal

1. Remove rocker arm assemblies.
2. Remove spark plug and install a suitable air adapter into the spark plug opening and apply air pressure into spark plug hole and attach to an air hose to hold the valve against its seat.
3. Install Tool J-26220. Compress the valve spring until valve keys are accessible, then remove keys, valve rotators and springs.

NOTE: If valve spring does not compress, tap tool with a hammer to break bind at rotator and keys.

b. Checking Rotators

The rotators cannot be disassembled and require replacement only when they fail to rotate the valve.

Rotator action can be checked by applying a daub of paint across the top of the body and down the collar. Run engine approximately 1500 rpm, there should appear to be motion between the body and collar, the body will appear to "walk" around the collar. Rotator action can be either clockwise or counterclockwise, sometimes on removal and reinstallation; the direction of rotation will change but this does not matter so long as it rotates.

Anytime the valves are removed for service the tips should be inspected for improper pattern which could

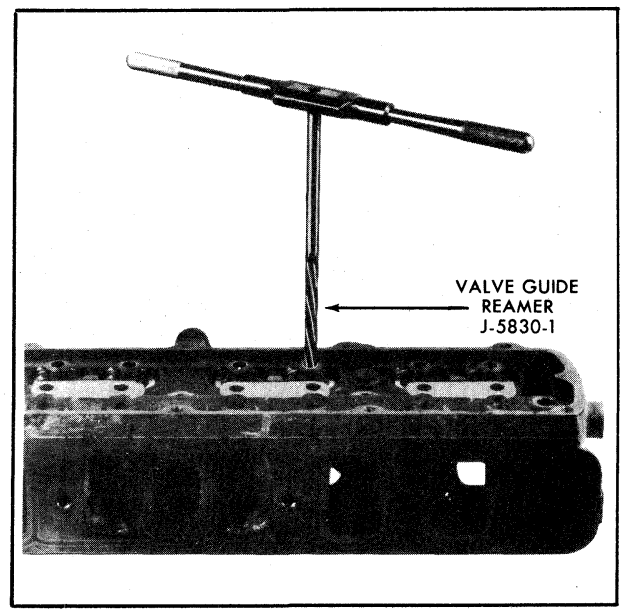


Fig. 6A-63 Reaming Valve Guide Bores

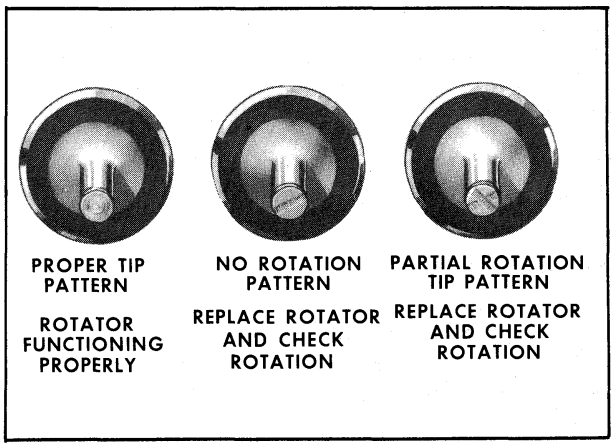


Fig. 6A-64 Valve Stem Wear

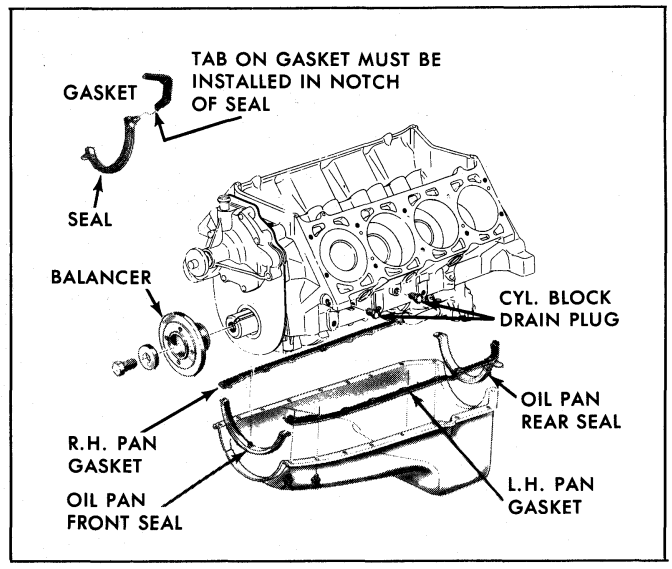


Fig. 6A-65 Oil Pan Assembly

indicate valve rotator malfunction, Fig. 6A-64.

c. Installation

1. Install valve spring and rotator. Using Tool J-26220, compress the valve spring until the valve keys can be installed.
2. Install spark plugs. Torque 25 ft.lbs.
3. Install rocker arm assemblies.

Oil Pan

a. Removal

1. Remove wheelhouse struts from right and left fenders.
2. Remove five screws securing radiator cover and remove cover.
3. Raise car.
4. Remove thru bolt from each front engine mount.
5. Remove four nuts, 2 each side, securing exhaust crossover pipe to manifold and remove pipe.
6. Remove starter motor as described on page 6D-40.
7. Remove four screws securing converter cover to transmission case and remove converter cover.
8. Remove oil pan attaching screws.
9. Raise engine as far as necessary to remove oil pan by placing a screw jack under the crankshaft pulley.

b. Installation

1. Apply sealer (1050026 or equivalent) to both sides of oil pan gaskets and install on block.
2. Install front and rear oil pan seals (rubber) to block and front cover. Tab on oil pan gasket must be installed under seal on front cover, Fig. 6A-65.
3. Wipe lubricant 1050169 or equivalent on seal area and position pan to block.
4. Install oil pan screws and torque to 10 ft.lbs.
5. Lower engine into place on its mounts.
6. Position converter cover to transmission housing and secure with four screws.
7. Install starter motor as described on page 6D-40.
8. Position exhaust crossover pipe to manifolds and secure with four nuts.
9. Install engine mount thru bolts and torque to 30 ft.lbs.
10. Lower car.
11. Position radiator cover over radiator and secure with five screws.
12. Install wheelhouse struts at each wheelhouse.

Oil Pump

a. Removal

1. Remove oil pan as described on page 6A-48.
2. Remove the oil pump to rear main bearing cap attaching bolts, then remove pump and drive shaft extension.

b. Disassembly

1. Remove the oil pump drive shaft extension, Fig. 6A-66. Do not attempt to remove the washers from the drive shaft extension. The drive shaft extension and washers must be serviced as an assembly if the washers are not 1-11/32" from end of shaft.
2. Remove the cotter pin, spring and the pressure regulator valve.

NOTE: Position thumb over pressure regulator bore before removing cotter pin, as the spring is under pressure.

3. Remove the oil pump cover attaching screws and remove the oil pump cover and gasket.
4. Remove the drive gear and idler gear from the pump body.

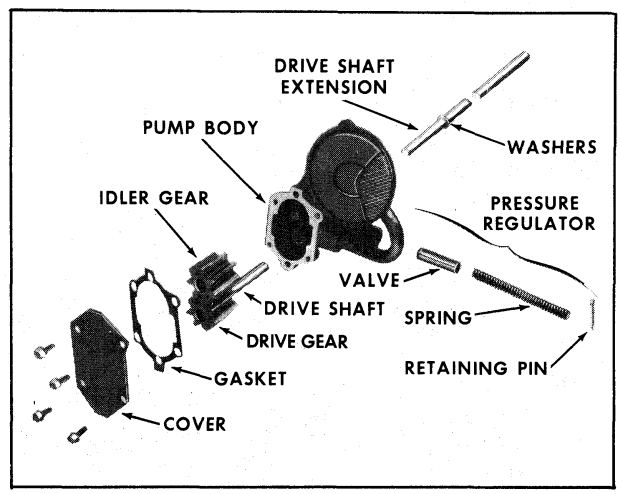


Fig. 6A-66 Oil Pump Exploded View

c. Inspection

Check the gears for scoring or other damage. If they are damaged, new gears should be installed. During assembly, the gear end clearance should be gauged. Proper end clearance is .0025" to .0065". Also check the pressure regulator valve, valve spring and bore for damage. Proper valve to bore clearance is .0025" to .0050". The checking of gear end clearance will be covered in "Assembly".

b. Assembly

1. Install the gears and shaft in the oil pump body and check the gear end clearance by placing a straight edge over the gears and measure the clearance between the straight edge and the gasket surface. The clearance should be between .0015" to .0085". If the end clearance is near the excessive reading check for scores in the cover that would bring the total clearance over the specified amount.

2. Install the cover screws and tighten alternately and evenly. The torque is 8 ft.lbs.

3. Position the pressure regulator valve into the pump cover, closed end first, then install the spring and retaining pin.

NOTE: When assembling the drive shaft extension to the drive shaft, THE END OF THE EXTENSION NEAREST THE WASHERS MUST BE INSERTED INTO THE DRIVE SHAFT.

e. Installation

1. Insert the drive shaft extension through the opening in the main bearing cap and block until the shaft mates into the distributor drive gear.

2. Position pump onto the rear main bearing cap and install attaching bolts. Torque bolts to 35 ft.lbs.

3. Install the oil pan as described on page 6A-48.

Connecting Rod and Piston Assembly-Removal

a. Removal

1. Remove intake manifold, head or heads as described on page 6A-41.

2. Remove oil pan as described on page 6A-48.

3. Remove oil pump assembly as described on page 6A-48.

NOTE: Stamp cylinder number on the machined surfaces of the bolt bosses of the connecting rod and cap for identification when reinstalling. If the pistons are to be removed from the connecting rod, mark cylinder number on piston with a silver pencil or quick drying paint for proper cylinder identification and cap to rod location. The right bank is numbered 2-4-6-8, left bank 1-3-5-7).

Examine the cylinder bore above ring travel. If ridge exists, remove ridge with ridge reamer before attempting to remove the piston and rod assembly.

4. Remove rod bearing cap and bearing.

5. Install guide hose or connecting rod guide J-3224 over threads of rod bolts. This is to prevent damage to bearing journal and rod bolt threads.

6. Remove rod and piston assembly through the top of the cylinder bore.

7. Remove other rod and piston assemblies in the same manner.

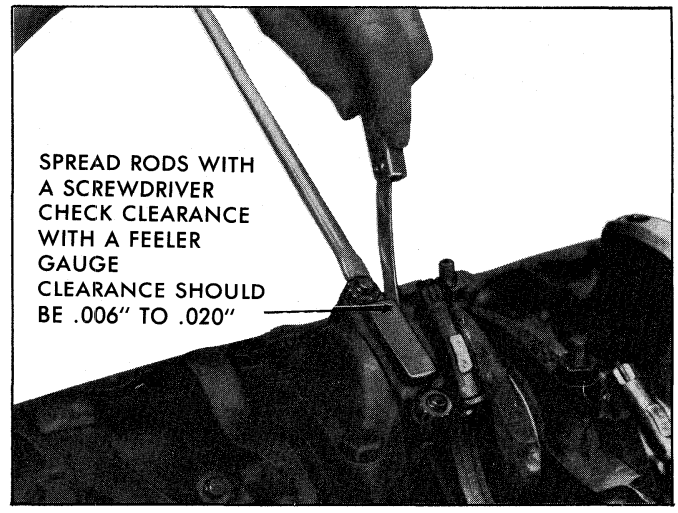


Fig. 6A-67 Connecting Rod Side Clearance

Connecting Rod Bearings

The connecting rod bearings are designed to have a slight projection above the rod and cap faces to insure a positive contact.

Connecting rod bearings can be replaced without removing the rod and piston assembly from the engine.

1. Remove oil pan as described on page 6A-48.

NOTE: It may be necessary to remove oil pump to provide access to rear connecting rod bearings.

2. With connecting rod journal at the bottom, stamp cylinder number on machined surfaces of connecting rod and cap for identification when reinstalling, then remove caps.

3. Inspect journals for roughness and wear. Slight roughness may be removed with a fine grit polishing cloth saturated with engine oil. Burrs may be removed with a fine oil stone by moving the stone on the hournal circumference. Do not move the stone back and forth across the journal. If the journals are scored or ridged, the crankshaft must be replaced.

4. The connecting rod journals should be checked for out-of-round and correct size with a micrometer. Maximum out-of-round must not exceed .0015".

NOTE: Refer to ENGINE SPECIFICATIONS Chart at the back of this section.

5. Clean oil from journal bearing cap, connecting rod and outer and inner surface of bearing inserts. Position insert so that tang is properly aligned with notch in rod and cap.

6. Place a piece of plastigauge in the center of lower bearing shell.

7. Reinstall bearing cap and torque to 42 ft.lbs.

8. Remove bearing cap and determine bearing clearances by comparing the width of the flattened plastigauge at its widest point with the graduation on the plastigauge container. The number within the graduation on the envelope indicates the clearance in thousandths of an inch. If this clearance is greater than .0035", replace the bearing and recheck clearance with plastigauge.

NOTE: Lubricate bearing with engine oil before installation. Repeat Steps 2 through 8 on remaining connecting rod bearings. All rods must be connected to their journals when rotating the crankshaft to prevent engine damage.

9. Measure the rod side clearance as shown in Fig. 6A-

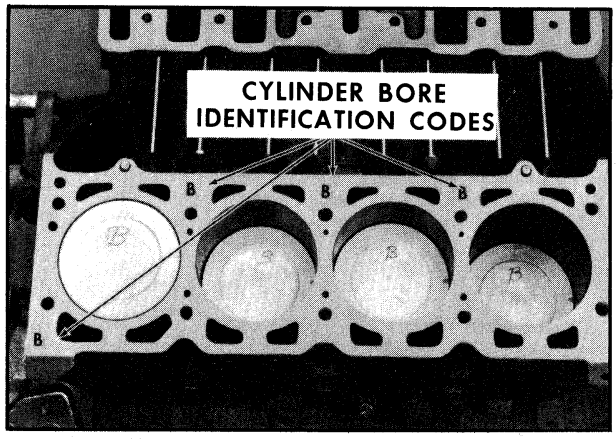


Fig. 6A-68 Cylinder Bore Marking

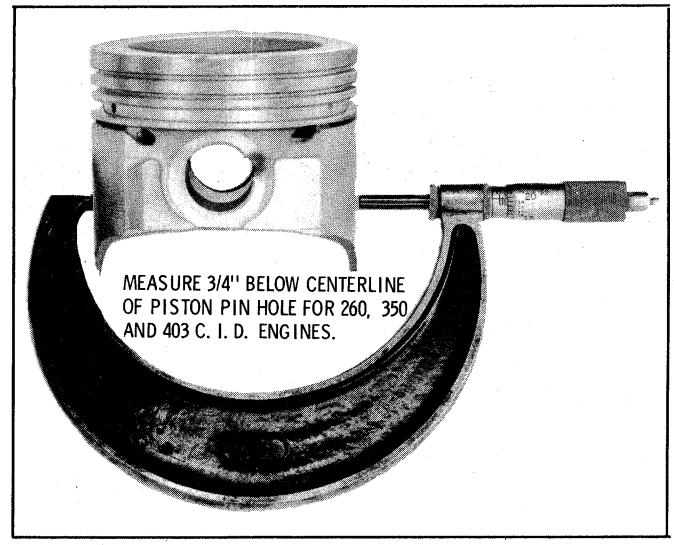


Fig. 6A-69 Measuring Piston

67. Clearance should be .006" to .020".

Reconditioning Rods

If a rod is twisted or bent, a new rod must be installed. NO ATTEMPT SHOULD BE MADE TO STRAIGHTEN CONNECTING RODS.

Measuring Piston

NOTE: Refer to PISTON INFORMATION Chart.

When replacing pistons, the original cylinder size is stamped with a code letter on the block near each cylinder on the cylinder head surface, Fig. 6A-68.

When measuring piston for size or taper, measurement must be made on skirt 90° from piston pin hole (with the piston pin removed), Fig. 6A-69.

When measuring taper, the largest reading must be at the bottom of the skirt. Allowable taper is .000" to .0001".

The piston and cylinder bore must be free of oil and at the same temperature.

NOTE: On some cars, oversize pistons may be found. These pistons will be .010" oversize.

1. Place a strip of .0015" feeler gauge against the upper side of the bore, at 90° to the normal piston pin location. Attach Scale J-5515 to feeler gauge, Fig. 6A-70.

2. Insert piston upside down with pin and rings removed, into bore.

3. While holding the piston in the center of its normal travel, slowly pull the scale in a straight line and note the reading on the scale. The reading should be between 3 to 12 pounds while pulling the feeler gauge out of the bore.

Each piston should be fitted to its individual cylinder and marked for that cylinder.

Checking Cylinder Bore

NOTE: Refer to PISTON INFORMATION Chart.

Cylinder bore size can be measured with inside micrometers or a cylinder gauge. Maximum allowable taper of the cylinder bore is .001". The most wear will occur at the top of the ring travel.

Reconditioned cylinder bores should be held to not more than .001" out-of-round and .001" taper.

If the cylinder bores are smooth, the cylinder walls should not be deglazed. If the cylinder walls are scored, the walls may have to be honed before installing new rings. It is important that reconditioned cylinder bores be thoroughly washed with a soap and water solution to remove all traces of abrasive material to eliminate premature wear.

Cleaning Piston

Clean the pistons by scraping carbon off the top of the piston. Deposits in the ring grooves should be removed with a suitable ring groove cleaning tool. It is important that the ring grooves be completely free of deposits.

Rings

The pistons have three rings (two compression rings and one oil ring). The oil ring consists of two rails and an expander.

a. Ring Tolerances

When installing new rings, ring gap and side clearance should be checked as follows:

b. Piston Ring and Rail Gap

Each ring and rail gap must be measured with the ring or rail positioned squarely and at the bottom of the ring-travel area of the bore.

The gap measurement should be .013" to .023" for compression rings and .015" to .055" for oil rings.

c. Side Clearance

Each ring must be checked for side clearance (see chart) in its respective piston groove by inserting a feeler gauge between the ring and its upper land. The Piston grooves must be cleaned before checking ring for side clearance.

NOTE: To check oil ring side clearance, the oil rings must be installed on the piston.

Rod and Piston Assembly-Installation

1. Install connecting rod bolt guide J-3224 or hose over rod bolt threads.

2. Apply engine oil to rings and piston, then install rod and piston assembly thru big end of piston ring compressing tool J-22666, Fig. 6A-71.

3. Install assembly in its respective cylinder bore so notch cast in top of piston is towards the front of engine.

4. Lubricate the crankshaft journal with engine oil and install connecting rod bearing and cap, with bearing index tang in rod and cap on same side.

NOTE: When more than one rod and piston assembly is being installed, the connecting rod cap attaching nuts

PISTON INFORMATION CHART

ENGINE	BORE DIAMETER	CYLINDER BORE SELECTION	BORE SIZES	PISTON SELECTION	PISTON SIZE	PISTON DIAMETER	PISTON TO CYL. BORE CLEARANCE	RING SIZE
350 Cu. In.	4.056-4.058 Std.	A	4.0560-4.0565	A	4.05525-4.05475	4.05675-4.05475 Std.	.00075 to .00175	Std.
		B	4.0565-4.0570	B	4.05575-4.05525			
		C	4.0570-4.0575	C	4.05625-4.05575			
		D	4.0575-4.0580	D	4.05675-4.05625			
	4.066-4.068 .010 O.S.	J	4.0660-4.0665	J	4.06525-4.06475	4.06675-4.06475 .010 O.S.		.010"O.S.
		K	4.0665-4.0670	K	4.06575-4.06525			
		L	4.0670-4.0675	L	4.06625-4.06575			
		M	4.0675-4.0680	M	4.06675-4.06625			

should only be tightened enough to keep each rod in position until all have been installed. This will facilitate installation of remaining piston assemblies.

The clearance between the adjacent rods, when checked with a feeler gauge on each crankpin, should be from .006" to .020", Fig. 6A-67.

5. Torque rod bolt nuts to 42 ft.lbs.

Piston Pin

The correct piston pin fit in the piston is .0003" to .0005" loose. If the pin to piston clearance is to the high limit (.0005"), the pin can be inserted in the piston with very little hand pressure and will fall through the piston by its own weight. If the clearance is .0003", the pin will not fall through. It is important that the piston pin hole be clean and free of oil when checking pin fit. The pin is a press fit in the connecting rod.

Whenever the replacement of a piston pin is necessary, use the following procedure:

a. Removal

1. Position the support fork of Tool J-24086-11 between the connecting rod and piston, Fig. 6A-72.

2. Install removal arbor, Tool J-24086-8, through the alignment hole in the tool base, Fig. 6A-72.

CAUTION: *Center the piston, rod and pin assembly with the removal arbor. Press the piston pin out of the connecting rod.*

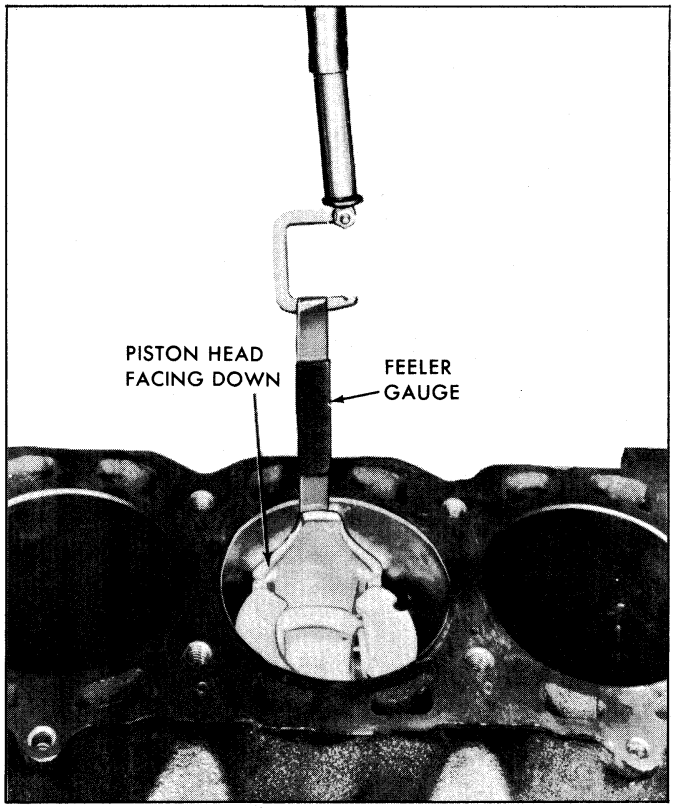


Fig. 6A-70 Checking Piston Clearance

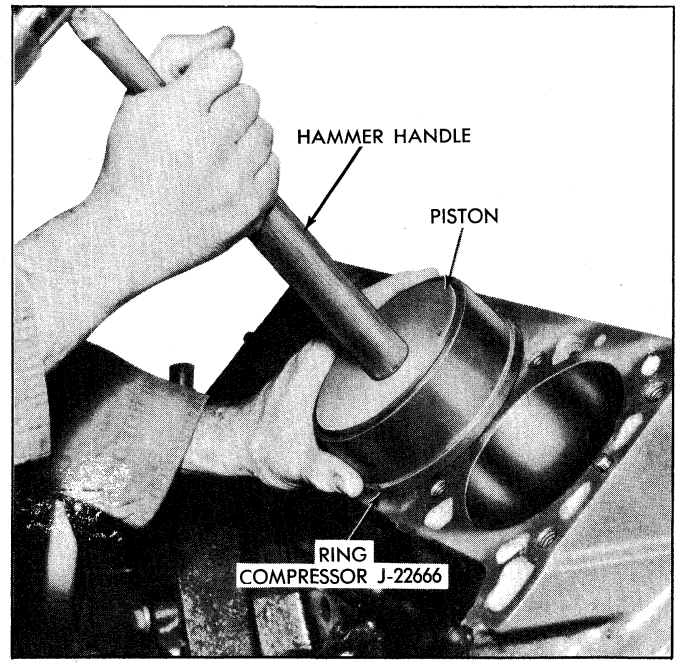


Fig. 6A-71 Piston Ring Compressor - Typical

Compression Rings	.002" to .004"
Oil Ring	.001" to .005"

b. Installation

1. Install pin guide J-24086-2 (green) through piston and into connecting rod. Hand tap pin guide into position for proper retention, Fig. 6A-73.

CAUTION: *The pin guide centers the connecting rod in the piston. When the piston, connecting rod, piston pin and pin guide assembly are positioned on the fork of the tool, the pin guide will also center this assembly in the tool. If a pin guide that is too small is used, the piston assembly will not be located centrally in the tool, and damage may occur to the fork of the tool.*

2. Install piston assembly into fork assembly of tool. Tool will support connecting rod at the piston pin. Be sure piston assembly slides onto the fork until the pin guide contacts the fork.

3. Adjust installing arbor, Tool J-24086-9, to H-4 by turning the numbered sleeve on the lettered shaft. Turn knurled nut to lock numbered sleeve on shaft.

4. Insert the installing arbor through the hole in the arch of the tool, Fig. 6A-74. Press piston pin into the connecting rod until the sleeve on the installing arbor contacts the top of the tool arch. The pin guide will fall out of the connecting rod as the piston pin is pressed in.

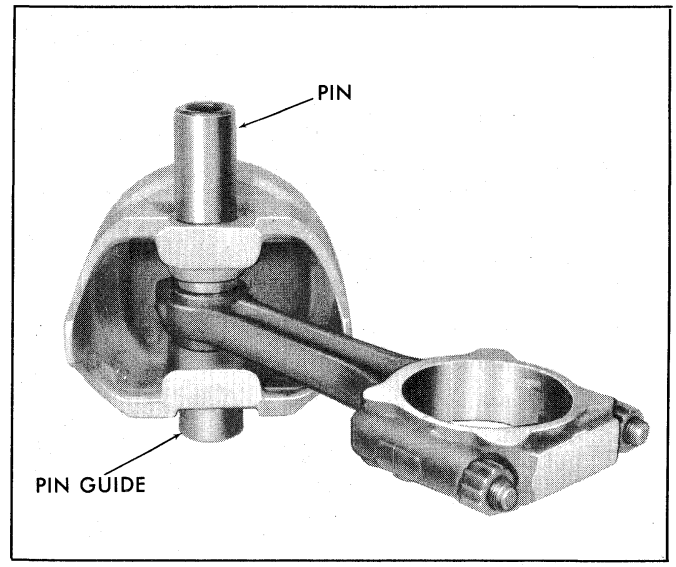


Fig. 6A-73 Installing Pin Guide

CAUTION: *Do not exceed 5000 pounds of force when stopping the installing arbor sleeve against the arch.*

NOTE: An alternate piston pin remover and installer Tool BT-7612 may be used using manufacturer's instructions.

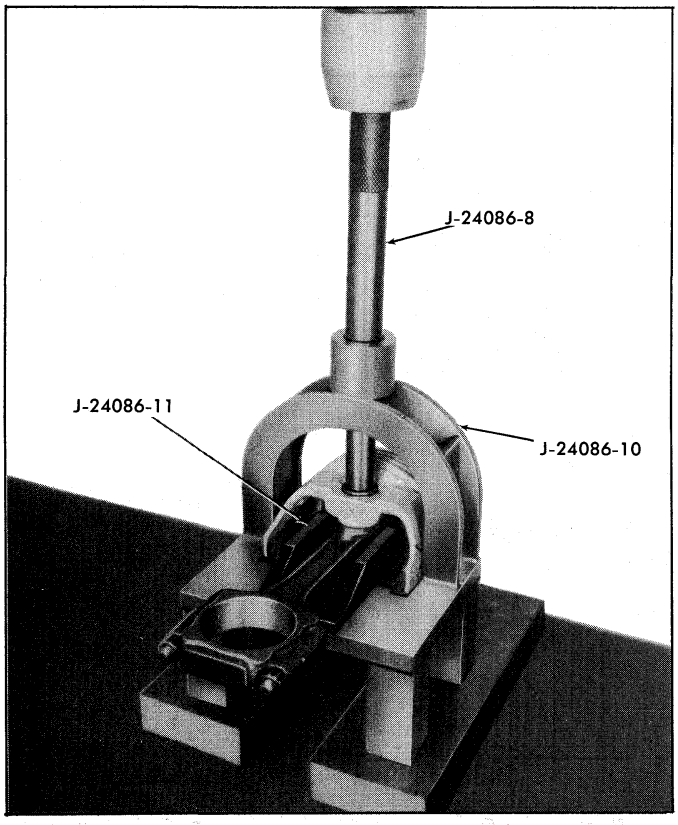


Fig. 6A-72 Removing Piston Pin

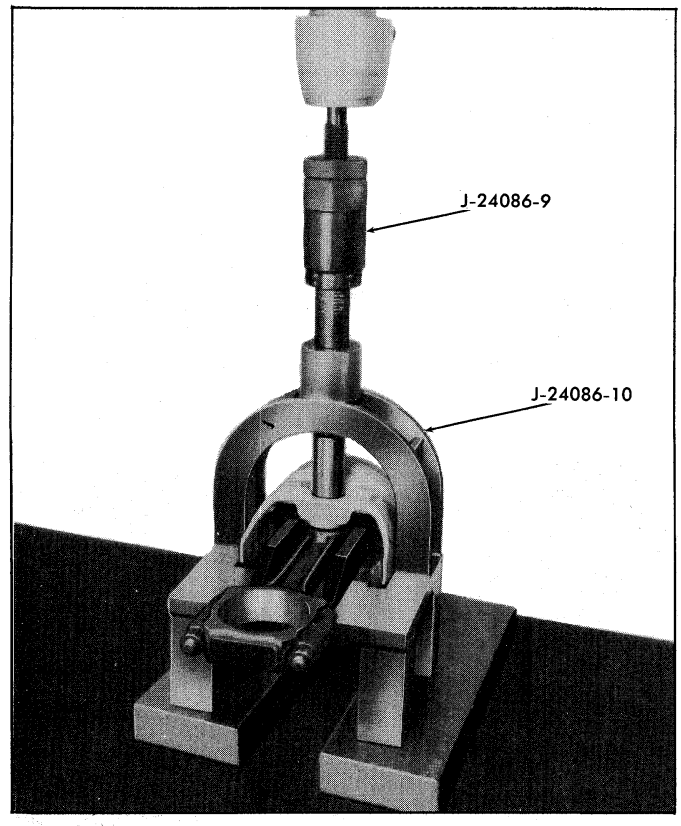


Fig. 6A-74 Installing Piston Pin

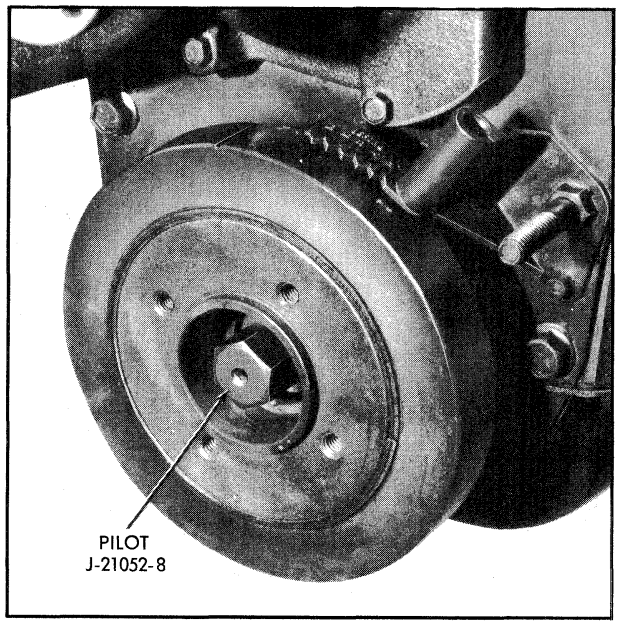


Fig. 6A-75 Harmonic Balancer Pilot

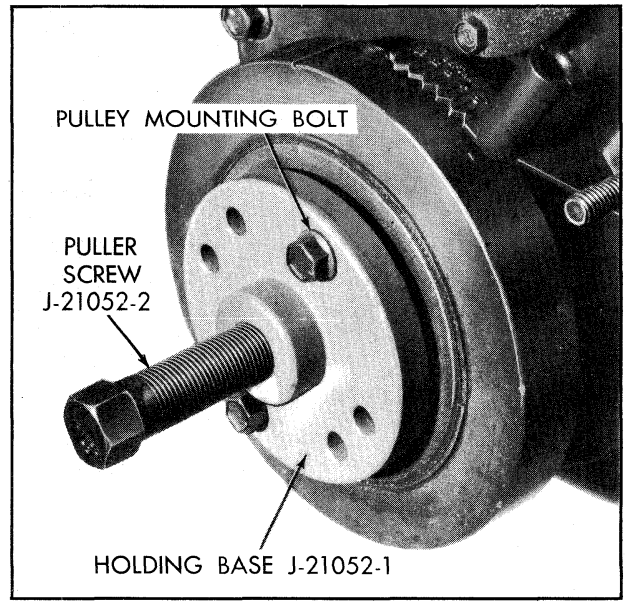


Fig. 6A-76 Removing Harmonic Balancer

CRANKSHAFT PULLEY

Removal

1. Remove belt(s).
2. Hoist car.
3. Remove four pulley bolts and pulley.

Installation

1. Install pulley, and four bolts. Torque to 10 ft.lbs.
2. Install belt(s). Adjust belts as described on page 6B-18.

Harmonic Balancer

a. Removal

1. Remove belt and crankshaft pulley.
2. Remove harmonic balancer hub bolt and washer.
3. Screw Adapter J-21052-8 into end of crankshaft, Fig. 6A-75.
4. Using balancer puller J-21052, remove balancer as shown in Fig. 6A-76.

CAUTION: *Use of any other type puller such as a universal claw type which pulls on the outside of the hub can destroy the balancer. The outside ring of the balancer is bonded in rubber to the hub; by pulling on the outside, rather than the hub, it is possible to break the bond. The timing mark is on the outside ring of the balancer; if the bond between the hub and the outside ring is broken, the outside ring could slip which would change the location of the timing mark.*

b. Installation

1. Apply sealer 1050026 or equivalent, to inside diameter of pulley hub and to crankshaft key to prevent possible oil leakage. Coat outside area of crankshaft pulley hub which enters seal with Special Seal Lubricant No. 1050169, or equivalent.
2. Align keyway in balancer with key on shaft and position balancer for installation.
3. Thread balancer installer J-25288 into end of crankshaft. Use thick balancer washer under bearing, Fig. 6A-77.
4. Draw balancer onto shaft by tightening nut while holding screw, Fig. 6A-77.

NOTE: Balancer to crankshaft fit is .001″ tight to .0007″ loose.

5. Remove tool and install washer and bolt. Torque 310 ft.lbs.
6. Install pulley and belt(s). Adjust belts as described on page 6B-18.

FRONT COVER

a. Removal

1. Drain cooling system. Disconnect radiator hoses and bypass hose.
2. Remove radiator upper support and radiator.
3. Remove all belts, fan and fan pulley, crankshaft pulley and harmonic balancer.
4. Remove cover to block attaching bolts and remove cover, timing indicator and water pump assembly, Fig. 6A-82.
5. Remove front cover and both dowel pins. It may be necessary to grind a flat on the pins to achieve a rough surface for gripping.

b. Installation

1. Grind a chamfer on one end of each dowel pin as shown in Fig. 6A-78.
2. Cut excess material from front end of oil pan gasket on each side of engine block.
3. Clean block, oil pan and front cover mating surfaces with solvent.
4. Trim approximately 1/8″ from each end of new front pan seal, using a sharp tool as shown in Fig. 6A-79.
5. Install new front cover gasket on engine block and new front pan seal on front cover. Apply 1050805 or equivalent sealer to gasket around water holes and place on block.

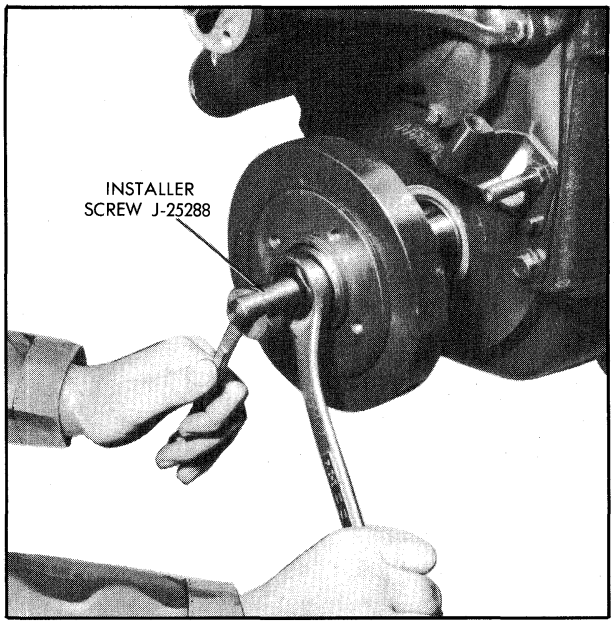


Fig. 6A-77 Installing Harmonic Balancer

6. Apply R.T.V. sealer at junction of block, pan and front cover as shown in Fig. 6A-80.

7. Place cover on front of block and press downward to compress seal. Rotate cover left and right and guide pan seal into cavity using a small screwdriver as shown in Fig. 6A-81.

8. Apply engine oil to bolts (threads and heads).

9. Install two bolts finger tight to hold cover in place.

10. Install two dowel pins (chamfered end first).

11. Install timing indicator and water pump assembly, then torque bolts evenly as indicated in Fig. 6A-82.

12. Apply lubricant 1050169 or equivalent, on balancer seal surface.

13. Install balancer and balancer bolt. Torque from 200-300 ft.lbs.

14. Connect bypass hose and radiator hoses.

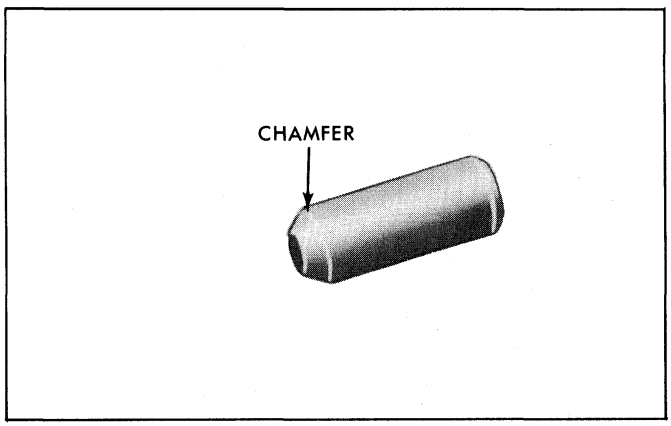


Fig. 6A-78 Grinding Chamfer on Dowel Pin

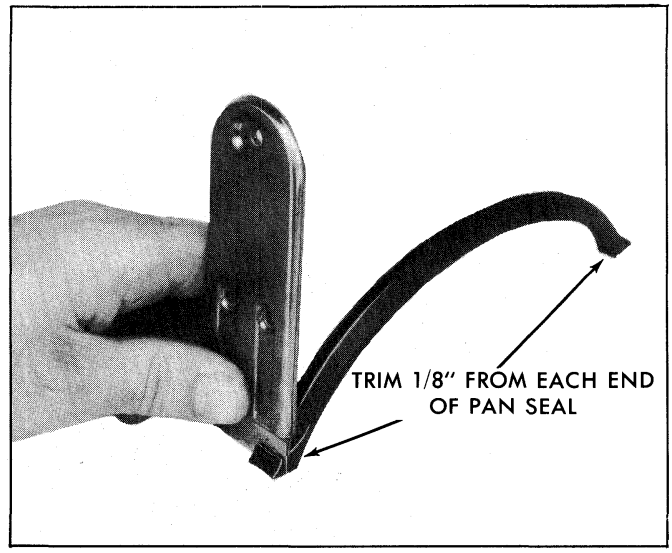


Fig. 6A-79 Timing Front Oil Pan Seal

15. Install crankshaft pulley and four attaching bolts. Torque to 10 ft.lbs.

16. Install fan pulley, fan and four attaching bolts. Torque bolts to 20 ft.lbs.

17. Install belts and adjust as described on page 6B-18.

18. Fill radiator and crankcase.

19. Road test car and check for leaks. Use of spray foot powder or equivalent may aid in detecting leaks.

Front Cover Oil Seal

a. Removal

1. Remove drive belts.

2. Remove the crankshaft pulley and balancer as described on page 6A-53.

3. Using puller J-1859-03 and arms J-23129 remove oil seal as shown in Fig. 6A-83.

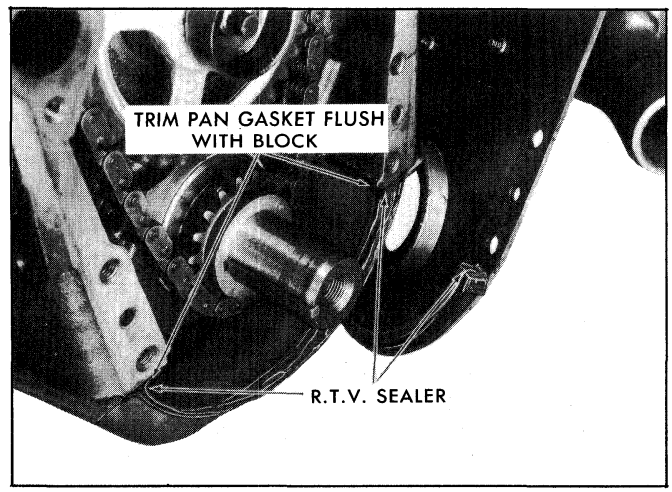


Fig. 6A-80 Applying R.T.V. Sealer



Fig. 6A-81 Installing Front Cover

b. Installation

1. Apply 1050026 Sealer or equivalent, to outside diameter of seal.
2. Using J-25264 and J-21150, install oil seal as shown in Fig. 6A-84.
3. Install the balancer and crankshaft pulley as described on page 6A-53.
4. Install and adjust belts as described on page 6B-18.

Crankshaft Timing Gear

a. Removal

Should removal of the crankshaft timing gear be required, puller J-25287 should be used as shown in Fig. 6A-85. Pull gear off shaft until crankshaft key may be removed. Remove key and gear will slip off shaft.

b. Installation

To install timing gear, slip gear on shaft and align key ways. Start key in keyways and gently tap key into position with a soft faced hammer.

Checking Valve Timing Without Removing Front Cover

1. Remove distributor cap, right valve cover, No. 4 cylinder intake and exhaust rocker arms and pivot.
2. Remove wire from "Bat." terminal of H.E.I. distributor.
3. Turn ignition switch on. Crank engine until rotor is in line with No. 4 spark plug wire position. No. 4 piston will be approximately at the top of the cylinder.

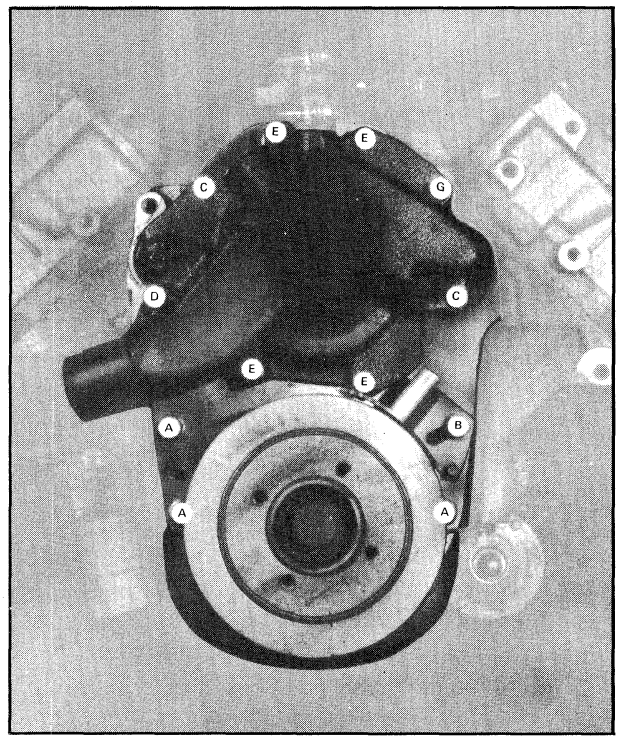


Fig. 6A-82 Engine Front Cover Screws

KEY	SIZE	TORQUE
A	3/8-16 x 3/4	35 ft.-lbs.
B	3/8-16 x 1 (stud head)	35 ft.-lbs.
C	5/16-18 x 1-1/2	22 ft.-lbs.
D	5/16-18 x 2-1/2	22 ft.-lbs.
G	5/16-18 x 1-1/2 (stud head)	22 ft.-lbs.

4. Measure from pivot boss on head surface to top of No. 4 intake push-rod. Record measurement, Fig. 6A-86.
5. Slowly turn engine 1-1/2 revolutions until rotor

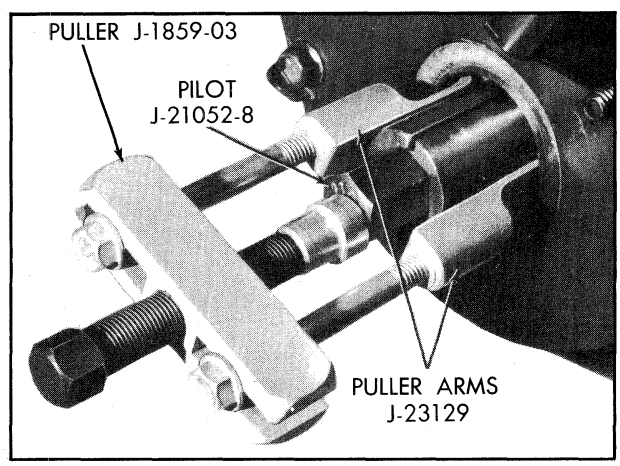


Fig. 6A-83 Front Oil Seal Removal

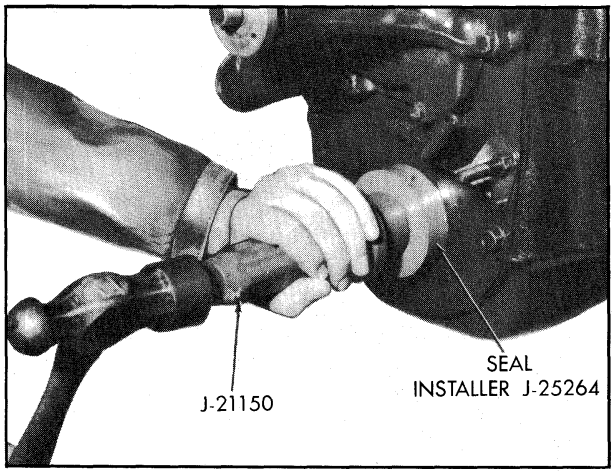


Fig. 6A-84 Front Oil Seal Installation

approaches No. 1 spark plug wire position. Continue to turn engine until timing mark on crank pulley is aligned with O on indicator. This is top dead center of No. 1 piston.

6. Again measure from pivot boss surface to top of No. 4 cylinder intake push-rod, Fig. 6A-86.

7. Measurement should increase over the first measurement as shown in Fig. 6A-86.

8. If measurement increase is not within 1/32" of that shown on chart, camshaft is advanced or retarded.

Camshaft

a. Removal

1. Disconnect battery and remove air cleaner.
2. Remove radiator as described on page 6B-9.
3. Remove four screws holding condenser to radiator cradle and swing condenser out of way. Secure condenser in this position.
4. Remove harmonic balancer as described on page 6A-53.
5. Remove front cover as described on page 6A-53.
6. Partially remove A/C compressor as described in Section 1.
7. Remove intake manifold as described on page 6A-41.
8. Remove right and left valve covers.
9. Remove rocker arms, push-rods and valve lifters.

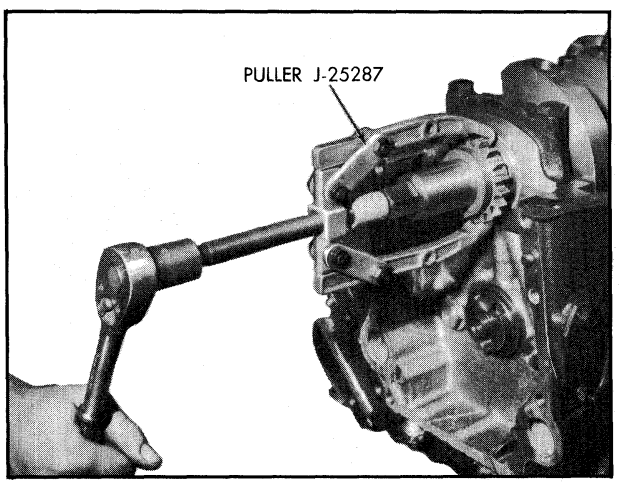


Fig. 6A-85 Crankshaft Gear Removal

NOTE: Parts position should be noted so that they may be installed in their original position.

10. Remove timing chain and camshaft sprocket.
11. Carefully remove camshaft.

CAUTION: *Do not force as camshaft bearings may be damaged.*

b. Installation

1. Coat camshaft and bearings liberally with lubricant 1051396 or equivalent and install camshaft.

CAUTION: *Do not force as camshaft bearings may be damaged.*

2. Align timing marks as shown in Fig. 6A-87 and install timing sprocket and chain. Torque screw to 65 ft.lbs.

NOTE: Camshaft is timed so that cylinder number 6 is in the firing position. This must be taken into consideration when intalling distributor.

3. Install front cover as described on page 6A-53.
4. Install harmonic balancer as described on page 6A-53.
5. Install rocker arms, push-rods and valve lifters in the same position as removed.
6. Install valve covers and install A/C compressor as described in Section 1.
7. Install intake manifold as described on page 6A-41. Observe distributor installation note in Step 2 above.
8. Position condenser to radiator cradle and secure with four screws.
9. Install radiator as described on page 6B-9.
10. Install air cleaner and connect battery.

Camshaft Bearings

The camshaft bearings must be replaced in complete sets. All bearings must be removed before any can be installed. No. 1 bearing must be removed first, then No. 2, then 3, 4, and 5. When installing the bearings, No. 5 must be installed first, then 4, 3, 2 and 1.

Camshaft Bearing Remover and Installer Set J-25262 is an available tool.

a. Removal

1. Install No. 1 Cam Bearing Remover and Installer J-25262-1 on Handle J-25262-7 and drive out front cam bearing, Fig. 6A-88.
2. Place Pilot J-25262-6 on Driver J-25262-7, Fig. 6A-89, and install No. 2 Cam Bearing Tool J-25262-2 on driver and drive out No. 2 bearing.
3. Remove No. 3, 4, and 5 bearings in the same manner, using J-25262-3, J-25262-4, and J-25262-5 removers.

NOTE: Each cam bearing is a different diameter and the correct sequence must be used both for removal and installation.

NOTE: To aid aligning bearings with oil passages, place a mark on the cylinder block in line with each oil hole, Fig. 6A-90. When installing the bearings the mark will act as a guide.

1. Place new No. 5 bearing on J-25262-5 and drive bearing in until the last white line on the driver, J-25262-7, is flush with the front face of the pilot, J-25262-6.
2. Use a bent wire to check oil hole alignment.
3. Remove J-25262-5 Installer and install J-25262-4 on Handle J-25262-7. Place No. 4 bearing on installer and drive in until second to last white line on driver is flush with pilot.
4. Follow the same procedure to install No. 3 and No. 2.
5. Install Tool J-25262-1 on Handle J-25262-7 and place N. 1 bearing on installer. Drive bearing in until white line

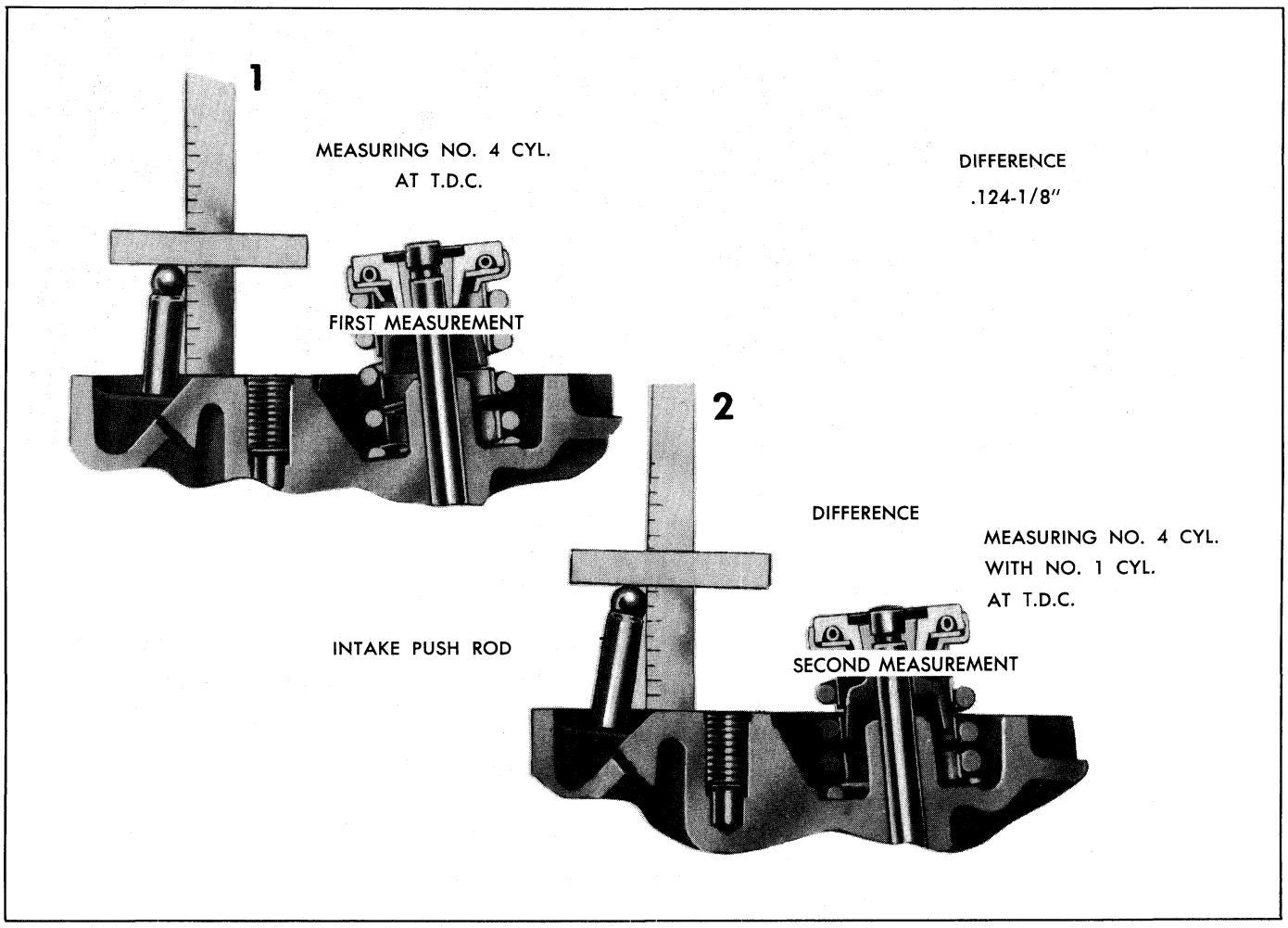


Fig. 6A-86 Checking Valve Timing

on Installer J-25262-1 is flush with front face of block.

6. Check all oil hole openings by looking down oil hole. Oil hole in bearing must be visable or the bearing will not receive lubrication.

c. Camshaft and Oil Gallery Plugs (Fig. 6A-91)

The left hand rear oil gallery plug is not shown. It is a threaded plug in the end of the left gallery just rearward of the distributor. A small hole is provided in the plug for distributor lubrication. The cup plug shown provides access to the threaded plug.

The front oil gallery plugs (not shown) are threaded. The plug on the right side has a small hole which provides lubrication for the timing chain and gears.

Crankshaft

a. Removal (Cylinder Heads On)

1. With engine on stand and oil pan, oil pump and front cover removed, rotate crankshaft to the position where the connecting rod nuts are most accessible.

2. Remove main bearng caps.

3. Remove connecting rod caps and install thread protectors.

4. Note position of keyway in crankshaft so it can be installed in the same position.

5. Lift crankshaft out of block. Rods will pivot to the center of the engine when the crankshaft is removed.

Do not allow pistons to move in their bore during or after crankshaft removal.

b. Installation

1. Install sufficient oil pan bolts in pan rails to align rods with rubber bands.

Align rods so that the inner thread protectors of adjacent rods overlap approximately one inch as shown. Alignment can be adjusted by increasing tension on rubber bands with additional turns around the pan bolts or thread protectors.

2. Position crankshaft keyway in the same position as removed and lower into block. The connecting rods will follow the crank pins into the correct position as the crankshaft is lowered.

3. Remove rubber bands, thread protectors and pan bolts and assemble engine.

c. Removal (Cylinder Heads Removed)

1. With engine on stand, remove oil pan, front cover, connecting rods, and oil pump.

2. Remove main bearing cups and lift crankshaft out of block, Fig. 6A-92.

d. Installation

1. Measure the crankshaft journals with a micrometer to determine the correct size rod and main bearings to be used.

NOTE: Whenever a new or reconditioned crankshaft is

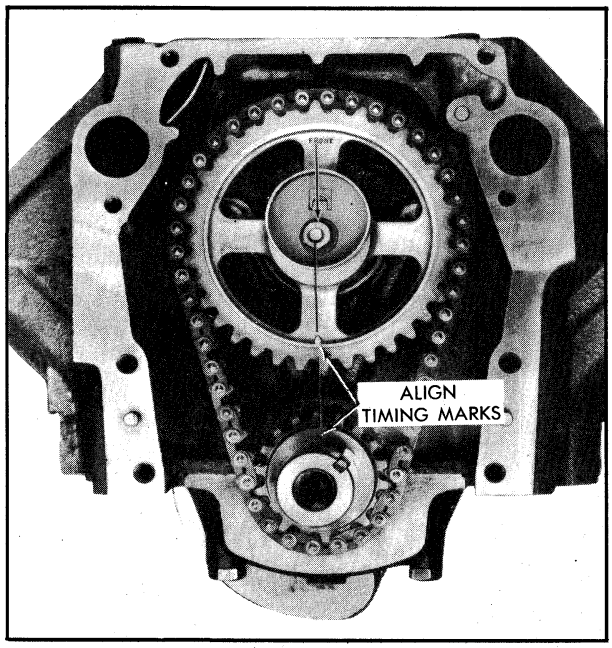


Fig. 6A-87 Aligning Timing Marks

installed, new connecting rod bearings and main bearings should be installed.

2. Position upper half of main bearings in block and lubricate with engine oil.

3. Install a new rear main bearing seal as described on page 6A-60.

4. After oil passages in crankshaft have been checked for being open and shaft is clean, place shaft in block. Lubricate thrust flanges of the center bearing with 1050169 Lubricant or equivalent. Install caps with lower half of bearing lubricated with engine oil. Lubricate cap bolts with No. 1050125 or equivalent, and install, but do not tighten.

5. With a block of wood, Fig. 6A-93, bump shaft in each direction to align thrust flanges of center main bearing.

NOTE: After bumping shaft in each direction, wedge the shaft to the front and hold it while torquing No. 3 cap bolts.

6. Torque No.s 1, 2, 3 and 4 main bearing cap bolts to 80 ft.lbs. and No. 5 bolt to 120 ft.lbs.

7. Reassemble engine and install in chassis.

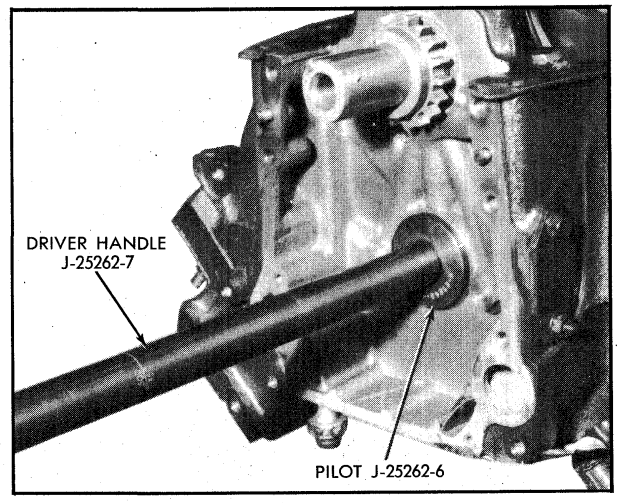


Fig. 6A-89 Driver Pilot

Main Bearings

Main bearing clearance must not exceed .0035" on all bearings. The .0035" clearance is permissible only if the engine is disassembled for other than a bearing noise condition. If bearings are noisy or if a visual inspection indicates defective bearings, new bearings must be installed within the specifications outlined under MAIN BEARINGS - REPLACE.

Bearings which fall within the .0035" specifications should not be rejected if the bearings show a normal wear pattern or slight radial grooves, unless it has been established to be defective.

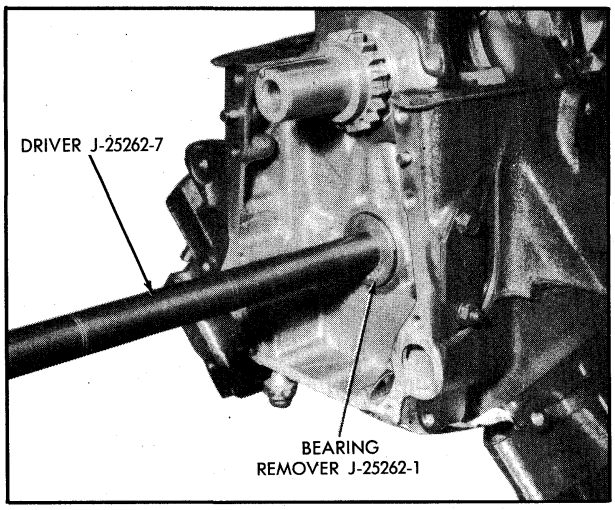


Fig. 6A-88 Removing No. 1 Cam Bearing

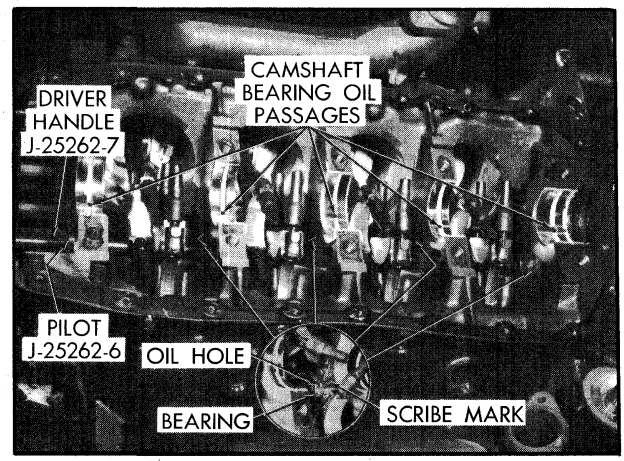


Fig. 6A-90 Installing Cam Bearings

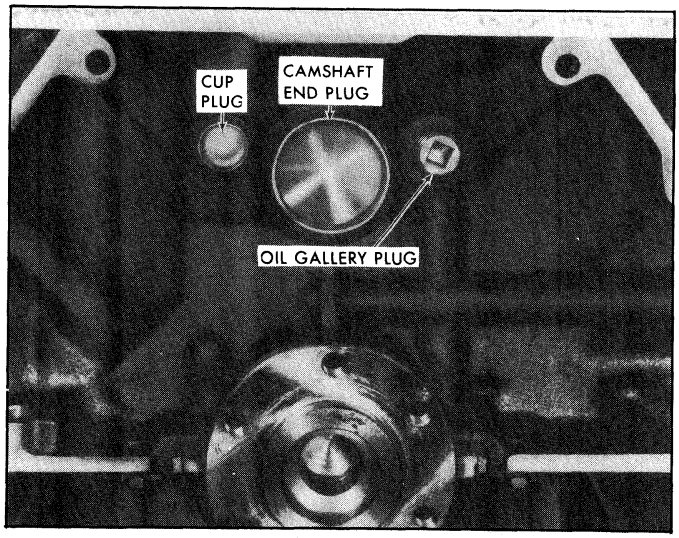


Fig. 6A-91 Oil Plugs

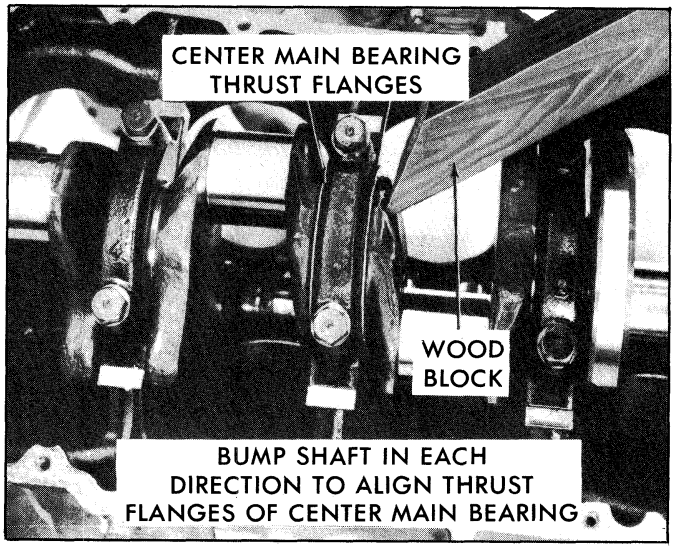


Fig. 6A-93 Aligning Thrust Bearings

a. Checking Bearing Clearances

1. Remove bearing cap and wipe oil from crankshaft journal and outer and inner surfaces of bearing shell.

2. Place a piece of plastigauge in the center of bearing.

3. Use a floor jack or other means to hold crankshaft against upper bearing shell. This is necessary to obtain accurate clearance readings when using plastigauge.

4. Reinstall bearing cap and bearing. Place Lubricant No. 1050125 or equivalent on cap bolts and install.

Torque Nos. 1, 2, 3 and 4 bolts to 80 ft.lbs. and No. 5 bolt to 120 ft.lbs.

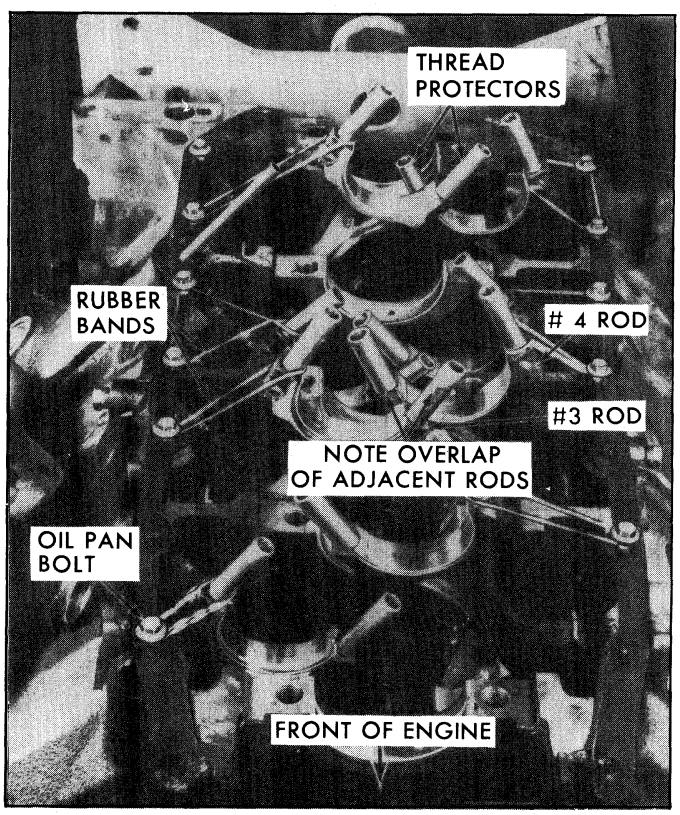


Fig. 6A-92 Removing Crankshaft

5. Remove bearing cap and determine bearing clearance by comparing the width of the flattened plastigauge at its widest point with graduation on the plastigauge container. The number within the graduation on the envelope indicates the clearance in thousandths of an inch, Fig. 6A-94. If this clearance is greater than .0035", REPLACE BOTH BEARING SHELLS AS A SET. Recheck clearance after replacing shells.

NOTE: Main bearing end thrust clearance should be .0035" to .0135" as checked with a dial indicator.

b. Main Bearings

Main bearing clearances must be corrected by the use of selective upper and lower shells. UNDER NO CIRCUMSTANCES should the use of shims behind the shells, to compensate for wear, be attempted.

NOTE: The upper and lower shells must be installed in

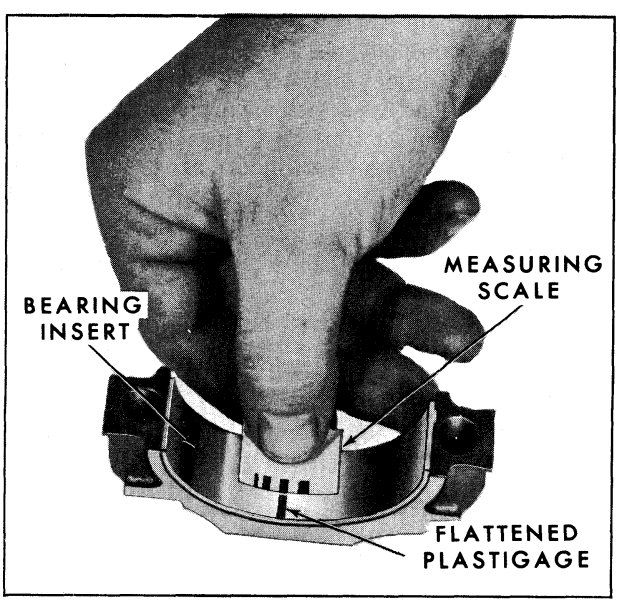


Fig. 6A-94 Checking Bearing Clearance

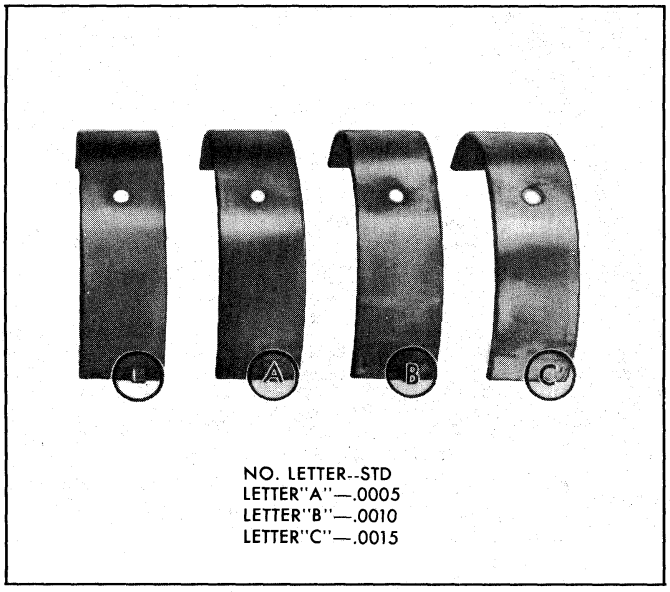


Fig. 6A-95 Bearing Identification

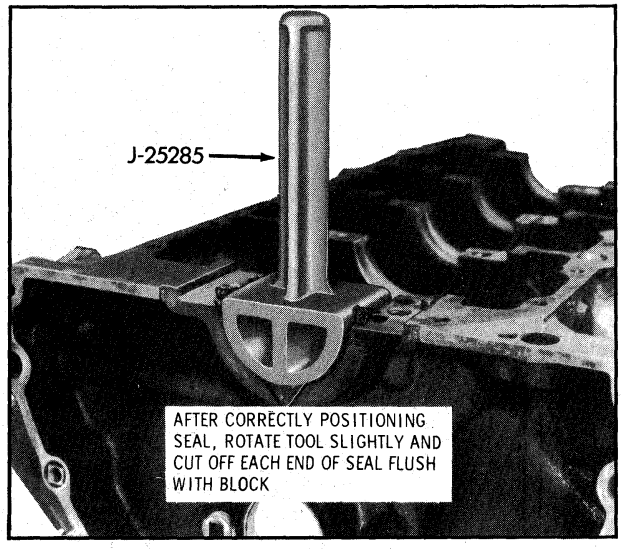


Fig. 6A-96 Installing Oil Seal - Upper

pairs. Sizes of the bearings are located on the tang, Fig. 6A-95. It is possible to have more than one bearing size in the same engine.

To install main bearing shells, proceed as follows:

1. Loosen all main bearing caps.

2. Remove bearing cap and remove lower shell.

3. Insert a flattened cotter pin or roll out pin J-8080 in the oil passage hole in the crankshaft, then rotate the crankshaft in the direction opposite to cranking rotation. The pin will contact the upper shell and roll it out.

4. The main bearing journals should be checked for roughness and wear. Slight roughness may be removed with a fine grit polishing cloth saturated with engine oil. Burrs may be removed with a fine oil stone. If the journals are scored or ridged, the crankshaft must be replaced.

NOTE: The journals can be measured for out-of-round with the crankshaft installed by using a crankshaft caliper and inside micrometer or a main bearing micrometer. The upper bearing shell must be removed when measuring the crankshaft journals. Maximum out-of-round of the crankshaft journals must not exceed .0015".

5. Clean crankshaft journals and bearing caps thoroughly before installing new main bearings.

6. Apply Special Lubricant, No. 1050169 or equivalent to the thrust flanges of bearing shells on No. 3 bearing.

7. Place new upper shell on crankshaft journal with locating tang in correct position and rotate shaft to turn it into place using cotter pin or roll out pin J-8080 as during removal.

8. Place new bearing shell in bearing cap.

9. No. 5 bearing - Install new asbestos oil seal in the rear main bearing cap as described on page 6A-60.

10. Install bearing caps, lubricate bolt threads with No. 1050125 Lubricant or equivalent, and install.

Torque Nos. 1 through 4 to 80 ft.lbs. and No. 5 to 120 ft.lbs.

Rear Main Bearing Upper Oil Seal

With the crankshaft out of the block, a new seal may be installed using Tool J-25285, Fig. 6A-96.

Rear Main Lower Oil Seal

a. Removal

1. Remove oil pan.
2. Remove the rear main bearing cap.
3. Remove rear main bearing insert and old seal.
4. Clean bearing cap and seal grooves and inspect for cracks.

b. Installation

1. Install seal into bearing cap, packing by hand.
2. Using seal installer J-25285, hammer seal into groove, Fig. 6A-97.
3. With tool slightly rotated, cut seal flush with mating surface. With screwdriver, pack seal end fibers towards center, away from edges. Rotate seal installer when cutting seal to avoid damage to tool.
4. Clean bearing insert and install in bearing cap.
5. Clean crankshaft bearing journal and seal contact. Install sealer on cap.
6. Install bearing caps, lubricate bolt threads with No. 1050125 Lubricant or equivalent and install. Torque to 120 ft.lbs.
7. Install pan with new gaskets.
8. Install lower flywheel cover.

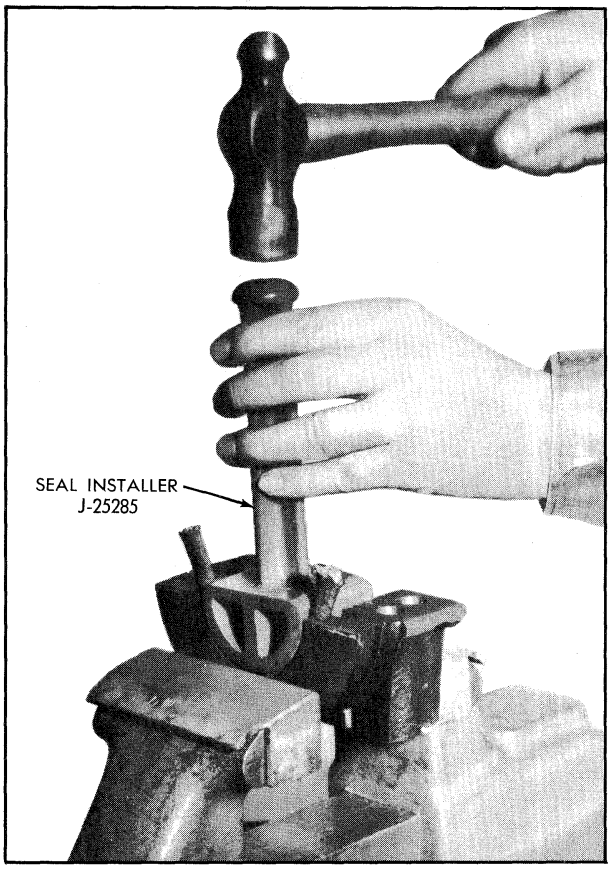


Fig. 6A-97 Installing Oil Seal - Lower

Flywheel

One bolt hole in the flywheel is offset and the flywheel will attach to the crankshaft in only one position. The flywheel ring gear is not replaceable.

SPECIFICATIONS

Item	All Series
CYLINDER BLOCK	
Bore	4.057"
Stroke	3.385"
Piston Displacement	350 cu. in.
Compresison Ratio	8.5:1
Firing Order	1-8-4-3-6-5-7-2
Main Bearing Bore (I.D.)	2.687"-2.688"
VALVES	INTAKE
Diameter Head	1.880"-1.870"
Diameter-Stem	.3425"-.3432"
Angle-Valve (A°) See Fig. 6A-61	44°
Angle-Valve Seat (B°) See Fig. 6A-61	45°
Width-Valve Seat (Cylinder Head)	.037"-.075"
Overall Length	4.667"
Clearance in Guide	.0010"-.0027"
Lash	Hydraulic
	EXHAUST
Diameter-Head	1.497"-1.507"
Diameter-Stem	.3420"-.3427"
Angle-Valve (A°) See Fig. 6	30°
Angle-Valve (B°) See Fig. 6	31°
Width-Valve Seat (Cylinder Head)	.050"-.090"
Clearance In Guide	.0015"-.0032"
VALVE SPRINGS	
Length	1.96"
Diameter-Wire	.192"
Inside Diameter	1.065"-1.041"
Load	76-84 Lbs. @ 1.670"
Load @ 1.270"	180-194 Lbs.
VALVE LIFTERS	
Diameter-Body	.8422"-.8427"
Length-Overall	2.000"
Clearance in Boss	.0005"-.0020"
Also available in .010" Over Size	
CAMSHAFT	
Bearing Journal Diameters	
No. 1	2.0365"-2.0357"
No. 2	2.0165"-2.0157"
No. 3	1.9965"-1.9957"
No. 4	1.9765"-1.9757"
No. 5	1.9565"-1.9557"
Width (including chamfers)	
No. 1	.810"
No. 2, 3 and 4	.741"
No. 5	.788"
Journal Clearance in Bearing (all)	.0020"-.0058"
End Clearance	.011"-.077"
Push Rod-Length	8.265"
CAMSHAFT SPROCKET	
Width of Sprocket	.420"-.400"
Pitch	.500"
No. of Teeth	36
TIMING CHAIN	
Width	Morse-.627, Linkbelt-.720"-.750"
No. of Links	48
Pitch	.500"
CONNECTING RODS	
Length-Center to Center	5.998/6.002"
Diameter-Connecting Rod Bore	2.2495"-2.2500"
Diameter-Pin Bore	.9789"-.9795"
Bearing Clearance - (Vertical)	.0004-.0033"
Side Clearance - Big End	.006"-.020"

Item	All Series
PISTON RINGS	
No. of Compression Rings (per piston)	2
Width of Compression Rings (top & bottom)	.0780"-.0770"
Gap Clearance Compression Rings	.010"-.023"
Clearance in Groove Compression Rings-Upper	.0020"-.0040"
-Lower	.0020"-.0040"
No. of Oil Rings (per piston)	1
Gap Clearance, Oil Ring	.015"-.055"
PISTON PINS	
Diameter	.9803"-.9807"
Length Overall	2.980"
Pin to Piston Clearance	.0003"-.0005"
Pin to Rod Fit	.0008"-.0018" Press
PISTON	
Diameter Nominal Outside	4.057"
Length Overall	3.620"
Top of Piston to Center of Pin	1.617/1.613"
Clearance at Thrust Surface (selective)	.001"-.002"
Weight Less Pin & Rings (all)	22.60 oz.
Skirt Taper	.0005"-.0015" Larger at Bottom
Ring Width (2 compression)	.0798"-.0808"
Ring Width (1 oil)	.1881"-.1891"
Oil Pump	
Clearance Pressure Relief Valve in Bore	.0025"-.0050"
End Clearance-Gear	.0025"-.0065"
CRANKSHAFT	
Diameter-Main Bearing Journal	2.4995"-2.4985" (2,3,4,5)
	2.4998"-2.4988" (1)
Width-Main Bearing Journal (with fillets)	
No. 1	1.185"
No. 2 & 4	1.156"-1.166"
No. 3	1.985"-2.005"
No. 5	1.882"
Diameter-Connecting Rod Bearing Journal	2.1248"-2.1238"
Width-Connecting Rod Bearing (with fillets)	1.877"-1.887"
Length-Overall Crankshaft	26.470"
Diameter - Oil Holes in Crankshaft	1.250"
Clearance - Crankshaft End	.0035-.0135"
MAIN BEARINGS	
Bearing Clearance - Crankshaft 1,2,3, & 4	.0005"-.0021"
(Vertical) 5	.0015"-.0031"
Width-Bearing Shell	
No. 1,2, and 4	.970"-.980"
No. 3	1.193"-1.195"
No. 5	1.624"
CRANKSHAFT SPROCKET	
Width of Sprocket	.410"-.400"
Overall Width of Gear	1.001"-.991"
Pitch	.500"
No. of Teeth	18
Flywheel	
No. of Teeth on Starter Gear	166
No. of Teeth on Starter Pinion	9

TORQUE SPECIFICATIONS

NOTE: Specified torque is for installation of parts only. Checking of torque during inspection may be 10% below specification.

Application	Ft. Lbs.
Crankshaft Bearing Cap Bolts Nos. 1, 2, 3 & 4	80
Crankshaft Bearing No. 5	120
E.G.R. Valve to Intake Manifold	25
Flywheel to Crankshaft	60
Oil Pump to Bearing Cap Bolts	35
Oil Pump Cover to Pump Bolts	8
Rocker Arm Pivot Bolt to Head	25
Valve Cover Bolts	7
Oil Pan Bolts	10
Oil Pan Drain Plug	30
Crankshaft Balancer or Hub to Crankshaft Bolt	310
Oil Filter Element to Base	20
Oil Filter Assembly to Cylinder Block Bolts	35
Front Cover to Cylinder Block Bolts 3/8"	35
Fan Pulley to Hub Bolts	20
Fan Pulley to Balancer Bolts	20
Water Pump to Front Cover Bolts	13
Water Outlet to Manifold Bolts	20
*Intake Manifold to Cylinder Head Bolts	40
Exhaust Manifold to Cylinder Head Bolts	25
Throttle Body Mounting Bolts	15
Air Cleaner	5
Engine Mount to Cylinder Block Bolts	65
Engine Mount to Frame Mount	30
Engine Mount thru Bolt	30
Distributor Clamp to Cylinder Block Bolt	17
Spark Plugs	25
*Cylinder Head Bolts	130
Connecting Rod Nuts	42

*Clean and dip in engine oil before tightening to obtain a correct torque reading.

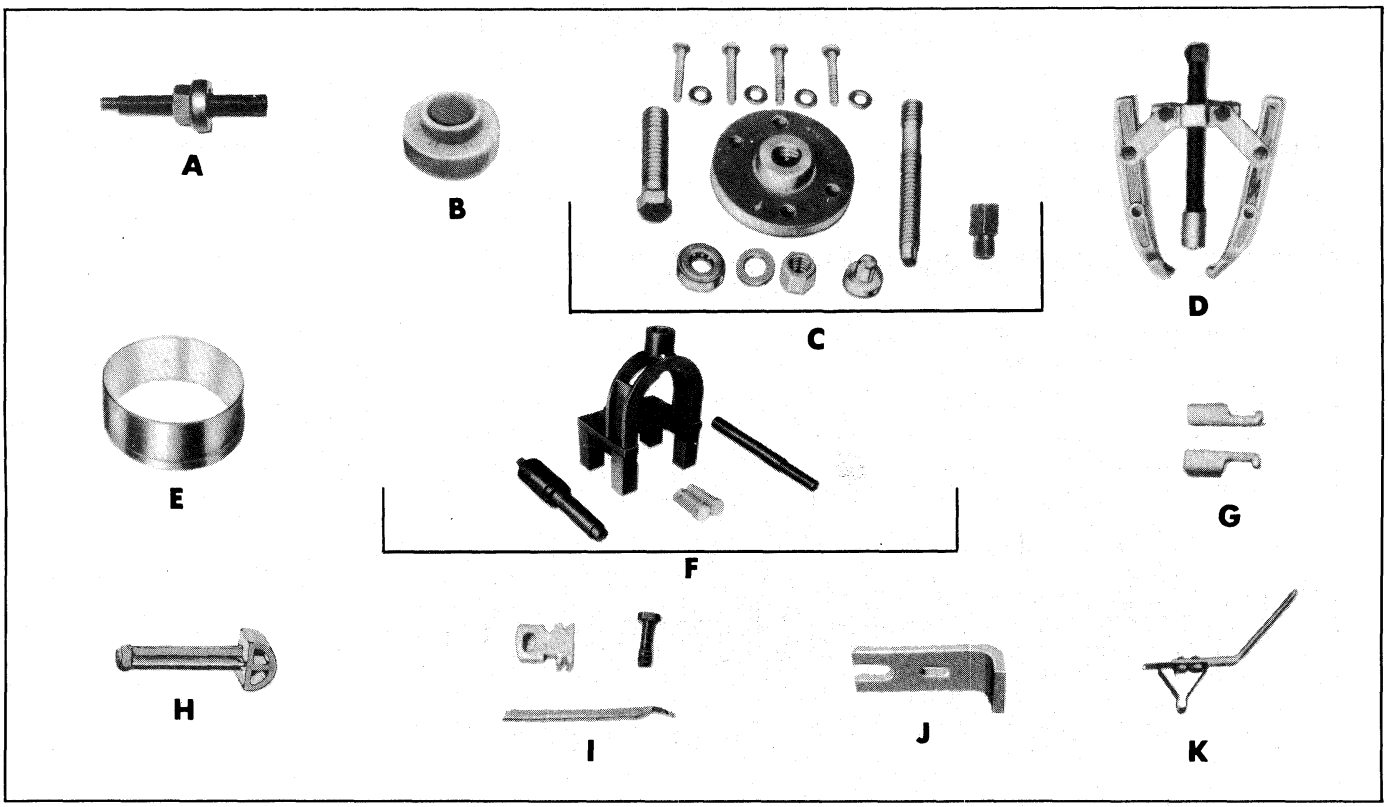


Fig. 6A-98 Special Tools

Key	Tool No.	Name
A	J-25288	Harmonic Balancer Installer
B	J-25264	Front Cover Oil Seal Installer
C	J-21052	Harmonic Balance Remover Set (Includes J-21052-8 Pilot)
D	J-25287	Crankshaft Timing Gear Puller
E	J-22666	Piston Ring Compressor
F	J-24086 BT7612	Piston Pin Remover and Installer Set
G	J-23129	Front Cover Oil Seal Remover Arms (Used with J-1859-03)
H	J-25285	Rear Main Oil Seal Installer
I	J-25286	Rear Main Oil Seal Packer
J	J-26220	Valve Spring Compressor
K	J-3074	Valve Lifter Leak-Down Tester

The following tools are available to perform specific operations on the 350 cubic inch engine.

Tool No.	Name
J-25262	Camshaft Bushing Remover and Installer Set
J-5830-1	Valve Guide Reamer (+.003)
J-5830-7	Valve Guide Reamer (+.013)
J-6621	Valve Guide Reamer (+.005)
J-3094	Valve Lifter Remover Pliers
J-8062	Valve Spring Compressor (Universal)
J-3224	Connecting Rod Bolt Guide Set
J-8080	Main Bearing Upper Shell Remover

ENGINE COOLING–EXCEPT SEVILLE

TABLE OF CONTENTS

Engine Cooling - Except Seville
General Description 6B-1
Diagnosis 6B-5
Leak Test 6B-3
Thermostat Test 6B-6
Testing Coolant Solutions 6B-6
Fan Clutch Diagnosis 6B-6
On Car-Service
Preventive Maintenance 6B-7
Flushing Procedure 6B-7
Thermostat 6B-8
Fan Assembly 6B-8
Fan Clutch Assembly 6B-8
Radiator 6B-9
Fan Shroud 6B-9
Water Pump 6B-9
Unit Repair
Water Pump 6B-10
Belt Adjustments 6B-12
Engine Cooling - Seville
General Description 6B-14
On-Car Service
Thermostat 6B-16
Fan and Clutch Assembly 6B-17
Water Pump 6B-17
Belt Adjustments 6B-18
Specifications 6B-20
Engine Accessory Drive Belts 6B-21
Torque Specifications 6B-21
Special Tools 6B-22

GENERAL DESCRIPTION

The 30.5″ radiator is of the cross-flow type and is rubber-mounted at top and bottom. It is retained at the top with a sheet metal cover, Fig. 6B-1.

The two-piece molded polypropylene fan shroud is fastened together with blind rivets. The shroud is attached to the radiator support at the bottom with screws and "J" nuts. At the top it attaches to the upper cover with screws and "J" nuts.

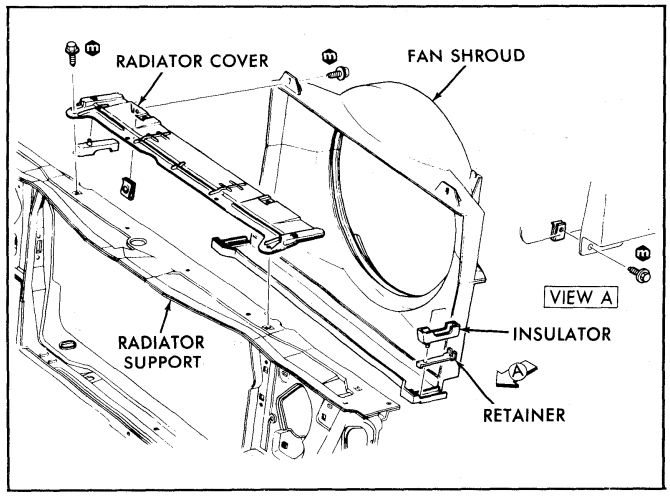


Fig. 6B-1 Radiator Cover and Fan Shroud - Except Seville

The Limousine, Commercial Chassis and Heavy Duty radiator is the same as other cars except for added copper in the core and a three plate transmission cooler in the outlet tank. All Cadillac radiators have a metal tab located near the bottom of the R.H. tank, engine side of radiator, giving the usage code. The following codes are used:

Standard Radiator Code AA

All except Heavy Duty Cooling and Limousine.

Heavy Duty Radiator Code AC

Heavy Duty Cooling and Limousine.

The coolant overflow bottle, Fig. 6B-2, is located on the right side of the engine compartment against the wheelhouse. It is mounted on the upper-cowl-to-radiator-strut by "U" nuts and bolts. The rear attachment utilizes a shoulder bolt driven from the inside. The other bolt is driven from the outside of the strut.

The cooling system is designed to be kept closed at all times. A coolant reservoir, Fig. 6B-3, keeps the system full, indicates the need for additional coolant, and allows coolant to be added without removing the radiator cap.

A vented radiator cap is used, which allows the coolant to expand through the normally open vent valve in the center

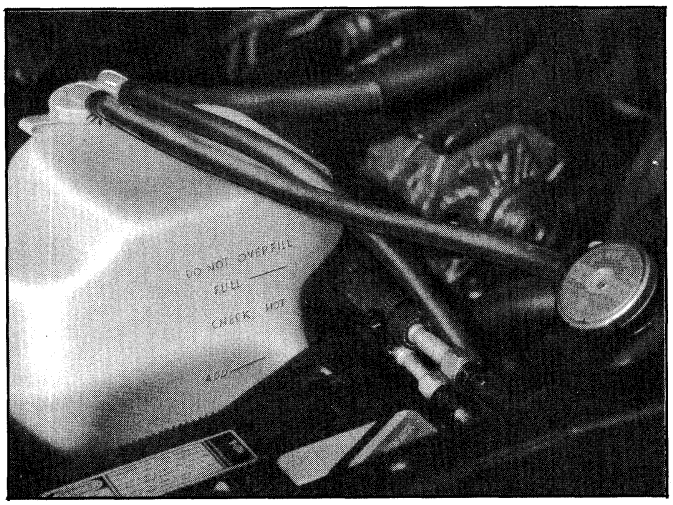


Fig. 6B-2 Coolant Overflow Bottle - Except Seville

of the cap without building unnecessary pressure. The expanding coolant flows into the coolant reservoir. The vent valve closes when the temperature of the coolant nears the boiling point and pressure is needed to control boiling. The 15 pound pressure will not be reached until the system is working at maximum capacity.

Any air or vapor in the cooling system is forced into the coolant reservoir under the liquid level and exhausts through the overflow hose at the top of the reservoir. As the system cools, extra coolant in the reservoir is drawn back to the radiator through the vent valve. In this manner, the radiator is kept full at all times. The need for additional coolant can be detected by observing the level of coolant in the reservoir while the engine is at normal operating temperature.

The radiator cap, Fig. 6B-4, should only be removed when draining and refilling the system or whenever it becomes necessary to add coolant because of lack of coolant in the reservoir, or when coolant has not been moving in and out of the reservoir.

WARNING: IF THERE IS EVIDENCE OF STEAM, DO NOT OPEN HOOD UNTIL STEAM IS DISPERSED.

Three different fan designs are used to meet the cooling requirements on Cadillac cars. All cars equipped with standard cooling system, except Eldorado, Limousine and Commercial, use a five blade flex fan with a 82 mm inch spacer. Eldorado's with standard cooling systems use a seven blade flex fan with a 2-3/4 inch spacer. A high viscosity fluid clutch is used for heavy duty cooling and Commercial Chassis-Limousine applications.

In addition, the limousine and commercial chassis cars also use a seven bladed fan.

The fan clutch is serviced only as an assembly and is designed to reduce fan speed and noise as engine cooling needs become less (engine is cold) or to maintain fan speed should cooling needs increase (engine is warm).

The flex fan is designed so that the blades flatten out (decrease their pitch) at high engine speeds when additional air flow is not needed due to the "ram air" provided by

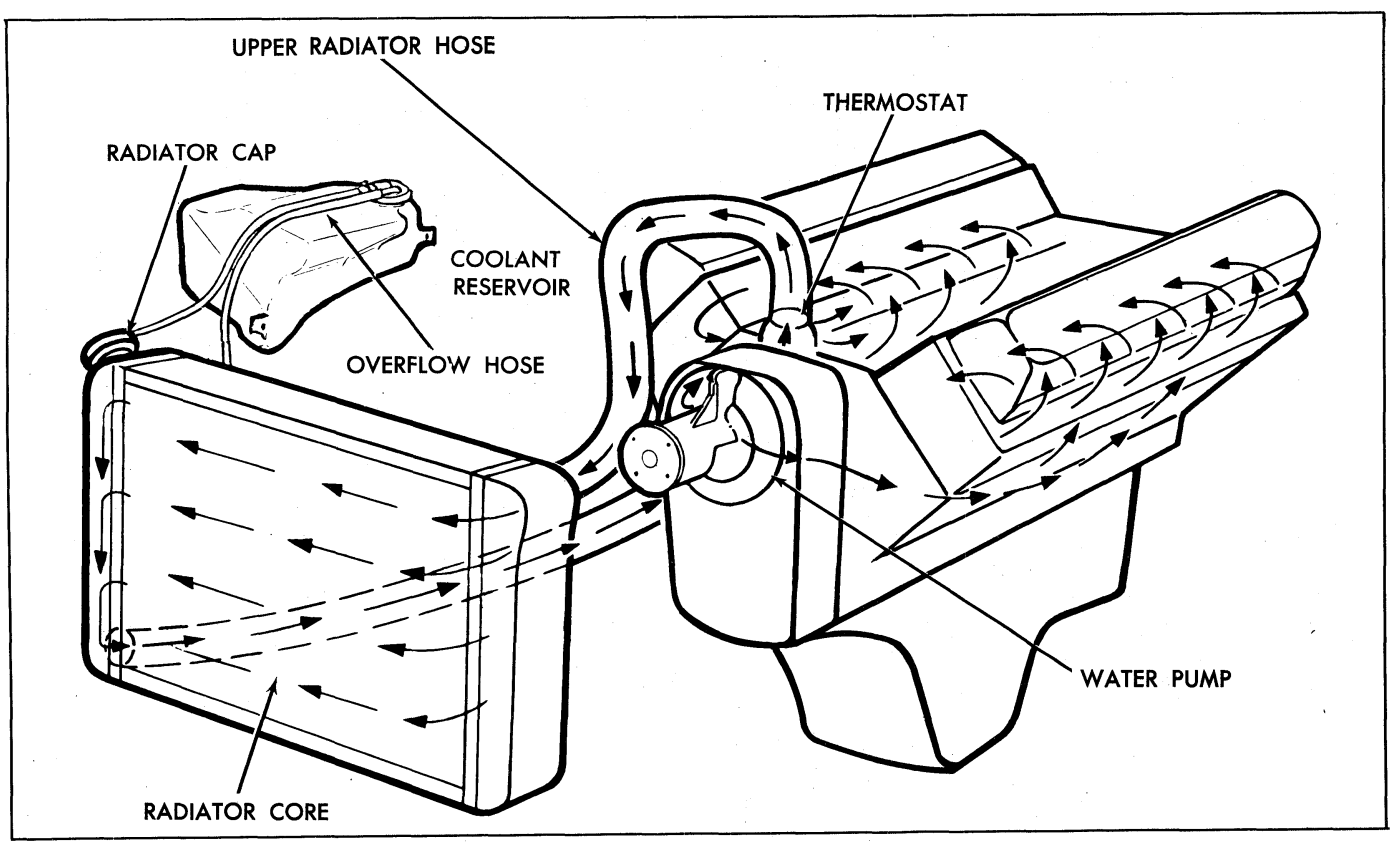


Fig. 6B-3 Flow of Coolant

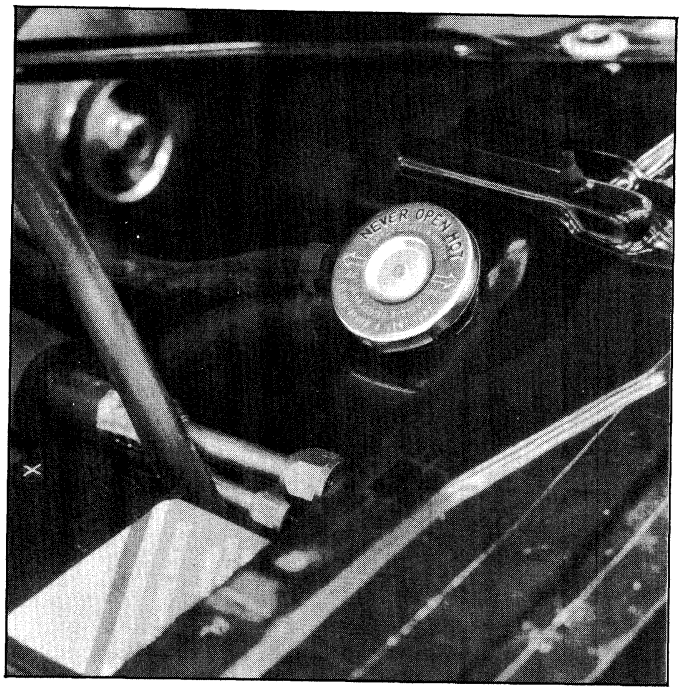


Fig. 6B-4 Radiator Cap

vehicle motion.

The fan assemblies are illustrated in Fig. 6B-5.

WARNING: IT IS ESSENTIAL THAT FAN ASSEMBLIES REMAIN IN PROPER BALANCE AND PROPER BALANCE CANNOT BE ASSURED ONCE A FAN ASSEMBLY HAS BEEN BENT OR DAMAGED. A FAN ASSEMBLY THAT IS NOT IN PROPER BALANCE COULD FAIL AND FLY APART DURING SUBSEQUENT USE CREATING AN EXTREMELY DANGEROUS CONDITION.

IF A FAN BLADE IS BENT OR DAMAGED IN ANY WAY, NO ATTEMPT SHOULD BE MADE TO REPAIR AND REUSE THE DAMAGED PART. A BENT OR DAMAGED FAN ASSEMBLY SHOULD ALWAYS BE REPLACED WITH A NEW FAN ASSEMBLY.

A double groove steel water pump pulley with a 1.24:1 ratio is used on all cars equipped with A.I.R. Non A.I.R. cars use a single groove steel pulley with a 1.14:1 ratio.

A water pump is mounted at the front of the engine. It is driven by a single "V" belt and may be serviced as described on page 6B-9.

Coolant is pumped to each bank of cylinders simultaneously, then through passages to the cylinder heads, through the thermostat housing at the top of the cylinder block to the left hand radiator tank. Radiator coolant flow is from the left hand tank through the core to the right hand tank, which is the source of coolant to the water pump inlet, Fig. 6B-3.

When the thermostat is closed, coolant from the cylinder heads is pumped through a by-pass passage below the thermostat housing to the water pump and recirculated. When the engine is sufficiently warm, the thermostat opens and coolant flows to the inlet tank on the left side of the radiator, and is cooled as it flows across the horizontal core tubes to the outlet tank on the right side of the radiator, completing the cycle.

The coolant temperature tell-tale light is located in the warning light cluster at the top of the instrument panel, Fig. 8-71. The light reads "COOLANT TEMPERATURE" and glows amber whenever coolant temperature becomes excessive (260°F. (127°C) or higher). The light is activated by a temperature sensitive switch in the water passage directly below the air conditioning compressor. To check operation of the "COOLANT TEMPERATURE" tell-tale light, turn the ignition switch to the Start position. The light should glow. As soon as the switch is moved away from Start, the light should go out.

In addition to the water temperature warning light, an engine metal temperature warning light and buzzer system is used.

The second tell-tale light to the right of the "COOLANT TEMPERATURE" indicator (Fig. 8-71) is a red light that reads "STOP ENGINE-TEMPERATURE". It will light whenever engine metal temperature is excessive. In addition to the glowing lamp, the key buzzer will sound.

The engine metal temperature switch, Fig. 6B-6, located at the rear of the left cylinder head senses the temperature of the casting rather than the temperature of the coolant. Since the switch screws into a blind hole in the cylinder head, sealer is not required and MUST NOT be used when installing this switch.

Operation of the "STOP ENGINE-TEMPERATURE" light is checked by opening the driver's door while ignition key is in Lock or Off positions. Light should glow and buzzer should sound. The high engine temperature warning system does not utilize the ignition switch "START" ground circuit for testing operation as do the other tell-tale lights. Therefore, the red "STOP ENGINE-TEMPERATURE" light should not glow when the ignition switch is in the Start position.

Thermostat

The thermostat consists of a restriction valve actuated by a thermostatic element. (Use of thermostats rated above 195 degrees F. control temperatures are not recommended.) This is mounted in the housing at the front of the intake manifold above the water pump. The thermostat should be installed with the arrow up toward the radiator. This way the coolant has a smooth unobstructed flow through the thermostat and water outlet.

When the thermostat is incorrectly installed, the thermostat valve acts as a baffle, forcing the coolant to change direction to pass around the valve. This change in direction interrupts the smooth unobstructed flow of coolant to the radiator and can possibly result in overheating conditions.

Thermostats are designed to open and close at predetermined temperatures and if not operating properly should be removed and tested as described on page 6B-6.

System Leak Test

1. Make visual check of hoses and hose connections for leaks. Tighten clamps as required.

2. Install Hose Gage, J-23636, on upper radiator hose all the way, Fig. 6B-7.

3. Before installation of Adapter, J-23699, make sure

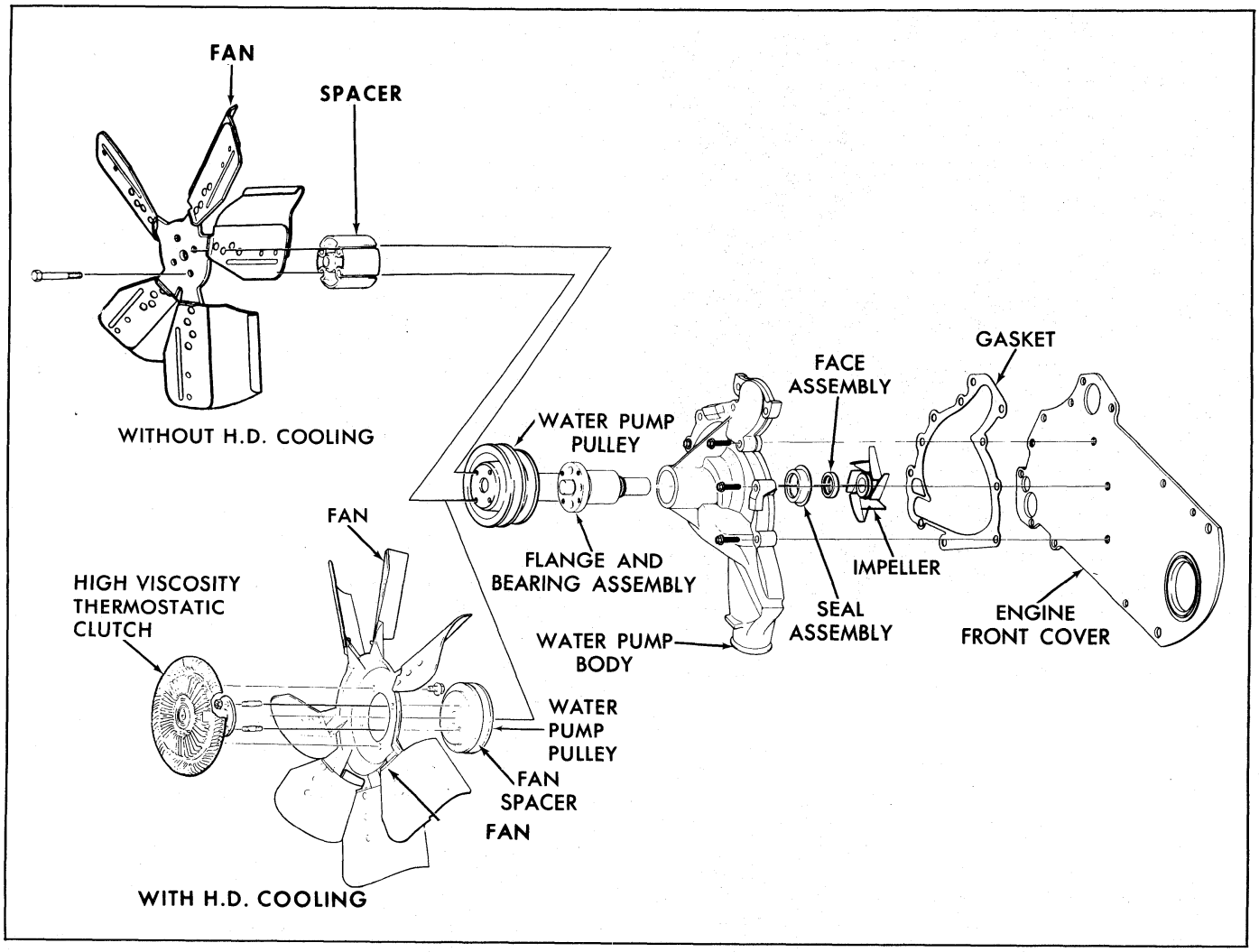


Fig. 6B-5 Water Pump Disassembled

rubber seal on pressure tester is fully extended and making full contact with adapter. Install Adapter, J-23699, on Pressure Tester, J-24460.

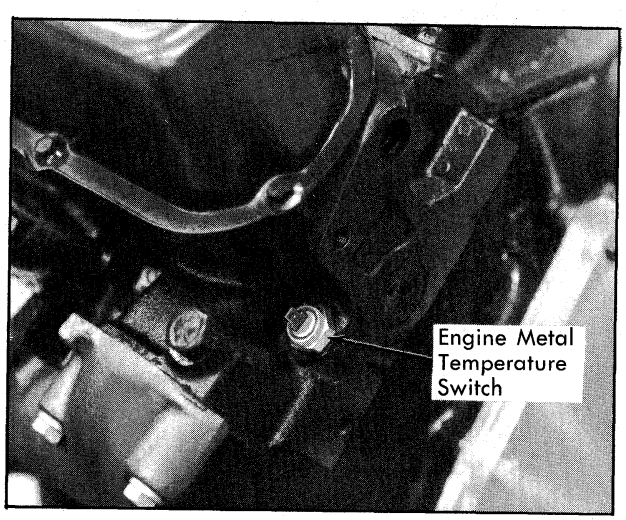


Fig. 6B-6 Metal Temperature Switch

4. Remove cap from reservoir and install pump adapter to hose on bottom of cap, Fig. 6B-7. Secure with clamp.

5. Pump system to 16 psi and watch for pressure drop on pump gage.

6. If pressure drops below 16 psi in 10 seconds, the cap spring washer gasket, the filler neck nipple, or an overflow hose connection is leaking. If pressure does not drop proceed to Step 12.

7. Open drain valve on radiator and drain until all pressure is out of system. Close valve and proceed.

8. Remove radiator cap and check for weak spring washer or damage to gasket. Check overflow tube to filler neck for solder crack. Check overflow hose for loose connections at each end.

9. If spring washer in cap is weak, install new radiator cap. If nipple is loose or cracked, re-solder. If hose connection is loose, replace clamp.

10. Re-install coolant and cap. If new cap is installed, wet both top and bottom sealing gasket with coolant.

11. Re-install pump to adapter and pressurize system to 16 psi. If system holds pressure for 10 seconds, cap gasket is sealing.

12. To check cap holding pressure, set red washer on

COOLING SYSTEM DIAGNOSIS

CONDITION	CAUSE	CORRECTION
Engine overheats (i.e., COOLANT and/or ENGINE TEMP lights come on and stay on, or coolant overflows from reservoir onto ground while engine is running).	Loss of coolant.	See "Loss of Coolant" condition below.
	Loss of system pressure.	Inspect system. Check hose connections and tighten as necessary.
	Low coolant protection (should be -37°F/38°C)	Test solution as described on page
	Belt tension too low.	See page
	Spark timing incorrect.	Set timing to 10° advance.
	Timing retarded by poor function of distributor vacuum advance unit	Check hose for kinks, partial collapse, or poor connections.
	Water pump inoperative.	Repair as required, page
	Radiator fins obstructed.	Clean away bugs, leaves, etc.
	Cooling system passages blocked by rust or scale.	Flush system - add fresh coolant.
	Reservoir hose pinched or kinked (especially at radiator filler neck).	Relieve kinks by re-routing. Replace hose if necessary.
	Lower radiator hose collapses.	Check for hose spring position by squeezing lower end of hose. Replace as necessary.
	Defective engine metal temp switch.	Replace switch.
	Exhaust system restriction.	Check muffler and exhaust pipe for collapse.
	Thermostat stuck in closed position.	Replace thermostat.
Loss of coolant.	Leaking radiator.	Inspect cooling system as described on page
	Leaking coolant reservoir or hose.	Replace reservoir or hose.
	Loose or damaged hoses or connections.	Reseat or replace hoses or clamps.
	Water pump seal leaking.	Repair water pump as described on page
	Water pump gasket leaking.	Replace gasket.
	Radiator cap damaged, or filler neck distorted.	Inspect cooling. If neck is distorted, use wood block and mallet to reform evenly to fit cap. reform evenly to fit cap.
	Cylinder head gasket leaking.	Replace gasket.
	Improper cylinder head screw torque.	Tighten screws to 115 foot-pounds. (156 N·m)
	Cylinder block core plug leaking.	Replace core plug.
	Cracked cylinder head or block or warped cylinder head or block gasket surface.	Resurface or replace.
	Leaking heater core.	Repair or replace core.
	Leaking heater water control valve.	Replace valve.
Engine fails to reach normal operating temperature. (Cool air from heater.)	Thermostat stuck open or wrong type thermostat.	Install new thermostat of correct type and heat range.
	Coolant below add mark.	Add coolant.

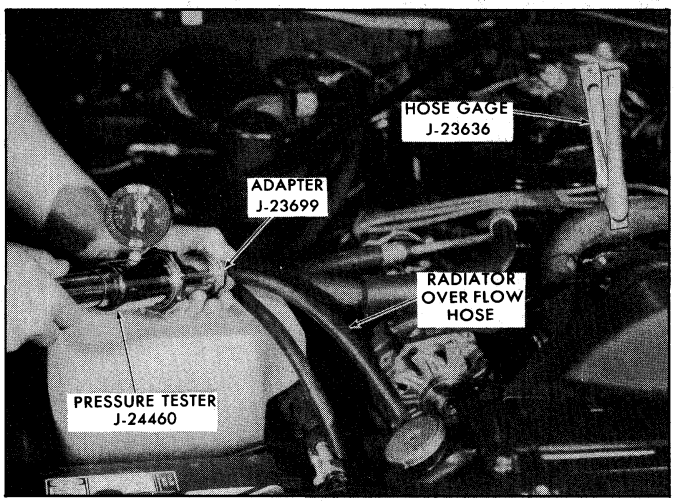


Fig. 6B-7 Testing Closed Cooling System

hose gage against movable handle.

13. With a **quick** turn, completely separate pump from adapter.

NOTE: Quick action is necessary to close the drop valve. If movable handle has moved 1/4" or more away from red washer, either the radiator cap is not holding pressure or the pump was not separated quickly enough from the adapter.

Pump up system again to 16 psi and quickly and completely separate pump from adapter. If handle still moves 1/4" or more, check radiator cap for pressure, as indicated in Step 17. Cap should hold 12 pounds minimum pressure.

14. Make sure red washer is seated against movable handle. After 5 minutes, wiggle hose and note position of movable handle relative to red washer.

15. If handle has not moved more than 1/4 inch in 5 minutes, cooling system is holding sufficient pressure. Release system pressure slowly to prevent entry of air into cooling system. Test is complete.

16. If handle has moved more than 1/4 inch, inspect for leaks. Repair as required and repeat Steps 11-15.

17. If leak is not obvious, repeat Steps 3 through 6 and Step 12. Remove adapter from hose on reservoir cap. Insert end of hose in a glass of water below liquid level and watch for bubbles. Presence of bubbles indicates a leaking relief valve or drop valve. Inspect relief valve gasket on cap and inner sealing surface of filler neck for damage or foreign debris.

Cap relief valve may be pressure checked by replacing end of Adapter, J-23699, with radiator cap and pumping pressure tester slowly to obtain minimum holding pressure. A reading of less than 12 pounds indicates a defective cap. If cap is defective, replace cap and repeat Steps 11-15.

18. Remove adapter from bottom of reservoir cap hose if not done in Step 17. Install reservoir cap and remove Hose Gage, J-23636.

Thermostat Test

The thermostat may be checked by suspending it, with the thermostat heat control unit **down,** in a small pan of ethylene glycol coolant containing a thermometer. Neither the thermostat nor the thermometer should rest on the bottom of the pan because of the uneven concentration of heat at this point when the pan is heated. The thermostat valve should start to open at a temperature between 192°F and 199°F (89°C and 93°C). When the coolant reaches a temperature of 219°F (104°C), the valve should be fully open (approximately 7/16 inch).

Testing Coolant Solutions

A hydrometer test will indicate whether ethylene glycol or water or both should be added to maintain the desired freezing point of the solution. The freezing point of the solution should give protection to an acceptable range of -35° To -45° (-37°C To -43°C), regardless of climatic conditions. This is necessary to provide adequate corrosion protection.

Some devices used for testing solutions will indicate the correct freezing point only when tested at a specific temperature. Other testers provide thermometers and tables indicating freezing points corresponding to readings made at various temperatures. Disregarding the temperature of the solution when testing may cause an error as large as 30°F (-1°C) in determining the freezing point.

Fan Clutch Diagnosis

1. NOISE

Fan noise is sometimes evident under the following normal conditions:

a. When clutch is engaged for maximum cooling.

b. During first few minutes after start-up until the clutch can re-distribute the silicone fluid back to its normal disengaged operating condition after overnight setting.

However, fan noise or an excessive roar will generally occur continuously under all high engine speed conditions (2500 rpm and up) if the clutch assembly is locked up due to an internal failure. If the fan cannot be rotated by hand or there is a rough grating feel as the fan is turned, the clutch should be replaced.

2. LOOSENESS

Under various temperature conditions, there is a visible lateral movement that can be observed at the tip of the fan blade. This is a normal condition due to the type of bearing used. Approximately 1/4" maximum lateral movement measured at the fan tip is allowable. This is not cause for replacement.

3. SILICONE FLUID LEAK

The operation of the unit is generally not affected by small fluid leaks which may occur in the area around the bearing assembly. However, if the degree of leakage appears excessive, proceed to item 4.

4. ENGINE OVERHEATING

a. Start with a cool engine to insure complete fan clutch disengagement.

b. If the fan and clutch assembly free-wheels with no drag (revolves over 5 times when spun by hand), the clutch should be replaced. If clutch performs properly with a slight drag go to Step C.

NOTE: Testing a fan clutch by holding the small hub with one hand and rotating the aluminum housing in a clockwise/counterclockwise motion will cause the clutch to free-wheel, which is a normal condition when operated in this manner. This should not be considered a test by which replacement is determined.

c. Position thermometer so that it is located between the fan blades and radiator. This can be achieved by inserting the sensor through one of the existing holes in the fan shroud or fan guard, or by placing between the radiator and the shroud. On some models, it may be necessary to drill a 3/16" hole in the fan shroud to insert thermometer.

CAUTION: *Check for adequate clearance between fan blades and thermometer sensor before starting engine.*

d. With thermometer in position, cover radiator grille sufficiently to induce a high engine temperature. Start engine and turn on A/C, operate at 2,000 rpm.

e. Observe thermometer reading when clutch engages. It will take approximately 5 to 10 minutes for the temperature to become high enough to allow engagement of the fan clutch. This will be indicated by an increase or roar in fan air noise and by a drop in the thermometer reading of approximately 5-15°F. (-15°C. to -9.4°C.). If the clutch did not engage between 150-195°F. (-65.5°C. to 90.5°C.) the unit should be replaced.

NOTE: Be sure fan clutch was disengaged at beginning of test.

If no sharp increase in fan noise or temperature drop was observed and the fan noise level was constantly high from start of test to 190°F. (87.7°C.) the unit should be replaced. Do not continue test past a thermometer reading of 190°F. to prevent engine overheating.

f. As soon as the clutch engages, remove the radiator grille cover and turn off the A/C to assist in engine cooling. The engine should be run at approximately 1500 rpm.

g. After several minutes the fan clutch should disengage, as indicated by a reduction in fan speed and roar.

If the fan clutch fails to function as described, it should be replaced.

ON-CAR SERVICE

Cooling System Preventive Maintenance

Every 12 months or 15,000 miles (whichever occurs first) inspect cooling system, wash radiator cap and filler neck, and pressure test cap and system. Tighten hose clamps as necessary and clean exterior of radiator core. Inspect condition of all cooling and heater hoses. Replace hoses if checked, swollen or otherwise deteriorated.

Regardless of climate, the cooling system should be drained, flushed with water only, and refilled every 24 months or 30,000 miles, whichever occurs first, with a 52° mixture of ethylene glycol-type coolant and water to protect the engine to at least -35° To -45°F. (-37°C. To -43°C.). These measures are necessary to retard corrosion, rust, and scale; keep water passages open; and seal against internal or external leakage.

NOTE: Supplemental inhibitors or additives claiming to provide increased cooling capability that have not been specifically approved by GM are not recommended for addition to the cooling system. These additives may be detrimental to the efficient operation of the system, and they represent an unnecessary operating expense.)

Check coolant level in reservoir at each engine oil change. The coolant reservoir is marked "FULL" and "ADD", Fig. 6B-8. These marks are approximately two quarts apart so that one quart of ethylene glycol and one quart of water can be added. The reserve above the full mark is to allow for expansion while parked after hot running. The coolant level should be between the "FULL" and "ADD" marks at normal operating temperature. The level may be observed below the "ADD" mark when the system cools below operating temperature.

Cooling System Flushing Procedure

1. Drain coolant from cooling system by opening radiator drain cock and removing two drain plugs from cylinder block. If coolant side of radiator cap is rusty, refill and drain system twice.

2. After drain points have been closed, refill system with fresh water only and install radiator cap. Set defrost lever to "DEF" position and turn temperature to 85°. This opens the water control valve and allows the water to pass through the heater core.

NOTE: On Fleetwood Sedans and Limousines, also turn rear heater system on and rotate temperature dial to 85°.

3. Run engine at medium speed for one-half hour at a temperature as hot as possible without boiling. Cover one-half the radiator if necessary.

4. Inspect the following points in the cooling system:

a. Radiator core for leaks.

b. Radiator air passages for plugging caused by bugs, leaves, etc.

c. Condition and tension of drive belts, as described on page 6B-12.

d. Condition of hoses and tightness of clamps.

5. Drain system by repeating Step 1. If flush water has a rust color, repeat procedure.

6. Add equal amounts of ethylene glycol base coolant and water to protect engine to at least -35° to -45°F. (-37°C. To -43°C.).

NOTE: Supplemental inhibitors or additives claiming to provide increased cooling capability that have not been specifically approved by GM are not recommended for addition to the cooling system. These additives may be detrimental to the efficient operation of the system, and they represent an unnecessary operating expense.

7. With the radiator cap removed and heater controls on maximum as outlined in Step 2, run engine with throttle set on fast idle cam for 10 minutes. Add coolant until the radiator is completely full and tighten radiator cap before stopping engine.

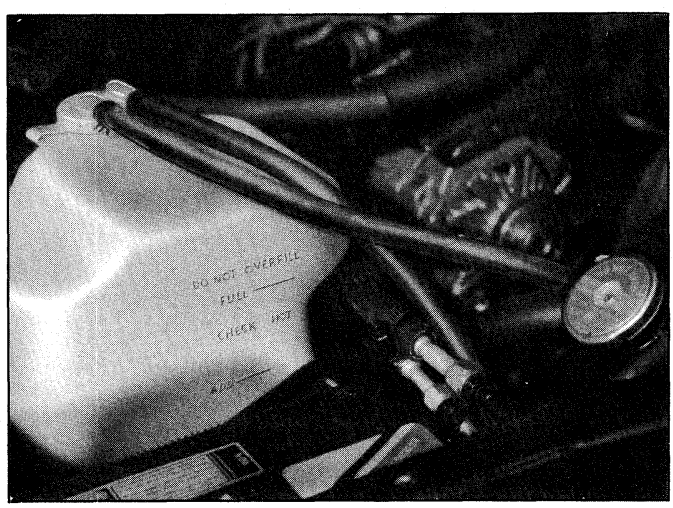


Fig. 6B-8 Coolant Reservoir

8. Check coolant level in the reservoir and add coolant as necessary to bring level up to the "FULL" mark.

9. Deterioration of the hoses in the engine compartment takes place over a period of time due to the exposure to high temperatures in this environment.

At 12-month or 15,000-mile intervals, wash radiator cap and filler neck with clean water, pressure test system and radiator cap for proper pressure holding capacity, tighten hose clamps, and inspect condition of all cooling and heater hoses. Replace hoses if checked, swollen or otherwise deteriorated.

Also each 12 months or 15,000 miles clean exterior of radiator core and air conditioning condenser. Every 24 months or 30,000 miles, drain, flush, and refill the cooling system with a new coolant solution as described.

Thermostat

a. Removal

1. Drain radiator until coolant level is below level of thermostat housing.

2. Disconnect upper radiator hose at thermostat housing.

3. Remove two screws securing thermostat housing to cylinder block and remove housing. Discard gasket.

4. Remove thermostat from cylinder block.

b. Installation

1. Install thermostat in opening at top of cylinder block with valve up.

2. Position a new gasket coated with gasket cement on cylinder block.

3. Install thermostat housing on cylinder block and secure with two screws. Tighten screws to 10 foot-pounds.

4. Connect upper radiator hose to thermostat housing.

5. Fill cooling system to proper level.

FAN ASSEMBLY

a. Removal

1. If working on Eldorado remove six screws securing radiator cover and remove one screw securing hose bracket to cover. Remove cover and proceed to Step 5.

2. Remove two screws each side securing radiator cover to strut support rods at radiator cover and loosen one screw each side at strut. Move support rods out of way.

3. Remove two screws securing fan shroud to radiator cover and one screw securing upper radiator hose brace to shroud.

4. Move shroud rearward (toward engine) and block into position to gain access to fan.

5. Unthread four screws holding fan and spacer to water pump hub. Screws are most easily loosened by loosening the generator and rotating the fan to put each screw at the top in turn.

NOTE: On Eldorado screws cannot be removed due to radiator clearance.

6. Remove fan, screws and spacer.

b. Installation

WARNING: IT IS ESSENTIAL THAT FAN ASSEMBLIES REMAIN IN PROPER BALANCE AND PROPER BALANCE CANNOT BE ASSURED ONCE A FAN ASSEMBLY HAS BEEN BENT OR DAMAGED. A FAN ASSEMBLY THAT IS NOT IN PROPER BALANCE COULD FAIL AND FLY APART DURING SUBSEQUENT USE CREATING AN EXTREMELY DANGEROUS CONDITION.

IF A FAN BLADE IS BENT OR DAMAGED IN ANY WAY, NO ATTEMPT SHOULD BE MADE TO REPAIR AND REUSE THE DAMAGED PART. A BENT OR DAMAGED FAN ASSEMBLY SHOULD ALWAYS BE REPLACED WITH A NEW FAN ASSEMBLY.

1. Make sure mounting holes in water pump pulley line up with threaded holes in water pump hub.

2. Position fan assembly and spacer to water pump hub and install four screws. Tighten screws to 18 ft. lbs.

3. If working on Eldorado position radiator cover and secure with six screws. Secure radiator hose clamp to cover with one screw.

4. Remove block and position fan shroud to radiator cover. Install two screws securing shroud to radiator cover. Secure upper radiator hose bracket to radiator cover with one screw.

5. Position radiator cover to strut support rods and secure with two screws each side at radiator cover. Tighten one screw each side at strut.

CLUTCH FAN ASSEMBLY (LIMOUSINE, COMMERCIAL AND HEAVY DUTY COOLING)

a. Removal

1. If working on Eldorado, remove six screws securing radiator cover and remove one screw securing radiator hose bracket to cover. Remove cover and proceed to Step 5.

2. Remove two screws each side securing radiator to strut support rods. Loosen one screw each side at strut. Move support rods out of way.

3. Remove two screws securing fan shroud and one screw securing radiator hose brace to shroud.

4. Move shroud rearward (toward engine) and block in position to gain access to fan.

5. Remove four nuts securing clutch hub to fan hub.

6. Remove fan and clutch by pulling forward off studs and then straight up.

b. Installation

NOTE: OBSERVE WARNING ON THIS PAGE.

1. Secure fan blade to clutch with four screws. Tighten screws to 18 foot-pounds.

2. Slide fan and clutch into position and install four attaching nuts. Tighten nuts to 18 foot-pounds.

3. If working on Eldorado, position radiator cover and secure with six screws. Secure radiator hose clamp to cover with one screw.

4. Remove block and position fan shroud and secure with two screws.

5. Secure upper radiator hose to fan shroud with one screw.

6. Position support rods and secure with two screws each at radiator. Tighten one screw each side at strut.

RADIATOR

a. Removal

1. If working on Eldorado, remove six screws securing radiator cover and remove one screw securing radiator hose bracket to cover and remove cover.

2. Disconnect negative battery cable.

3. Place drain pan under radiator and open drain cock at bottom right corner of radiator. Remove radiator cap so coolant will flow freely.

4. Loosen hose clamps and disconnect upper and lower radiator hoses at radiator.

5. Loosen clamp and disconnect heater return hose at right radiator tank.

6. Disconnect two transmission cooler lines at transmission fluid cooler tank on right side of radiator. Plug all openings to prevent loss of fluid.

7. Remove one screw securing upper radiator hose clamp to upper fan shroud.

8. Remove two screws each side securing radiator cover to strut support rods. Loosen one screw each side at strut and move support rods out of way.

9. Remove two screws securing fan shroud to radiator cover.

10. Remove two screws securing radiator cover and remove cover.

11. Remove reservoir hose from filler neck.

12. Being careful not to damage radiator, remove radiator by lifting straight up.

b. Installation

1. Carefully lower radiator into position in cradle.

2. Connect reservoir hose to filler neck.

3. If working on Eldorado position radiator cover and secure with six screws. Secure radiator hose clamp to cover with one screw.

4. Install radiator cover panel and secure with two screws.

5. Install two screws securing shroud to radiator cover.

6. Position radiator support rods and secure with two screws each side. Tighten one screw each side at strut.

7. Install one screw securing upper radiator hose clamp to upper fan shroud.

8. Connect two transmission cooler lines at transmission fluid cooler tank on right side of radiator, tightening to 20 ft. lbs.

9. Connect upper and lower radiator hoses at radiator and secure with hose clamps.

10. Connect heater return hose to right radiator tank.

11. Close radiator drain cock, and fill cooling system with recommended coolant.

12. Connect negative battery cable.

13. Set Automatic Climate Control to "DEF" position and rotate temperature dial to 85°.

14. Run engine sufficiently to pump coolant through entire system and check radiator and transmission for fluid levels.

15. Install radiator cap and check all connections for leaks.

FAN SHROUD (Except Eldorado)

a. Removal

1. Remove radiator as described on page 6B-9.

2. Remove two screws securing shroud to bottom of radiator cradle.

3. Carefully tilt shroud out and over fan and remove shroud.

b. Installation

1. Carefully install shroud over fan.

2. Position shroud to radiator cradle and secure with two screws.

3. Install radiator as described on page 6B-9.

WATER PUMP

a. Removal

1. Disconnect negative battery cable.

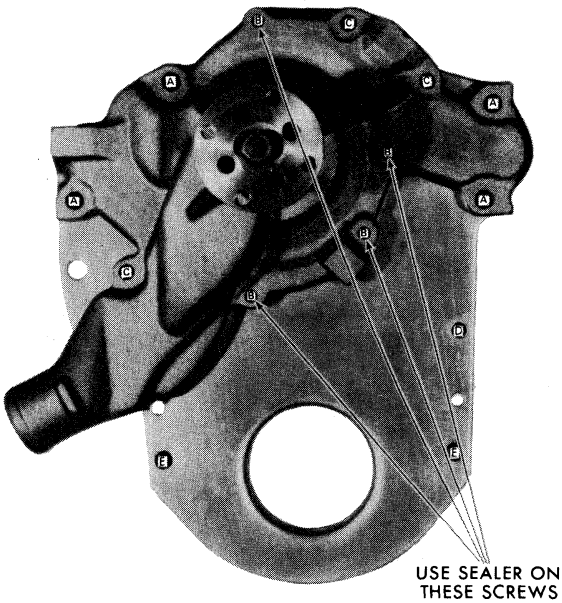
2. Drain radiator.

3. If working on Eldorado, remove six screws securing radiator cover and remove one screw securing radiator hose bracket to cover. Remove cover and proceed to Step 7.

4. Remove two screws each side at radiator securing support rods. Loosen one each side at strut and move support rods out of way.

5. Remove two screws from upper fan shroud and remove one screw securing upper radiator hose brace.

6. Drill out nine rivets securing upper fan shroud to lower fan shroud and remove upper shroud.



Key	No.	Size	Torque
A	(4)	3/8 - 16 x 1-3/8	22 foot-pounds
B	(4)	1/4 - 20 x 1-1/8	70 inch-pounds
C	(3)	5/16 - 18 x 1-1/4	15 foot-pounds

Fig. 6B-9 Water Pump Assembly Attaching Screws

7. Remove fan assembly as described on page 6B-8.
8. Loosen generator mounting screws and remove drive belt.
9. Loosen power steering pump mounting screws and remove power steering pump belt.
10. Remove water pump pulley from shaft.
11. Disconnect water inlet hose from water pump.
12. Disconnect fuel line at carburetor inlet and fuel pump. Remove fuel line.
13. Loosen four screws securing crankshaft pulley to hub approximately 1/2 way and move pulley out slightly.
14. Remove 11 screws securing water pump to engine front cover and remove pump. Discard gasket and clean gasket surfaces.
15. Remove studs from pump flange if vehicle is so equipped.

b. Installation

1. Position new gasket on water pump flange.
2. Position pump on engine, lining up holes in pump with holes in engine front cover, and install eleven screws with sealer as indicated in Fig. 6B-9.
3. Tighten four crankshaft pulley to hub screws to 15 ft. lbs.
4. Connect water inlet hose to pump.
5. Position water pump pulley on pump.
6. Loosely install all drive belts.
7. Install fan assembly as described on page 6B-8.
8. Tension all drive belts as described on page 6B-12.
9. Install fuel line and secure at carburetor inlet and fuel pump.
10. If working on Eldorado, position radiator cover and secure with six screws. Secure radiator hose clamp to cover with one screw.
11. Install upper fan shroud and secure to lower shroud with nine screws and "J" nuts.
12. Install two screws securing shroud to radiator cover.
13. Install support rods and secure with two screws each side at radiator. Tighten one screw each side at strut.
14. Position upper radiator hose bracket to upper fan shroud and secure with one screw.
15. Fill cooling system to proper concentration and level with ethylene glycol base coolant.
16. Reconnect negative battery cable.
17. Run engine and check for leaks.

UNIT REPAIR

WATER PUMP

Disassembly and Assembly - On Bench

NOTE: Some water pumps may have a greenish coolant stain at the vent hole below the shaft. This is a normal condition. The water pump should not be serviced unless it is obviously leaking with the engine running and under pressure.

a. Disassembly

1. Position Support, J-23675-4, around shaft of water pump between pump body and flange so that water pump casting fits in slight recess, Fig. 6B-10.
2. Position pump impeller-side-up in arbor press so that shaft and bearing assembly is free to move when pressed.
3. Position J-23675-1 on impeller side of shaft and press shaft and bearing assembly and impeller hub through impeller and pump body and out front of pump, Fig. 6B-10.
4. Remove special tools and remove impeller from pump body.
5. Discard all parts except pump body, Fig. 6B-5.

b. Assembly

1. Position Bearing Locator, J-23675-3, into rear of pump and place pump, face up, in arbor press, Fig. 6B-11.

NOTE: Locator, J-23675-3, determines depth that bearing is installed in water pump body. The body rests on the lower step and bearing outer race bottoms against the upper step upon installation of the bearing.

2. Using Shaft and Bearing Installer, J-23675-2, press shaft and bearing into pump until bearing outer race bottoms on Locator, J-23675-3, Fig. 6B-11.

NOTE: If a hydraulic press is used, care should be exercised not to exert excessive pressure on the pins of J-23675-2. If available, a press without hydraulic assist is best used for this job.

Installer, J-23675-2, acts only as an installer, not as a gage. The notches on the pins of J-23675-2 accommodate production variations of the flange and bearing assembly and water pump body. On a few pumps, outer race of bearings may be below water pump body. However, the low steps of J-23675-2 will never touch the pump body when correctly installed.

3. Position Support, J-23675-4, between water pump body and flange, so that water pump casting fits in slight recess, Fig. 6B-12.

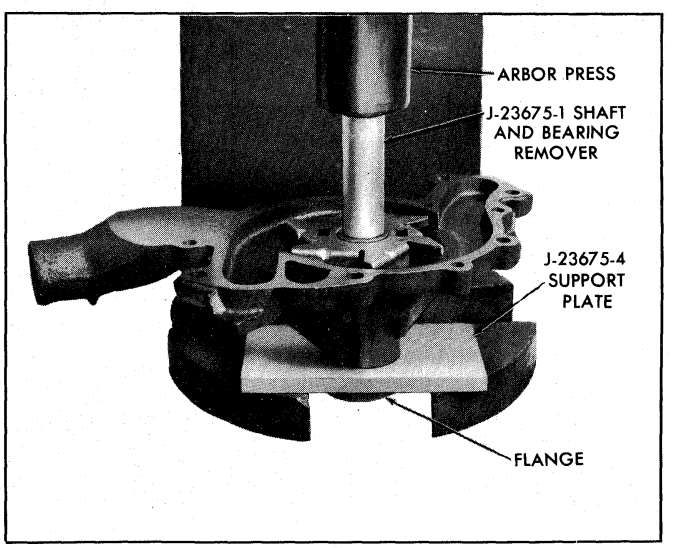


Fig. 6B-10 Disassembling Water Pump

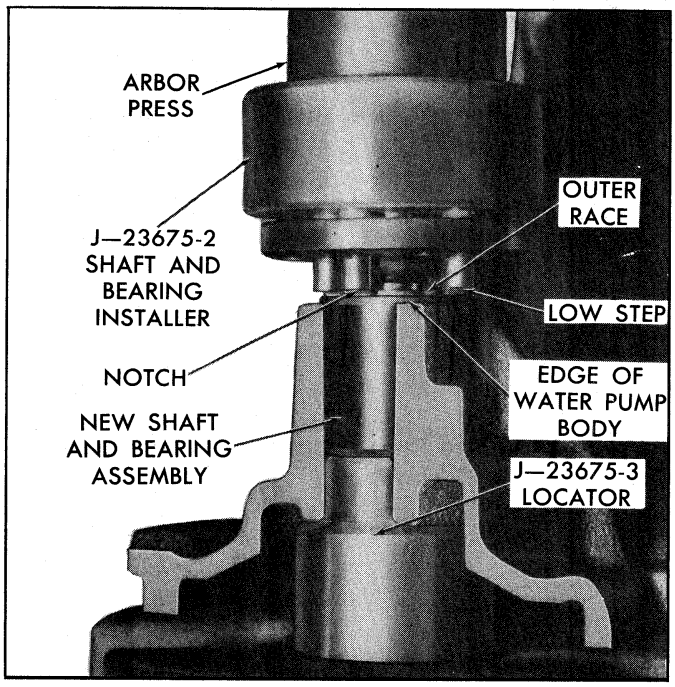


Fig. 6B-11 Installing Shaft and Bearings

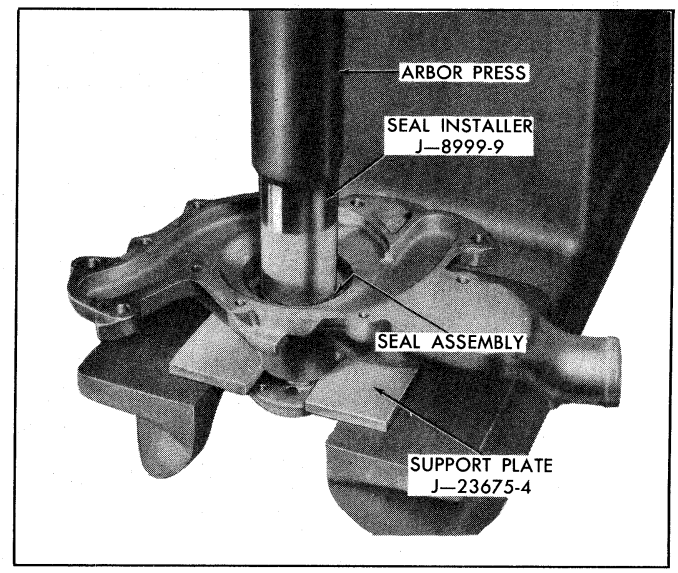


Fig. 6B-12 Installing Seal

4. Position new seal assembly over shaft with spring end up and press into position using Seal Installer, J-8999-9, Fig. 6B-12.

NOTE: Support Plate, J-23675-4, supports the pump body as the seal assembly is seated against the body. This arrangement prevents an accidental dislocation of the bearing in its relation to the pump body.

5. Dip ceramic seal in ethylene glycol before installing over shaft. Install ceramic seal and drive rubber over shaft with ceramic side down.

6. Position Bearing Installer, J-23675-2, with pins down and not supporting assembly into cut out section of Support Plate, J-23675-4, and position shaft on flange into hole in J-23675-2, Fig. 6B-13.

7. Position impeller vanes down over shaft and exactly center recess of J-23675-1 on impeller hub, Fig. 6B-13. Press impeller into position until tool bottoms on shaft.

NOTE: J-23675-1 positions the impeller so the shaft is .010" 0.20" above impeller hub. This aligns the impeller so the blades will not strike the engine front cover. When installing the impeller, shaft is supported on its ends by J-23675-1 and J-23675-2. This arrangement prevents an accidental dislocation of the bearing in its relation to the pump body.

8. Check to see that impeller does not strike engine front cover upon installation. This may be done by placing a straight edge across the body and rotating the impeller. Shaft and impeller blades should cear the straight edge.

9. If blades clear, install pump on car. If the blades do not clear, the following corrective action may be taken.

10. Repeat Steps 6 and 7 and check for impeller clearance. Also, if blades do not stick out past the body excessively, the engine front cover gasket may provide the necessary clearance.

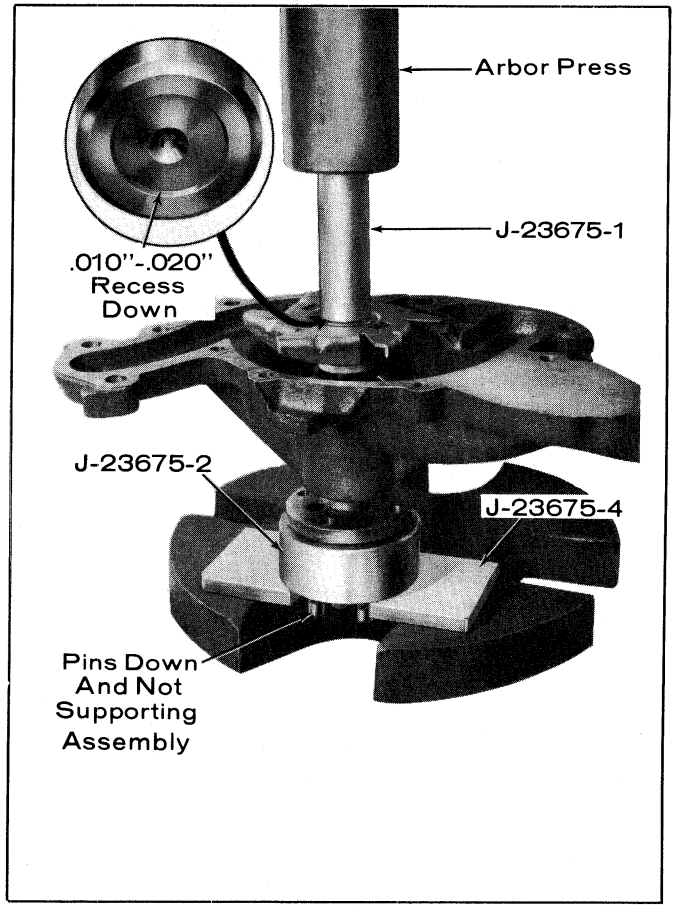


Fig. 6B-13 Installing Impeller

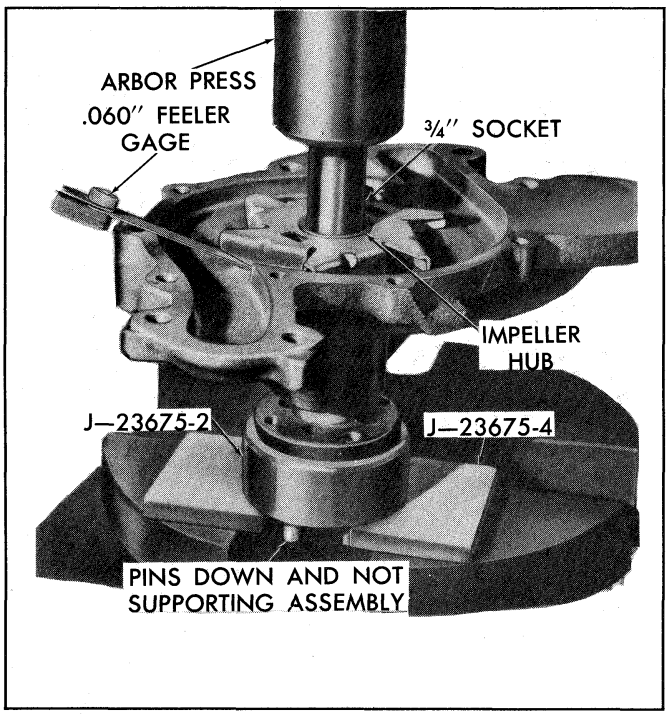


Fig. 6B-14 Gaging Impeller

11. If Step 10 does not correct problem, an attempt may be made to relocate the impeller hub. Position Bearing Installer, J-23675-2, with pins down and not supporting assembly, into cut out section of Support Plate, J-23675-4. Position shaft on flange into hole in J-23675-2, Fig. 6B-14. Center a 3/4" socket on impeller hub and insert .060" feeler gage between pump body and impeller blade. Carefully press impeller hub until correct clearance is obtained. Specification between body and blade is .030" to .060".

CAUTION: *Do not press too far or rebuilt pump may be damaged.*

12. Install studs to pump flange if fan clutch is to be used.

Belt Adjustments

Drive belt specifications are shown on page 6B-21.

a. Checking Drive Belts

1. Drive belts should be checked for signs of wear, cuts, and fraying. Deteriorated belts should be replaced.

2. Place Belt Tension Gage, J-23600 midway between pulleys on drive belt being checked, locations A,B,C or D indicated in Fig. 8B-15.

3. Check gage reading for belt being checked. Proper belt tension is shown in the table on page 6B-21. If belt tension is incorrect, adjust specific belt according to the corresponding procedure described in b, c, d, or e of this procedure.

NOTE: A belt that has been previously tensioned is considered a used belt. A belt that has never been tensioned is considered a new belt.

4. If, after tensioning, a belt fails to maintain the minimum tension specified in chart, it should be replaced.

b. Generator Belt Tension (Except H.D. Generator)

1. Place Belt Tension Gage, J-23600 on drive belt midway between pulleys at location A in Fig. 6B-15.

2. Loosen generator link adjusting screw and pivot screw under generator.

3. Move generator as required until correct belt tension is obtained on gage.

4. Tighten generator link adjusting screw to 20 foot-pounds (27 N·m).

5. Tighten pivot screw under generator to 28 foot-pounds (38 N·m) and remove Belt Tension Gage.

c. Power Steering Pump and/or Air Conditioning Compressor Belt Tension

1. Place Belt Tension Gage, J-23600 on drive belt midway between pulleys at location "B" in Fig. 6B-15.

2. Loosen, (1) steering pump adjusting nut at top of pump mounting bracket, (2) lower adjusting slot bolt and (3) pivot bolt.

3. Move power steering pump as required until correct belt tension is obtained on gage.

4. Snug lower adjusting slot bolt.

5. Snug lower pivot bolt.

6. Snug upper adjusting slot nut.

7. Tighten lower adjusting slot bolt to 30 foot-pounds (40.5 N·m).

8. Tighten lower pivot bolt to 30 foot-pounds (40.5 N·m).

9. Tighten upper adjusting slot nut to 22 foot-pounds (30 N·m).

d. A.I.R. Pump Belt Tension

1. Raise front of car.

2. Loosen A.I.R. Pump pivot bolt.

3. Place Belt Tension Gage, J-23600 on drive belt midway between pulleys at location C in Fig. 6B-15.

4. Loosen A.I.R. Pump adjuster link screw below pump.

5. Move A.I.R. Pump as required until correct belt tension is obtained on gage.

CAUTION: *To avoid internal damage, pry as close to rear of pump cover as possible, near dowel pin.*

6. Tighten adjuster link screw to 20 ft. lbs. (27 N·m).

7. Tighten pivot screw to 25 ft. lbs. (34 N·m) and remove Belt Tension Gage.

8. Lower car.

e. Heavy Duty Generator Belt Tension

1. Place belt tension gage, J-23600 on drive belt midway between pulleys at location A in Fig. 6B-15.

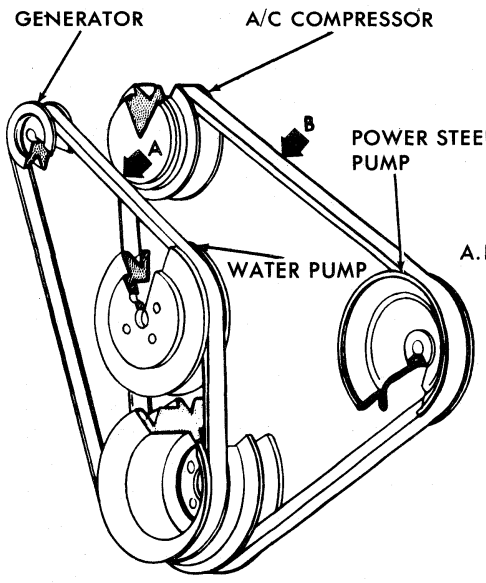
2. Loosen idler bracket adjusting and pivot bolts.

3. Move idler pulley as required until correct belt tension is obtained on gage.

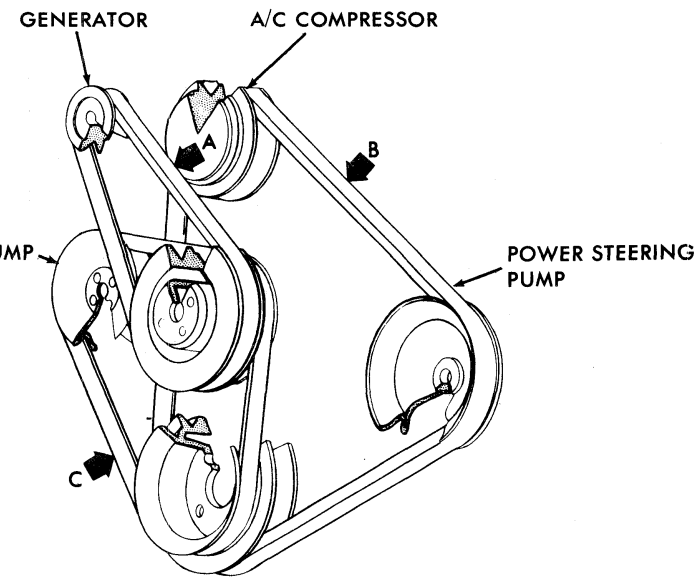
4. Tighten idler adjusting bolt to 20 foot-pounds (27 N·m).

5. Tighten idler pivot bolt to 28 foot-pounds (38 N·m) and remove belt tension gage.

EXCEPT COMMERCIAL CHASSIS

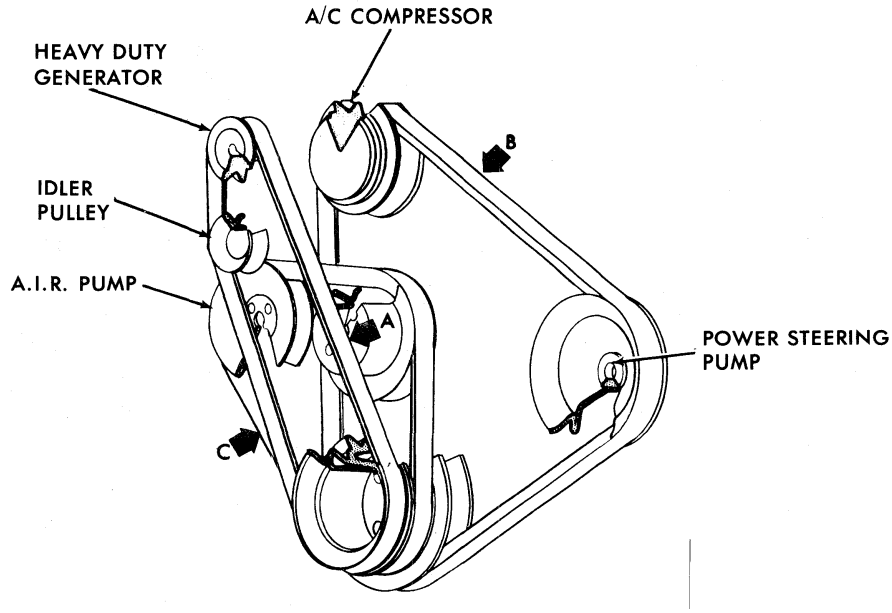


WITHOUT A.I.R.



WITH A.I.R.

COMMERCIAL CHASSIS ONLY



WITH H.D. GENERATOR

Fig. 6B-15 Belt Tensioning

ENGINE COOLING — SEVILLE

GENERAL DESCRIPTION

ENGINE COOLING-SEVILLE

The cooling system is designed to be kept closed at all times. A coolant reservoir, Fig. 6B-16, keeps the system full, indicates the need for additional coolant, and allows coolant to be added without removing the radiator cap.

A vented radiator cap is used, which allows the coolant to expand through the normally open vent valve in the center of the cap without building unnecessary pressure. The expanding coolant flows into the coolant reservoir. The vent valve closes when the temperature of the coolant nears the boiling point and pressure is needed to control boiling. The 15 pound pressure will not be reached until the system is working at maximum capacity.

Any air or vapor in the cooling system is forced into the coolant reservoir under the liquid level and exhausts through the overflow hose at the top of the reservoir. As the system cools, extra coolant in the reservoir is drawn back to the radiator through the vent valve. In this manner, the radiator is kept full at all times. The need for additional coolant can be detected by observing the level of coolant in the reservoir while the engine is at normal operating temperature.

The radiator cap, Fig. 6B-17, should be removed only under the following conditions, when it becomes necessary to add coolant because of lack of coolant in the reservoir, when coolant has not been moving in and out of the reservoir or when inspecting a 12 month or 15,000 mile interval. A seven bladed flexible fan and thermostatic clutch is used.

WARNING: IF THERE IS EVIDENCE OF STEAM, DO NOT OPEN HOOD UNTIL STEAM IS DISPOSED.

The fan clutch is serviced only as an assembly and is designed to reduce fan speed and noise as engine cooling needs become less (engine is cold) or to maintain fan speed should cooling needs increase (engine is warm).

The fan assembly is illustrated in Fig. 6B-21.

A cast iron water pump is mounted at the front of the engine. It is driven by two 7/16 inch wide "V" belts.

Coolant is pumped to each bank of cylinders simultaneously, then through passages to the cylinder heads, through the thermostat housing at the top intake manifold to the left hand radiator tank. Radiator coolant flow is from the left hand tank through the core to the right hand tank, which is the source of coolant to the water pump inlet, Fig. 6B-16.

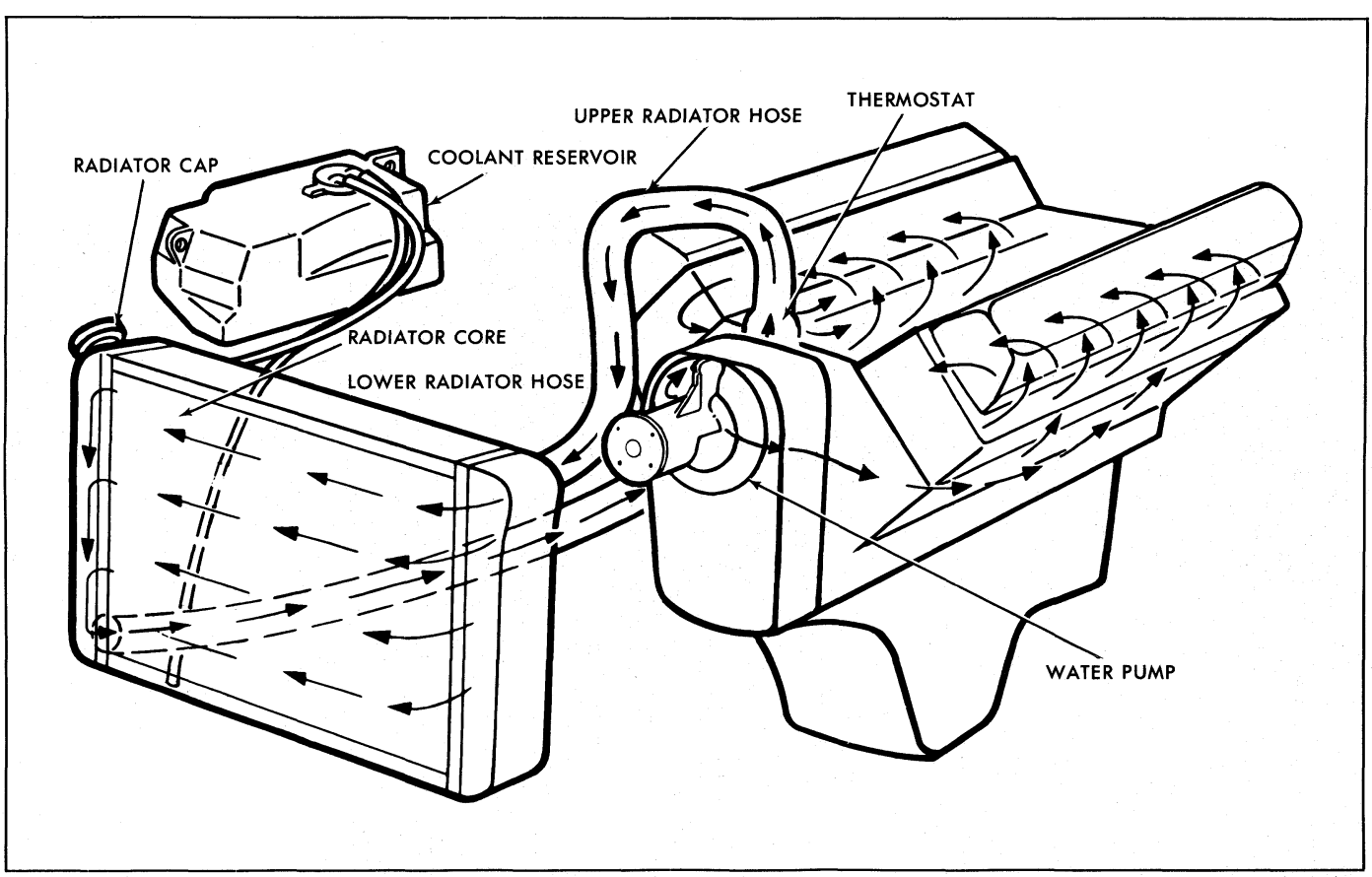


Fig. 6B-16 Flow of Coolant

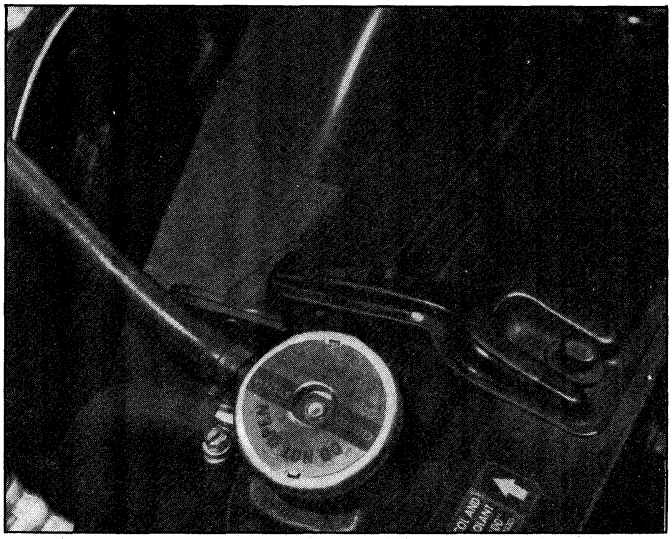


Fig. 6B-17 Radiator Cap

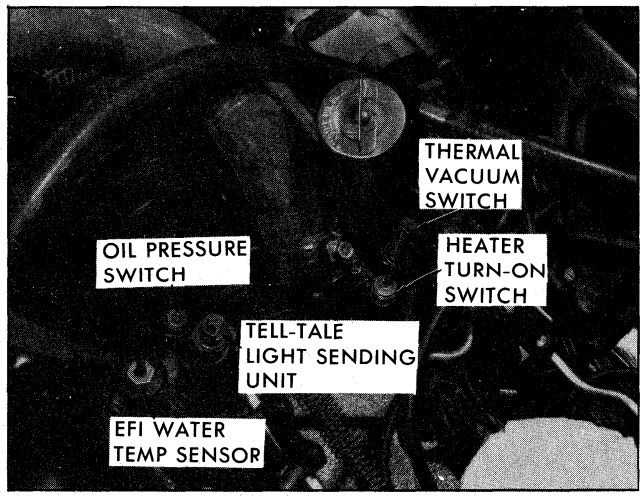


Fig. 6B-18 Thermal Vacuum and Tell-Tail Switch

WARNING: IT IS ESSENTIAL THAT FAN ASSEMBLY REMAIN IN PROPER BALANCE AND PROPER BALANCE CANNOT BE ASSURED ONCE A FAN ASSEMBLY HAS BEEN BENT OR DAMAGED. A FAN ASSEMBLY THAT IS NOT IN PROPER BALANCE COULD FAIL AND FLY APART DURING SUBSEQUENT USE CREATING AN EXTREMELY DANGEROUS CONDITION.

IF A FAN BLADE IS BENT OR DAMAGED IN ANY WAY, NO ATTEMPT SHOULD BE MADE TO REPAIR AND REUSE THE DAMAGED PART. A BENT OR DAMAGED FAN ASSEMBLY SHOULD ALWAYS BE REPLACED WITH A NEW FAN ASSEMBLY.

When the thermostat is closed, coolant from the cylinder heads is pumped through external by-pass passage between the thermostat housing and the water pump and recirculated. When the engine is sufficiently warm, the thermostat opens and coolant flows to the inlet tank on the left side of the radiator, and is cooled as it flows across the horizontal core tubes to the outlet tank on the right side of the radiator, completing the cycle.

The thermal vacuum valve, Fig. 6B-18, is located in the front of the intake manifold. It has three fittings: one to manifold vacuum, one to ported vacuum above the throttle valves and one to the distributor vacuum diaphragm. At coolant temperatures above 220°F (104°C.) this valve switches from ported vacuum to manifold vacuum, advancing the ignition timing to full vacuum advance at idle. This reduces the possiblity of engine overheating under extremely high temperature operation.

The coolant temperature tell-tale light is located in the warning light cluster at the top of the instrument panel, Fig. 8-78. The light reads "COOLANT TEMPERATURE" and glows amber whenever coolant temperature becomes excessive (260°F. or higher). The light is activated by a temperature sensitive switch, Fig. 6B-18, in the water passage to the left of the thermostat housing. To check operation of the "COOLANT TEMPERATURE" tell-tale light, turn the ignition switch to the Start position. The light should glow. As soon as the switch is moved away from Start, the light should go out.

In addition to the water temperature warning light, an engine metal temperature warning light and buzzer system is used.

The fourth tell-tale light to the right of the "COOLANT TEMPERATURE" indicator (Fig. 8-78) is a red light that reads "STOP ENGINE-TEMPERATURE". It will light whenever engine metal temperature is excessive. In addition to the glowing lamp, the key buzzer will sound.

The engine metal temperature switch, Fig. 6B-19, located in a cylinder head bolt on the left side of the engine senses the temperature of the bolt head rather than the temperature of the coolant. Since the switch screws into a blind hole in the bolt head, sealer is not required and MUST NOT be used when installing this switch.

Operation of the "STOP ENGINE-TEMPERATURE" light is checked by opening the driver's door while ignition key is in Lock or Off positions. Light should glow and buzzer should sound. The high engine temperature warning system does not utilize the ignition switch "START" ground circuit for testing operation as do the other tell-tale lights. Therefore, the red "STOP ENGINE-TEMPERATURE" light should not glow when the ignition switch is in the Start position.

The transmission oil cooler is located in the outlet tank on the right side of the radiator.

Thermostat

The thermostat consists of a restriction valve actuated by a thermostatic element. (Use of thermostats rated above 195°F. (90.5°C.), control temperatures are not recommended.) This is mounted in the housing at the front of the intake manifold above the water pump. The thermostat should be installed with the word FRONT up and toward the radiator. This way the coolant has a smooth unobstructed flow through the thermostat and water outlet, Fig. 6B-20.

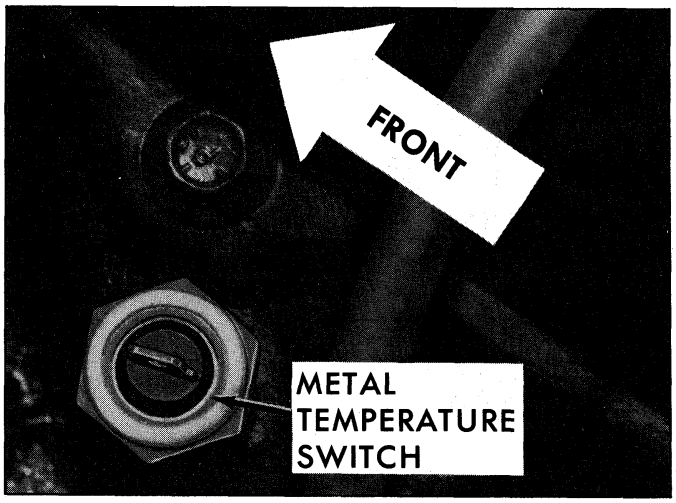


Fig. 6B-19 Metal Temperature Switch

When the thermostat is incorrectly installed, the thermostat valve acts as a baffle, forcing the coolant to change direction to pass around the valve. This change in direction interrupts the smooth unobstructed flow of coolant to the radiator and can possibly result in overheating conditions.

Thermostats are designed to open and close at predetermined temperatures and if not operating properly should be removed and tested as described on page 6B-6.

Fan Clutch Diagnosis

See page 6B-6 for procedure.

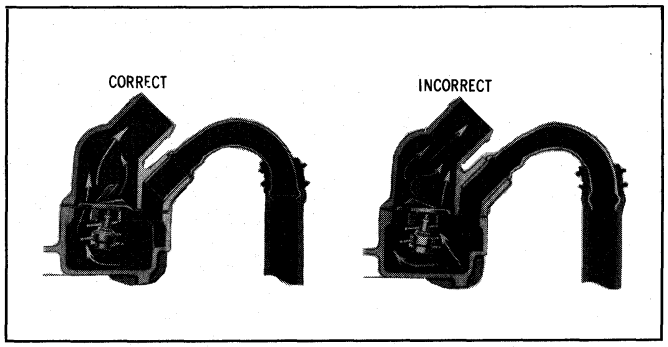


Fig. 6B-20 Thermostat Installation

System Leak Test

See page 6B-3 for procedure.

Thermostat Test

See page 6B-6 for procedure.

Testing Coolant Solutions

See page 6B-6 for procedure.

Cooling System Preventive Maintenance

See page 6B-7 for procedure.

Cooling System Flushing Procedure

See page 6B-7 for procedure.

ON-CAR SERVICE

Thermostat (Fig. 6B-20)

a. Removal

1. Drain radiator until coolant level is below level of thermostat housing.

2. Loosen clamp on by-pass hose at thermostat housing.

3. Disconnect upper radiator hose at thermostat housing.

4. Loosen A.I.R. pump support rod at pump and pivot rod out of way.

5. Remove two screws securing thermostat housing to cylinder block.

6. Remove housing from by-pass hose and discard gasket.

7. Remove thermostat from cylinder block.

b. Installation

1. Install thermostat in opening at top of cylinder block with valve up, Fig. 6B-20.

2. Position a new gasket coated with gasket cement on cylinder block.

3. Install thermostat housing in by-pass hose.

4. Position thermostat housing on cylinder block and secure with two screws. Tighten screws to 20 foot pounds (27.1 N·m).

5. Connect upper radiator hose to thermostat housing.

6. Tighten clamps on upper radiator hose and by-pass hose. Tighten clamp screws to 25 inch pounds (2.8 N·m).

7. Install A.I.R. pump support rod.

8. Fill cooling system to proper level.

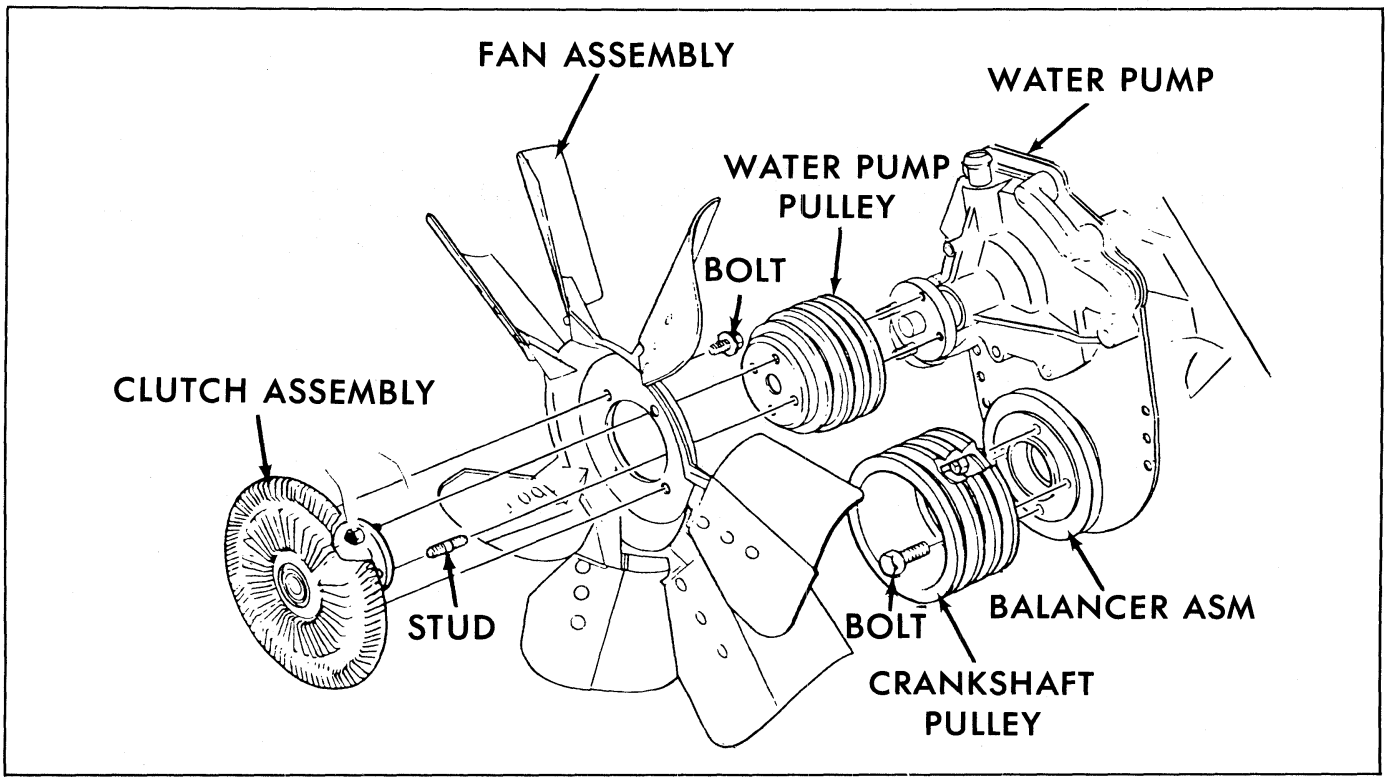


Fig. 6B-21 Water Pump Assembly

Fan and Clutch Assembly (Fig. 6B-21)

a. Removal

1. Remove one screw securing upper radiator hose to shroud.

2. Remove two screws securing shroud at top of radiator cover. Lift shroud up to remove from lower clips and place shroud over fan.

3. Remove four nuts securing clutch hub to fan hub.

4. Remove fan and clutch by pulling forward off studs

b. Installation

WARNING: IT IS ESSENTIAL THAT FAN ASSEMBLY REMAINS IN PROPER BALANCE AND PROPER BALANCE CANNOT BE ASSURED ONCE A FAN ASSEMBLY HAS BEEN BENT OR DAMAGED. A FAN ASSEMBLY THAT IS NOT IN PROPER BALANCE COULD FAIL AND FLY APART DURING SUBSEQUENT USE CREATING AN EXTREMELY DANGEROUS CONDITION.

IF A FAN BLADE IS BENT OR DAMAGED IN ANY WAY, NO ATTEMPT SHOULD BE MADE TO REPAIR AND REUSE THE DAMAGED PART. A BENT OR DAMAGED FAN ASSEMBLY SHOULD ALWAYS BE REPLACED WITH A NEW FAN ASSEMBLY.

1. Secure fan blade to clutch with four screws. Tighten screws to 18 foot-pounds (24.4 N·m).

2. Slide fan and clutch into position and install four attaching nuts. Tighten nuts to 18 foot-pounds (24.4 N·m).

3. Position fan shroud and secure at bottom with two clips and secure at top with two screws.

4. Secure upper radiator hose to shroud with one screw. Tighten to 25 inch-pounds (2.8 N·m).

Water Pump (Fig. 6B-22)

a. Removal

1. Drain radiator.
2. Remove lower radiator hose at water pump.
3. Remove by-pass hose at water pump.
4. Remove fan and clutch assembly as described on page 6B-17.
5. Remove all pulley belts.
6. Remove water pump pulley.
7. Remove front A/C compressor bracket.
8. Remove front A.I.R. bracket and support rod.
9. Remove PS pump adjusting bracket.
10. Remove water pump mounting bolts and remove water pump.

b. Installation

1. Install new gasket to water pump using part No. 1050026 Seal or equivalent to retain gasket.
2. Position water pump and install mounting bolts, Fig. 6B-22.
3. Install PS pump adjusting bracket.
4. Install front A.I.R. pump bracket and support rod.
5. Install front A/C compressor bracket.
6. Install water pump pulley.
7. Loosely install all pulley belts.

8. Install fan and clutch assembly as described on page 6B-17.

9. Install by-pass hose at water pump.

10. Install lower radiator hose.

11. Tension all drive belts as described on page 6B-18.

12. Fill cooling system to proper concentration and level with ethylene glycol base coolant. Run engine and check for leaks.

Belt Adjustments

Drive belt specifications are shown on page 6B-21.

a. Checking Drive Belts

1. Drive belts should be checked for signs of unusual wear, cuts, and fraying. Worn belts should be replaced.

2. Place Belt Tension Gage, J-23600 midway between pulleys on drive belt being checked, locations A, B, C, or D indicated in Fig. 6B-23.

3. Check gage reading for belt being checked. Proper belt tension is shown on page 6B-21. If belt tension is incorrect, adjust specific belt according to the corresponding procedure described in b, c, d, or e of this note.

NOTE: A belt that has been previously tensioned is considered a used belt. A belt that has never been tensioned is considered a new belt.

4. If, after tensioning, a belt fails to maintain 55 foot-pounds tension (74.5 N·m) it should be replaced.

b. Generator Belt Tension

NOTE: Power steering pump belt must be adjusted to tension before tensioning generator belt.

1. Place Belt Tension Gage, J-23600 on drive belt midway between pulleys at location A in Fig. 6B-23.

2. Loosen generator link adjusting screw and generator pivot screw.

3. Move generator as required until correct belt tension is obtained on gage.

4. Tighten generator link adjusting screw to 20 foot-pounds (27.1 N·m).

5. Tighten generator pivot bolt to 20 foot-pounds (27.1 N·m) and remove Belt Tension Gage.

c. Power Steering Pump Belt Tension

1. Place Belt Tension Gage, J-23600 on drive belt midway between pulleys at location "B", Fig. 6B-23.

2. Loosen, (1) steering pump adjusting nut at top of pump mounting bracket, (2) lower front pivot bolt, and (3) rear pivot bolt.

3. Move power steering pump as required until correct belt tension is obtained on gage.

4. Snug lower adjusting slot bolt.

5. Snug lower front pivot bolt.

6. Snug upper adjusting slot nut.

7. Tighten lower rear pivot bolt to 30 foot-pounds (40.7 N·m).

8. Tighten lower pivot bolt to 30 foot-pounds (40.7 N·m).

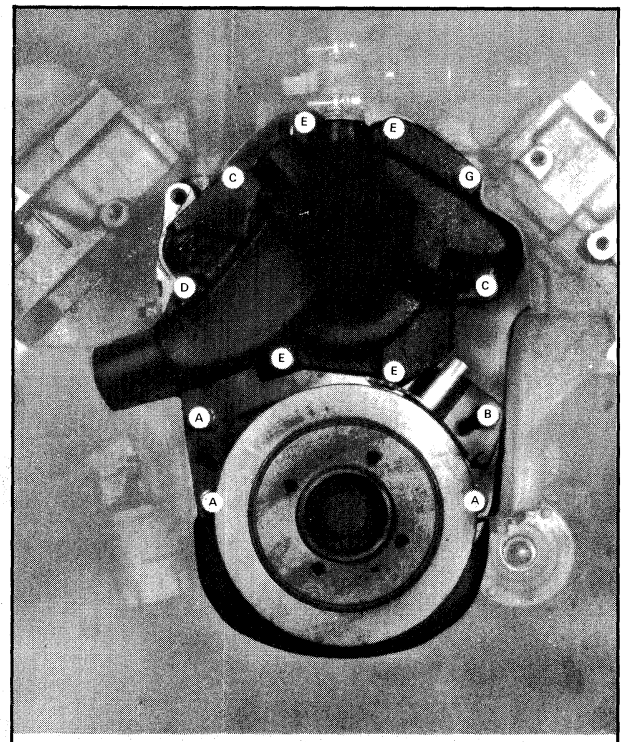
9. Tighten upper adjusting slot nut to 30 foot-pounds (40.7 N·m).

d. Air Conditioning Compressor Belt Tension

1. Place Belt Tension Gage, J-23600 on drive belt midway between pulleys at location "C". Fig. 6B-23.

2. Loosen, (1) A/C compressor adjusting nut at A.I.R. pump mounting bracket, (2) rear adjusting slot bolt, and (3) upper pivot bolts.

3. Move A/C compressor as required until correct belt tension is obtained on gage.



Key	No.	Size	Torque
C	(2)	5/16-18 x 1-1/2	22 Foot Pounds
D	(1)	5/16-18 x 2-1/2	22 Foot Pounds
E	(4)	1/4 -20 x 1-1/4	13 Foot Pounds
G	(1)	5/16-18 x 1-1/2 (stud on head)	22 Foot Pounds

Fig. 6B-22 Water Pump Assembly Attaching Screws

4. Snug rear adjusting slot bolt.

5. Snug upper pivot bolt.

6. Snug air pump bracket adjusting slot nut.

7. Tighten lower adjusting slot bolt to 22 foot-pounds (29.8 N·m).

8. Tighten lower pivot bolt to 22 foot-pounds (29.8 N·m).

9. Tighten upper adjusting slot nut to 22 foot-pounds (29.8 N·m).

e. A.I.R. Pump Belt Tension

1. Loosen A.I.R. pump pivot bolt.

2. Place Belt Tension Gage, J-23600, on drive belt midway between pulleys at location D in Fig. 6B-23.

3. Loosen A.I.R. pump adjuster link screw.

4. Move A.I.R. pump as required until correct belt tension is obtained on gage.

CAUTION: *To avoid internal damage, pry as close to rear of pump cover as possible, near dowel pin.*

5. Tighten adjuster link screw to 30 ft. lbs. (40.7 N·m).

6. Tighten pivot screw to 30 ft. lbs. (40.7 N·m) and remove Belt Tension Gage.

7. Lower car.

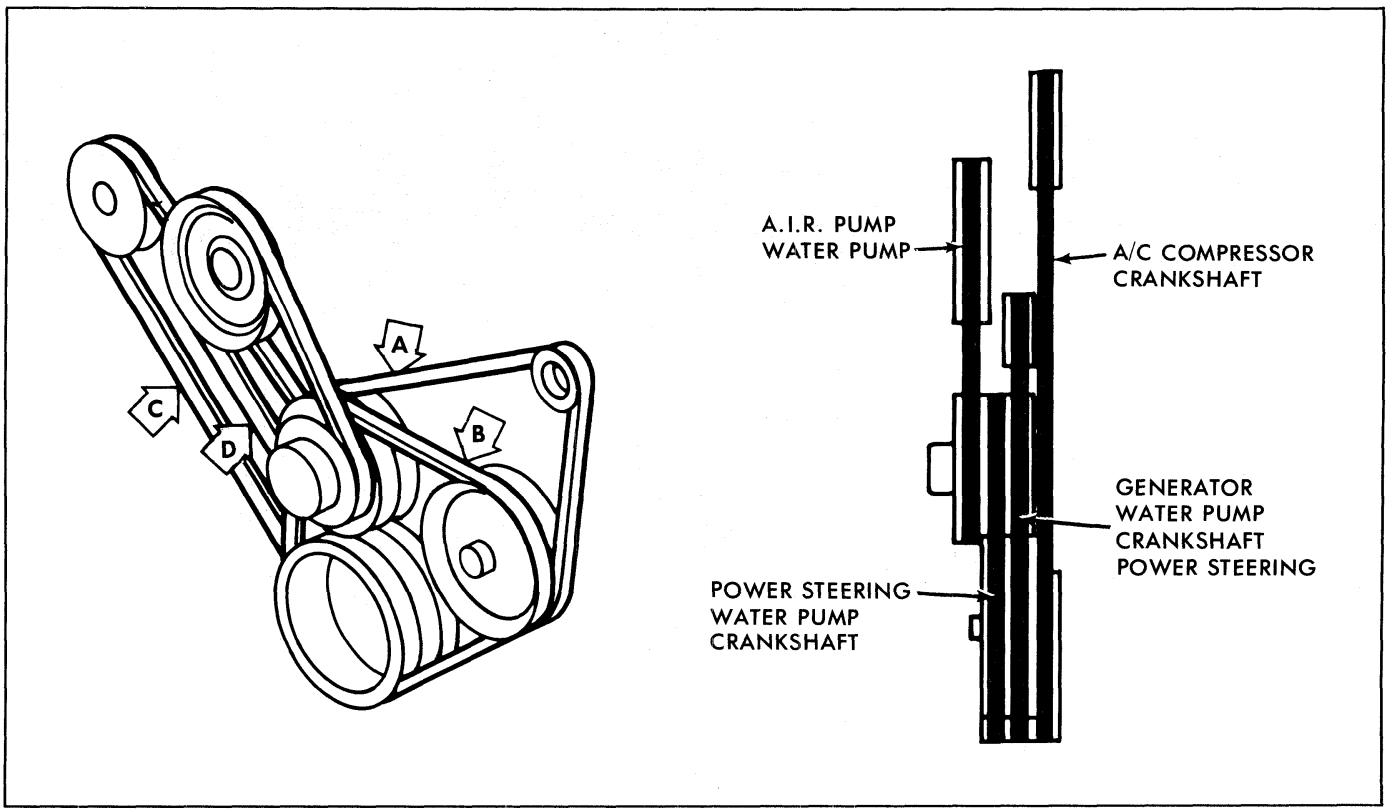


Fig. 6B-23 Belt Tensioning

SPECIFICATIONS

Fan, Number of Blades	
Except Eldorado	5
Eldorado	7
Seville (With Fan Clutch)	7
Heavy Duty, Limousines and Commercial (With Fan Clutch)	7
Hoses	
Type	Reinforced Molded
Thermostat	
Starts to Open — 425 CID	192°F. to 199°F. (89°C to 93°C)
350 CID	202°F. (91°C.)
Fully Open (Approximately 7/16") — 425 CID	219°F. (104°C)
350 CID	175°F. to 182°F. (79°C. to 83°C.)
Drive Belt Ratios	
Water Pump, Without A.I.R.	1.18 to 1
With A.I.R.	1.14 to 1
Seville	1.30 to 1
Generator	
63 Amp., Without A.I.R.	3.09 to 1
63 Amp., With A.I.R.	3.36 to 1
80 Amp., Without A.I.R.	2.86 to 1
80 Amp., With A.I.R.	3.12 to 1
80 Amp., Seville	2.97 to 1
145 Amp.	3.12 to 1
Power Steering Pump, Except Seville	1.26 to 1
Seville	1.11 to 1
Air Conditioning Compressor, Except Seville	1.48 to 1
Seville	1.44 to 1
A.I.R. Pump, Except Seville	1.20 to 1
Seville	1.16 to 1
Capacity of System	
Except Eldorado and Seville	20.8 Qts. (17.5 Imp. Qts.)
Eldorado	25.75 Qts. (21.5 Imp. Qts.)
Seville	17.2 Qts. (14.5 Imp. Qts.)
Area of Core, Except Seville	517 Sq. In.
Seville	446 Sq. In.
Core Depth, Except Seville	1.96 In.
Seville	1.98 In.
Core Center Constant — Except Commercial and Heavy Duty Cooling	.18 In.
Heavy Duty Cooling	.14 In.
Tubing Spacing	.55 In.
Radiator Cap Pressure	15 psi

ENGINE ACCESSORY DRIVE BELTS

EXCEPT SEVILLE

Belts	Type	Tension		Except California		California	
		New	Used	Width	Length	Width	Length
A.I.R. Pump	36° Wedge	110 - 140 Lbs. ALL	60 - 120 Lbs. ALL	.500"	45.25"	.500"	45.25"
Generator							
63 AMP	39° Wedge			.410"	51.0"	.410"	3.85"
80 AMP	39° Wedge			.410"	51.5"	.410"	3.85"
145 AMP	36° Wedge			.500"	56.5"	.500"	56.5"
Power Steering Pump and Air Conditioning Compressor	36° Wedge			.500"	60.0"	.500"	60.2"

SEVILLE

Belts	Type	Tension		Width	Length
		New	Used		
A.I.R. Pump, Water Pump	36° Wedge	110-140 Lbs.	60-120 Lbs.	7/16 in.	37.0"
Generator, Water Pump Power Steering Crankshaft	36° Wedge	110-140 Lbs.	60-120 Lbs.	7/16 in.	57.0"
Power Steering Pump Water Pump Crankshaft	36° Wedge	110-140 Lbs.	60-120 Lbs.	7/16 in.	45.00"
A/C Compressor Crankshaft	36° Wedge	110-140 Lbs.	60-120 Lbs.	7/16 in.	60.0"

TORQUE SPECIFICATIONS

EXCEPT SEVILLE

Material Number	Application	Size	Torque
280M	Fan Blade Assembly Mounting Screw/Nut	5/16-24	18 Ft. Lbs.
1010	Heater Hose Clamp	10-24	13 In. Lbs.
280M	Thermostat Housing Screw	5/16-18	10 Ft. Lbs.
260M	Water Pump to Cylinder Block Screw	3/8-16	22 Ft. Lbs.
260M	Water Pump to Cylinder Block	5/16-18	15 Ft. Lbs.
260M	Water Pump to Front Cover Screw	1/4-20	70 In. Lbs.

SEVILLE

Material Number	Application	Size	Torque
280M	Fan Blade to Fan Clutch Attaching Bolts	5/16-18	18 Ft. Lbs.
260M	Fan and Fan Clutch Assembly to Hub Stud Nuts	5/16-18	18 Ft. Lbs.
260M	Studs to Water Pump Hub	5/16-18, 5/16-24	8 Ft. Lbs.
280M	Thermostat Housing	5/16-18	20 Ft. Lbs.
Brass	Temperature Sending Unit	Pipe	30 Ft. Lbs.
280M	Water Pump Bolts to Cylinder Block	5/16-18	15 Ft. Lbs.
260M	Self Tapping Bolts to Front Cover Oil Before Installing	1/4-20	13 Ft. Lbs.
280M	Water Pump to Front Cover 5/16" Bolts	5/16-18	22 Ft. Lbs.
280M	Water Pump Cover to Timing Chain Cover	3/8-16	7 Ft. Lbs.

NOTE: Refer to back of Manual for nut and bolt markings and steel classifications.

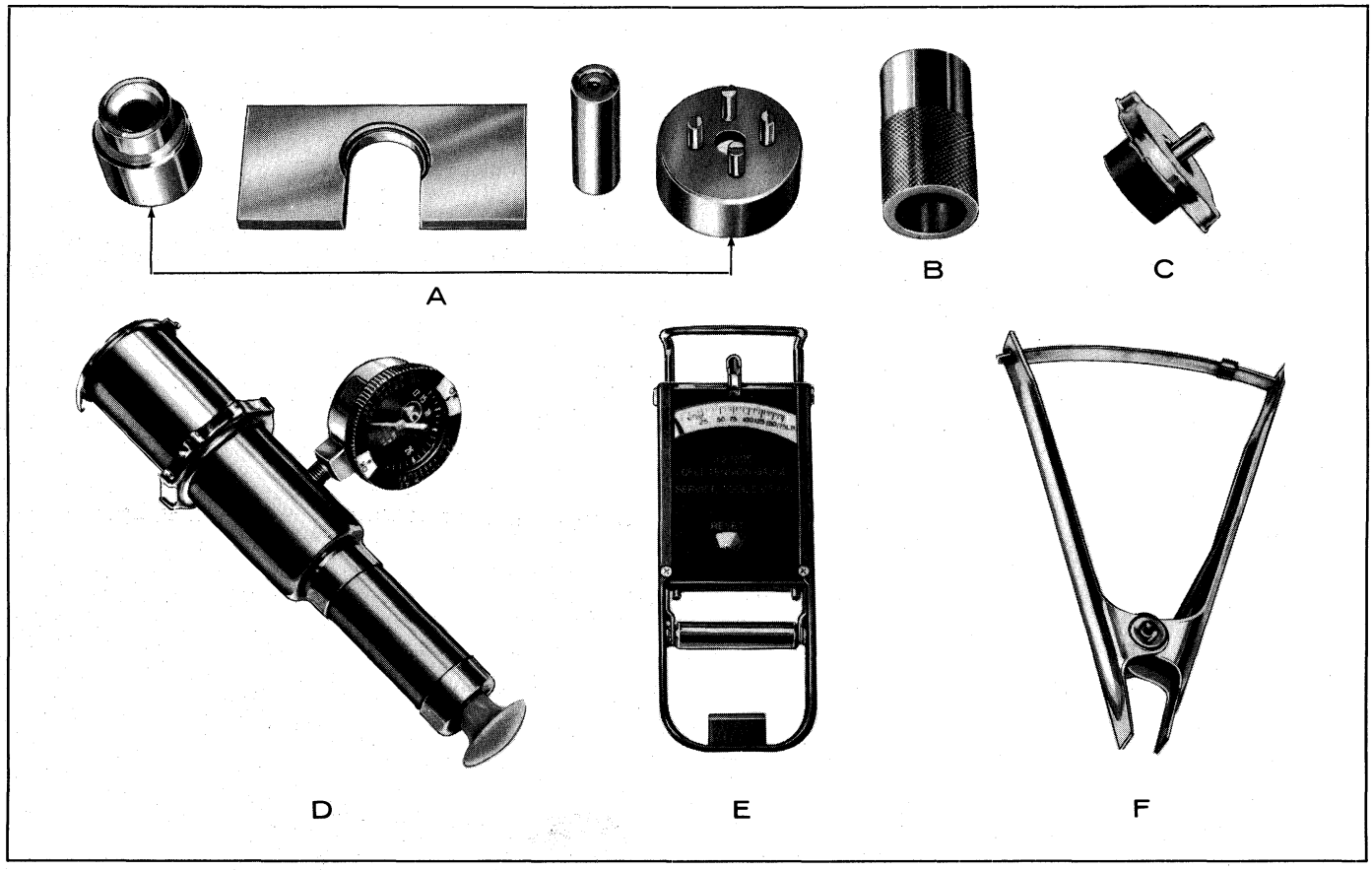


Fig. 6B-24 Special Tools

KEY	TOOL NUMBER	NAME
A	J-23675*	Water Pump Overhaul Kit
B	J-8999-9	Seal Installer
C	J-23699	Pressure Tester Adapter
D	J-24460	Pressure Tester
E	J-23600	Belt Tension Gage
F	J-23636	Hose Gage

FUEL SYSTEM

CARBURETION

ALL NEW 1977 CADILLACS ARE CERTIFIED BY THE UNITED STATES DEPARTMENT OF HEALTH, EDUCATION AND WELFARE AS CONFORMING TO THE REQUIREMENTS OF THE REGULATIONS FOR THE CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES. THIS CERTIFICATION IS CONTINGENT ON CERTAIN ADJUSTMENTS BEING SET TO FACTORY STANDARDS. FOR THIS REASON, THE FACTORY PROCEDURE FOR SETTING IGNITION TIMING, AND SLOW IDLE MUST BE FOLLOWED EXACTLY WHEN ADJUSTMENTS ARE MADE.

TABLE OF CONTENTS

GENERAL DESCRIPTION 6C-1
DIAGNOSIS
Fuel System 6C-6
CARBURETION
M4ME-M4MEA 6C-2
FUEL SUPPLY
FUEL FILTER 6C-24
Fuel Pump 6C-24
Fuel Tank and Lines 6C-31
Evaporative Emission Control System (EECS) 6C-36
ACCELERATOR CONTROLS 6C-40
SPECIFICATIONS 6C-44
SPECIAL TOOLS 6C-46
ELECTRONIC FUEL INJECTION (EFI)
General Description 6C-46
Diagnosis 6C-53
On-Car Service 6C-100

GENERAL DESCRIPTION

CAUTION: *All engines require the use of unleaded fuel, only. Use of leaded and/or low lead fuels can result in engine damage and reduce the effectiveness of the Emission Control Systems.*

Carburetor

All Cadillacs are equipped with either a 4-barrel quadrajet carburetor attached to the intake manifold, or Electronic Fuel Injection.

Fuel Filter

All carburetor engines have a pleated paper fuel filter and check valve assembly located in the carburetor inlet.

All cars have a woven plastic fuel filter in the fuel tank on the lower end of the pickup pipe.

Mechanical Fuel Pump

The mechanical fuel pump is located at the left front of engine.

Evaporative Emission Control System (EECS)

The Evaporative Emission Control System is a closed system that prevents gasoline vapors in the fuel tank and carburetor from entering the atmosphere.

Fuel Tank and Lines

The fuel tank is attached under the trunk pan by two (2) straps.

Filler necks are soldered into the tank except Commercial Chassis. All filler necks have restrictors to prevent the entry of leaded fuel nozzles.

In all series the tank is vented during filling by an internal baffle inside the filler neck.

The tank outlet consists of a combination fuel pickup, filter and fuel gage tank unit. The tank unit can be removed by removing a cam ring which retains the unit.

The fuel lines are coated, welded steel tubing. Connections from the tank unit to the line and from the line to the fuel pump are made with synthetic rubber hose attached with spring clamps.

Fuel Cap

The fuel cap is a screw on type, and incorporates a ratchet action which prevents over tightening.

MODELS M4ME - M4MEA CARBURETOR

The M4ME - M4MEA model carburetors, Fig. 6C-1, are two stage carburetors of downdraft design. The triple venturi system is used on the primary side of the carburetor with 1 3/8" throttle valve bores.

The secondary side has two large bores (2-1/4"). Using the air valve principle in the secondary side, fuel is metered in direct proportion to the air passing through the secondary bores.

1. All carburetors are recalibrated to meet requirements of the 1977 engine.

2. A straight vacuum hose is used from the air horn to the front vacuum break as this location is no longer used for distributor vacuum.

3. The 1/4" pipe thread brake booster vacuum tap at the rear of the throttle body is removed from carburetors used on Eldorado since these vehicles do not use a vacuum booster.

4. An air horn baffle is added to all carburetors for improved secondary tip-in feel on heavy acceleration.

5. High Altitude carburetors have a separate APT adjustment (similar to M4ME carburetors with an aneroid cross channel restriction).

6. A full manifold vacuum tube is used on all non-California carburetor float bowls as a full vacuum source for the EFE system.

7. The accelerator pump assembly is revised for improved fuel delivery.

8. Carburetors for use in California have a ported vacuum tube added to the float bowl (The EGR tube is removed from the throttle body). This tube provides timed vacuum for the back pressure E.G.R. valve system.

9. All secondary metering rods are revised.

ADJUSTABLE PART THROTTLE

On altitude models, a factory adjusted part throttle screw (similar to M4ME models) is used in the float bowl to calibrate fuel mixtures for good emission control. In addition, an aneroid - metering rod assembly, preset at the factory, is used in the float bowl to control part throttle mixtures at altitude.

On these models, extended top and side main well bleeds are used on the primary side for improved mixture control during main metering system operation.

CAUTION: *No attempt should be made to change the APT adjustment. If float bowl replacement is required, the new bowl assembly will include an adjustment screw pre-set by the factory.*

An expander (garter) spring beneath the plunger cup on

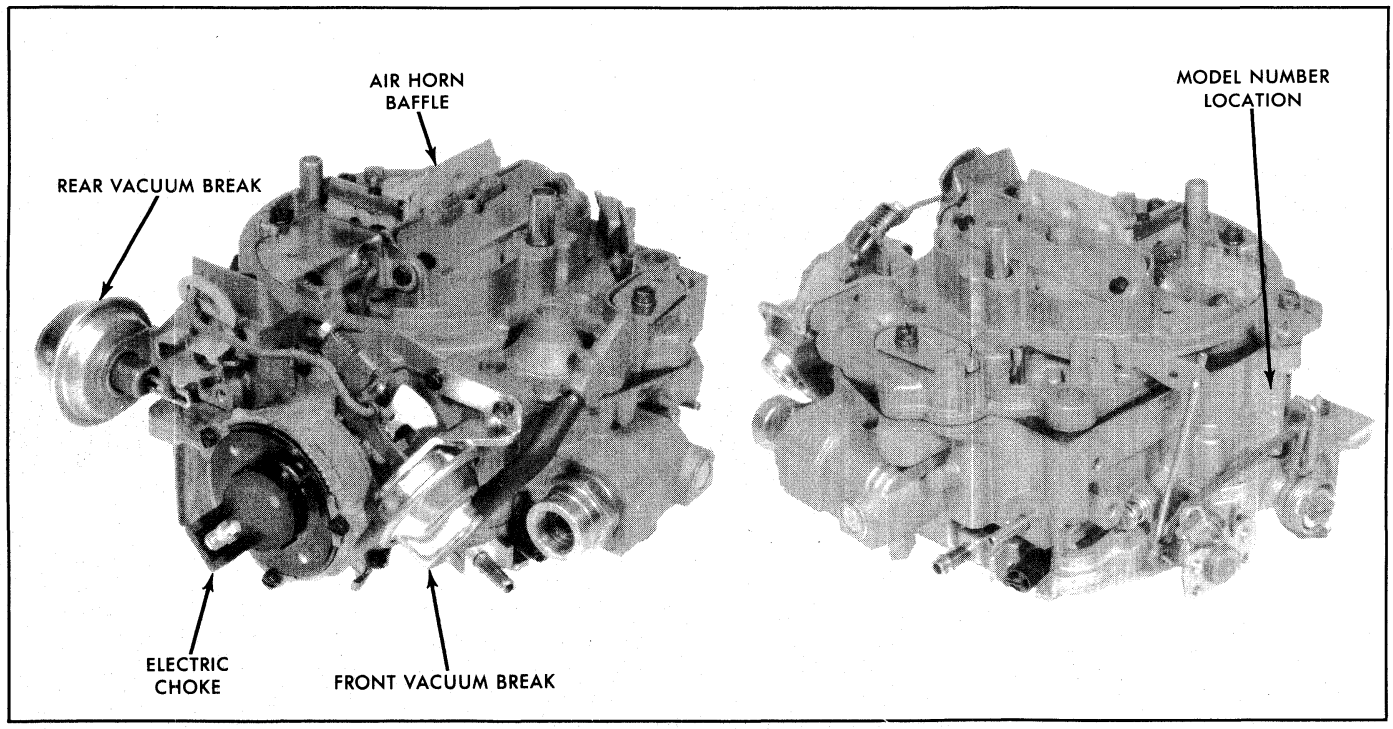


Fig. 6C-1 M4ME - M4MEA Carburetors

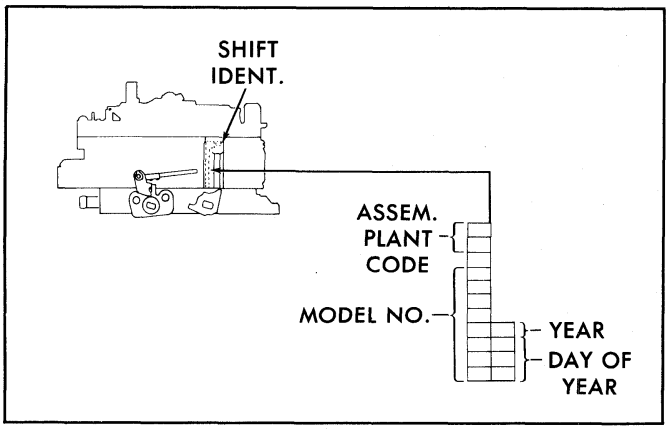


Fig. 6C-2 M4ME - M4MEA Carburetor Identification

the accelerator pump assembly improves pump fuel delivery.

All models use a bowl mounted choke housing with an electric thermostatic choke coil assembly. In addition, a dual vacuum break system is used for good cold engine warm-up and drive-away performance. A delay valve is used in the rear vacuum break unit to allow a slight enrichment of the choke valve mixture to prevent engine stalling during the warm-up period.

The carburetor part number is stamped on a vertical section of the float bowl, near the secondary throttle lever, Fig. 6C-2. Refer to the part number on the bowl when servicing the carburetor. When replacing the float bowl assembly, follow the instructions contained in the service package. Stamp or engrave the model number on the new float bowl.

The primary side of the carburetor has six systems of operation. They are float, idle, main metering, power, pump, and choke. The secondary side has one metering system which supplements the primary main metering system and receives fuel from a common float chamber, See Figs. 6C-3 thru 6C-11.

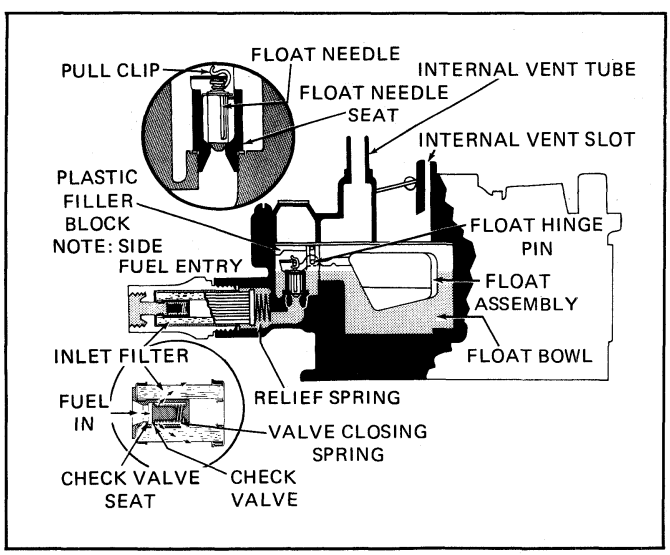


Fig. 6C-3 Float System

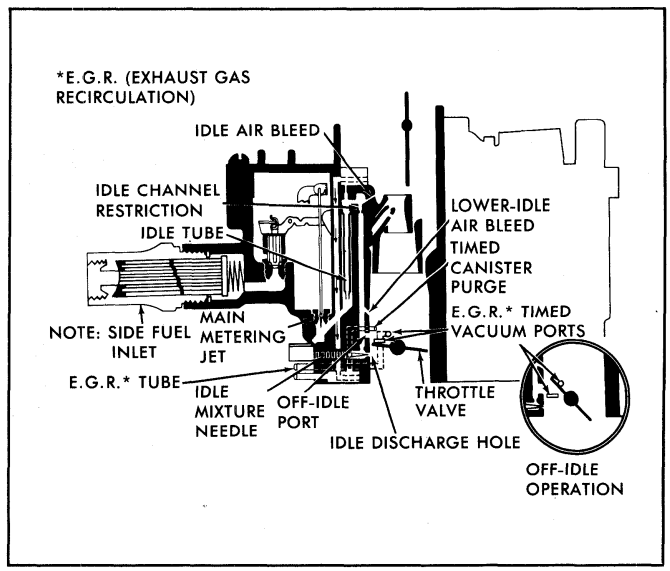


Fig. 6C-4 Idle System Except California

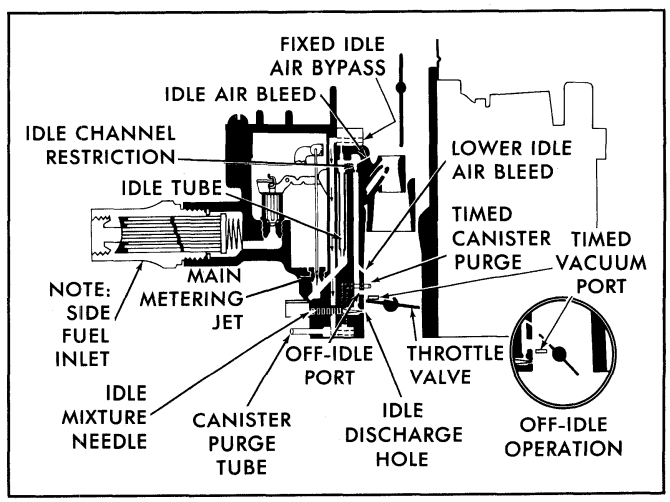


Fig. 6C-5 Idle System California Models

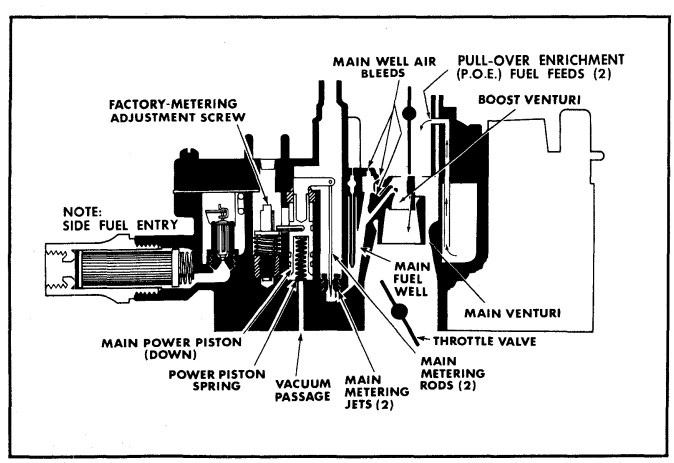


Fig. 6C-6 Main Metering System Except California

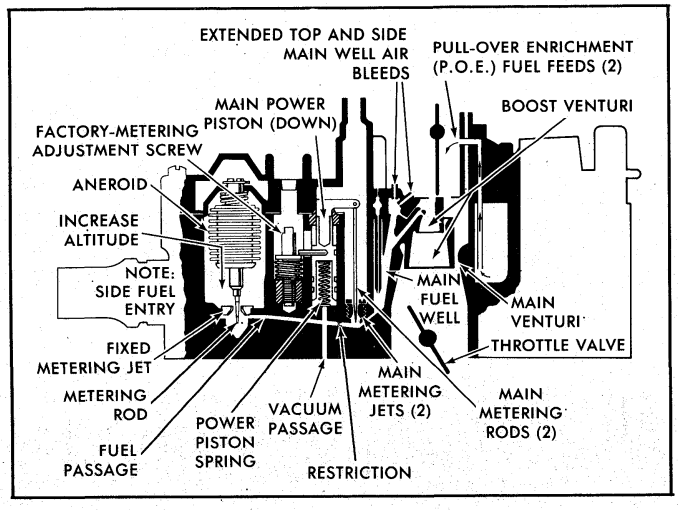


Fig. 6C-7 Main Metering System (Altitude Option)

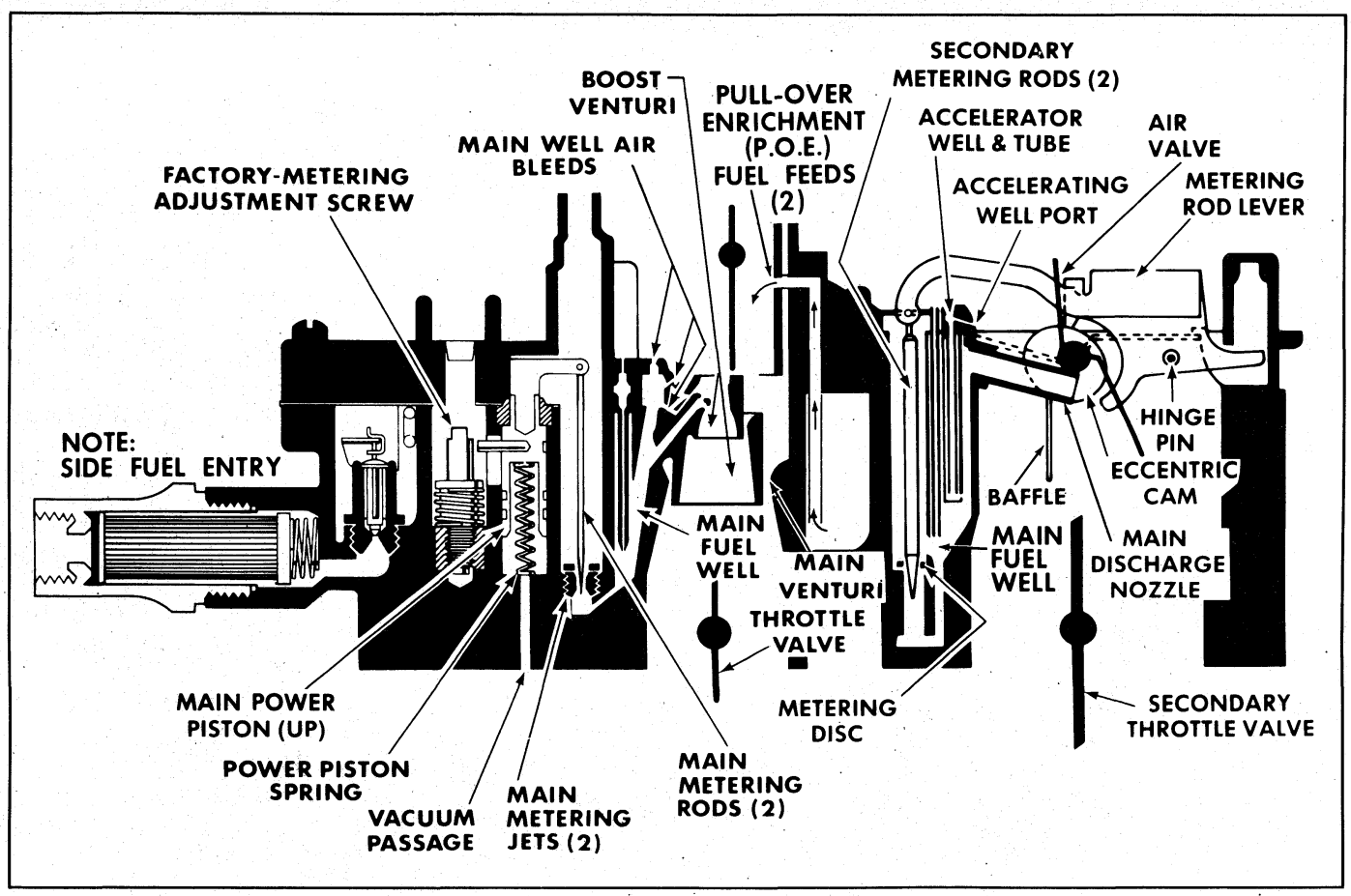


Fig. 6C-8 Power System Except California

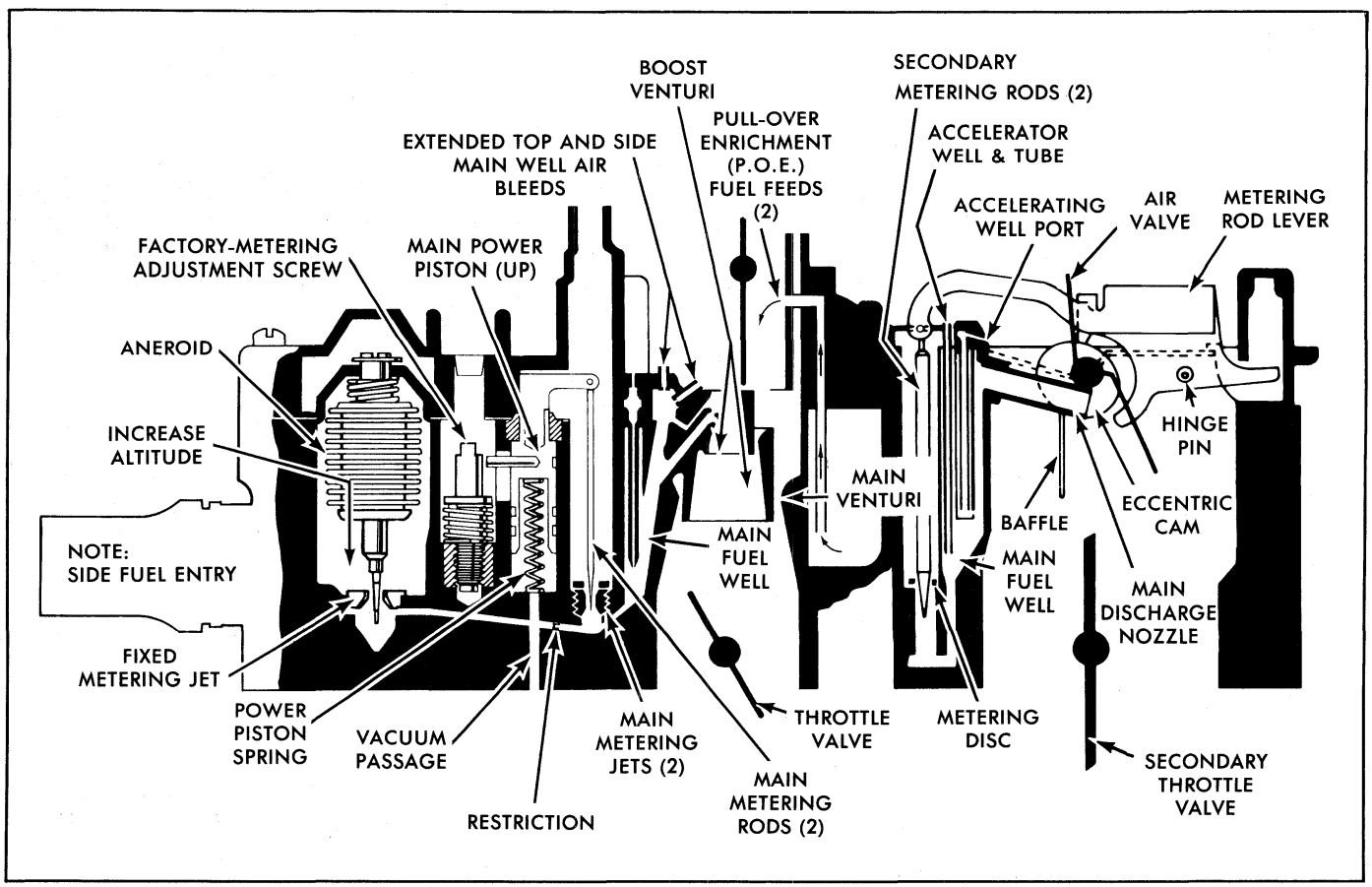


Fig. 6C-9 Power System (Altitude Option)

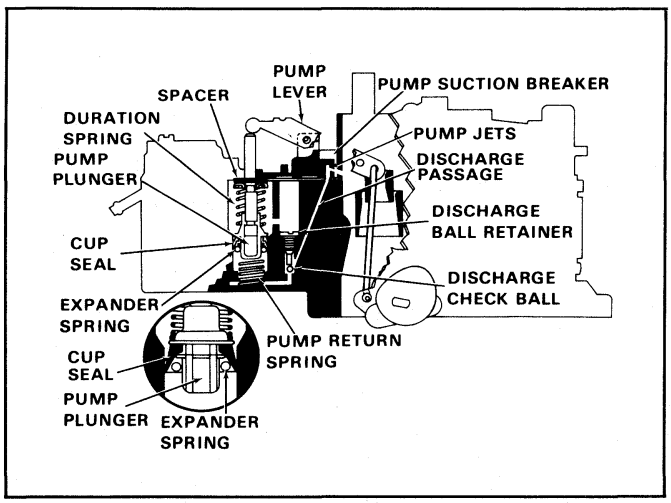


Fig. 6C-10 Accelerating Pump System

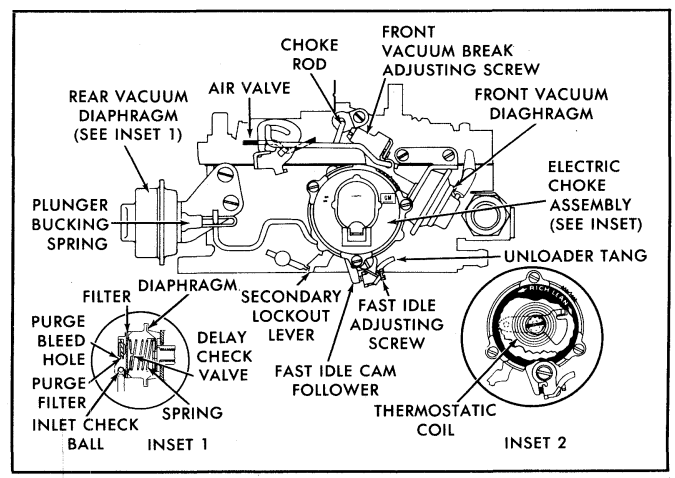


Fig. 6C-11 Choke System

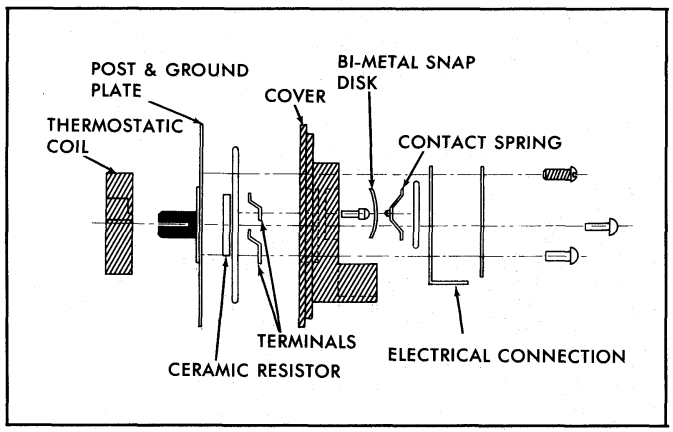


Fig. 6C-12 Electric Choke Assembly

Electric Choke Assembly (Fig. 6C-12)

The electric choke receives an electric current operating through the engine oil pressure switch whenever the engine is running. The electric current flows to a ceramic resistor that is divided into separate sections - a small center section for gradual heating of the thermostatic coil, and a large outer section for additional rapid heating of the thermostatic coil.

The ceramic resistor functions as follows:

Air Temperature Below 50°F, (10°C)

Electric current, applied to the small section of the ceramic resistor causes the section to heat up and warm the thermostatic coil which allows gradual opening of the choke valve for good cold engine warm-up performance. As the small section of the ceramic resistor continues to produce heat, a temperature-sensitive bi-metal disk causes a spring loaded contact to close also applying electric current to the large section of the ceramic resistor causing the large section to heat up. Heat from the larger section of the ceramic resistor increases the rate of heat flow to the thermostatic coil for more rapid opening of the choke valve.

Air Temperature 70°F (21°C) and Above

Electric current is applied directly to both the small section, and through the spring contact, to the large section of the ceramic resistor to provide a rapid heating of the thermostatic coil for greater choke valve opening when leaner air/fuel mixtures are desired at warmer ambient temperatures.

NOTE: Ground contact for the electric choke is provided by a metal plate located at the rear of the choke assembly. **DO NOT INSTALL A CHOKE COVER GASKET BETWEEN THE ELECTRIC CHOKE ASSEMBLY AND THE CHOKE HOUSING).**

The electric choke assembly is indexed properly by aligning the scribe mark on the front cover with the specified index mark on the choke housing, See Adjustments, page 6C-27.

The electric choke and thermostatic coil are serviced as a complete assembly and may be checked as described on Page 6C-18.

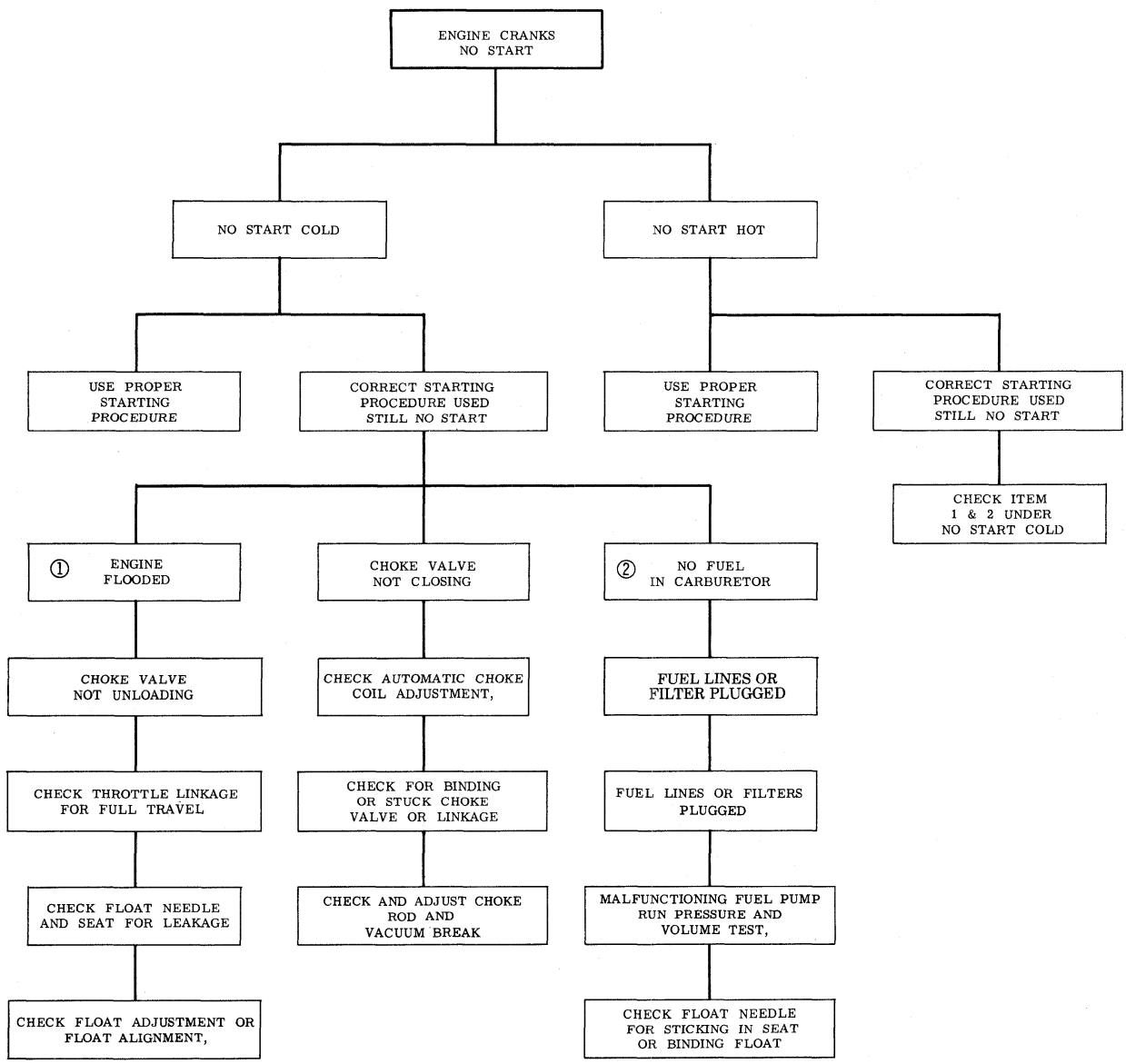
Diagnosis of Fuel System

All diagnosis related to the fuel system not found in this diagnosis section can be found in the Engine Performance Diagnosis located at the beginning of Section 6.

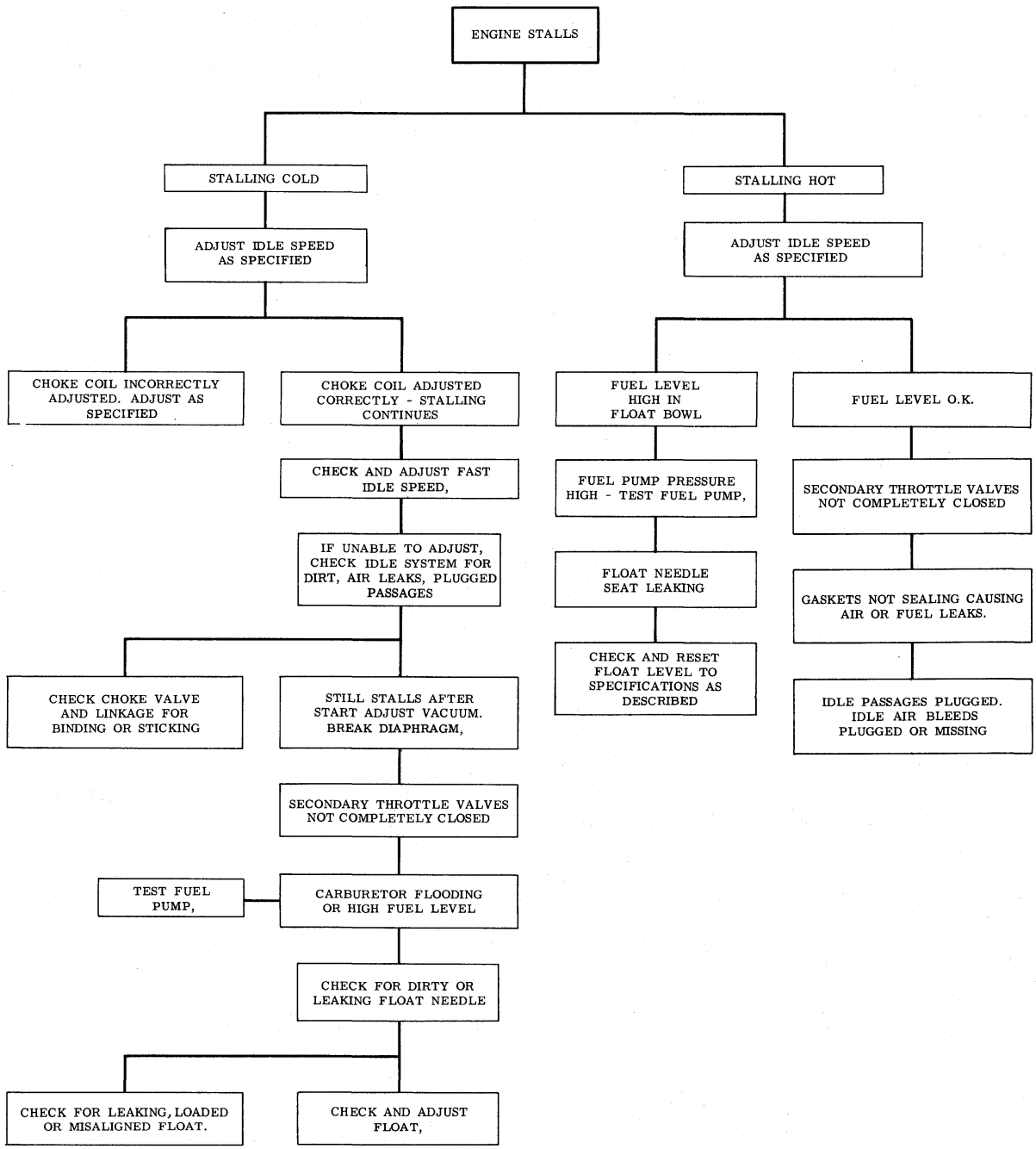
EVAPORATIVE EMISSION SYSTEM

Condition	Possible Cause	Correction
Fuel Odor.	1. Vapor leak from evap. system.	1. Inspect and correct as necessary fuel and evaporation hoses and pipes, fuel sender sealing gasket, and fuel cap.

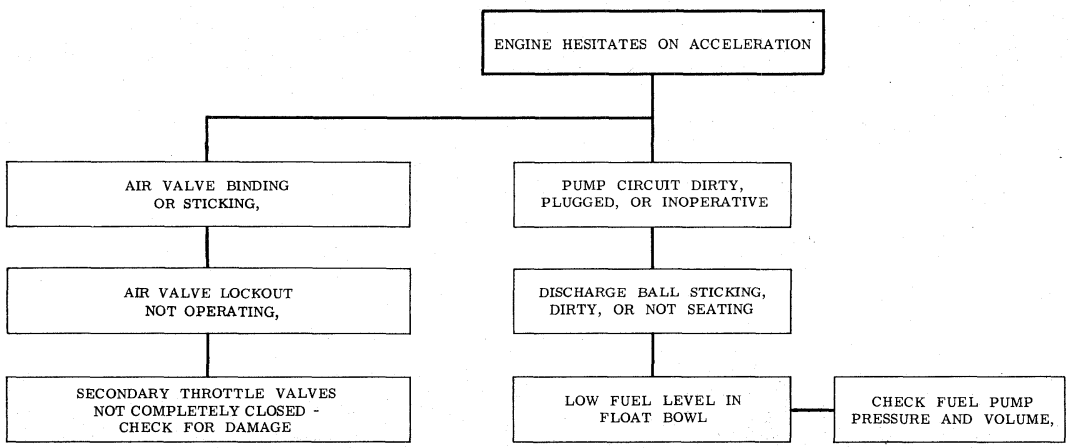
QUADRAJET 4MV
CARBURETOR DIAGNOSIS CHART

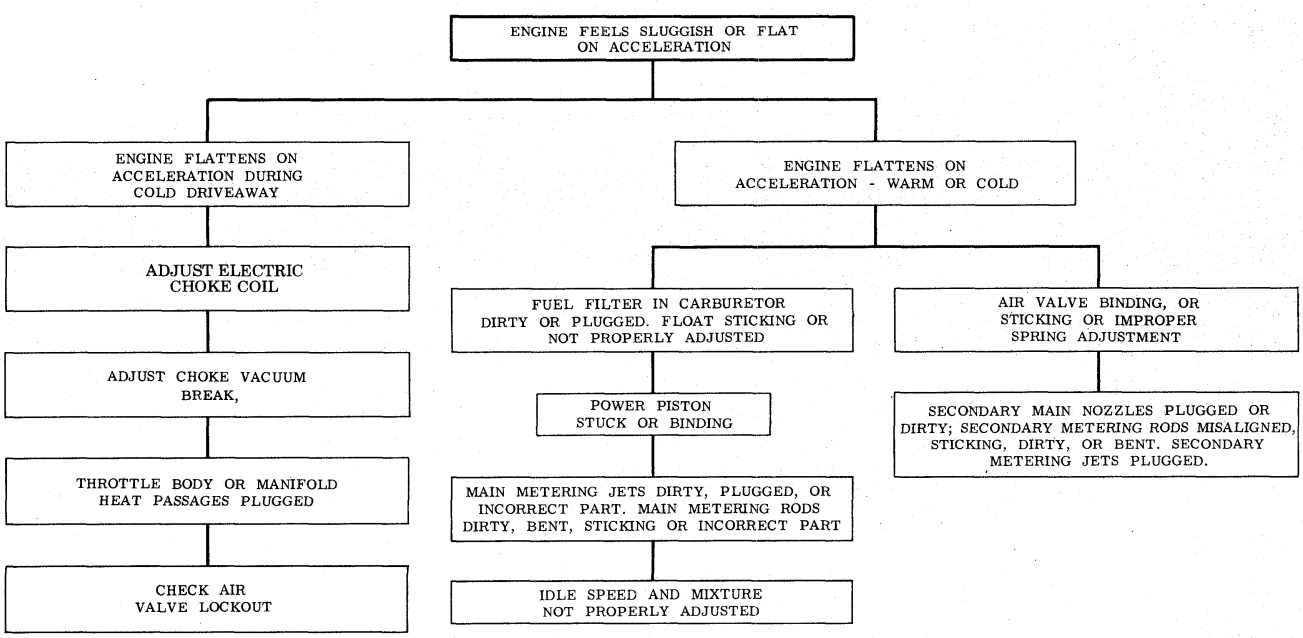


QUADRAJET 4MV
CARBURETOR DIAGNOSIS CHART (Cont'd.)

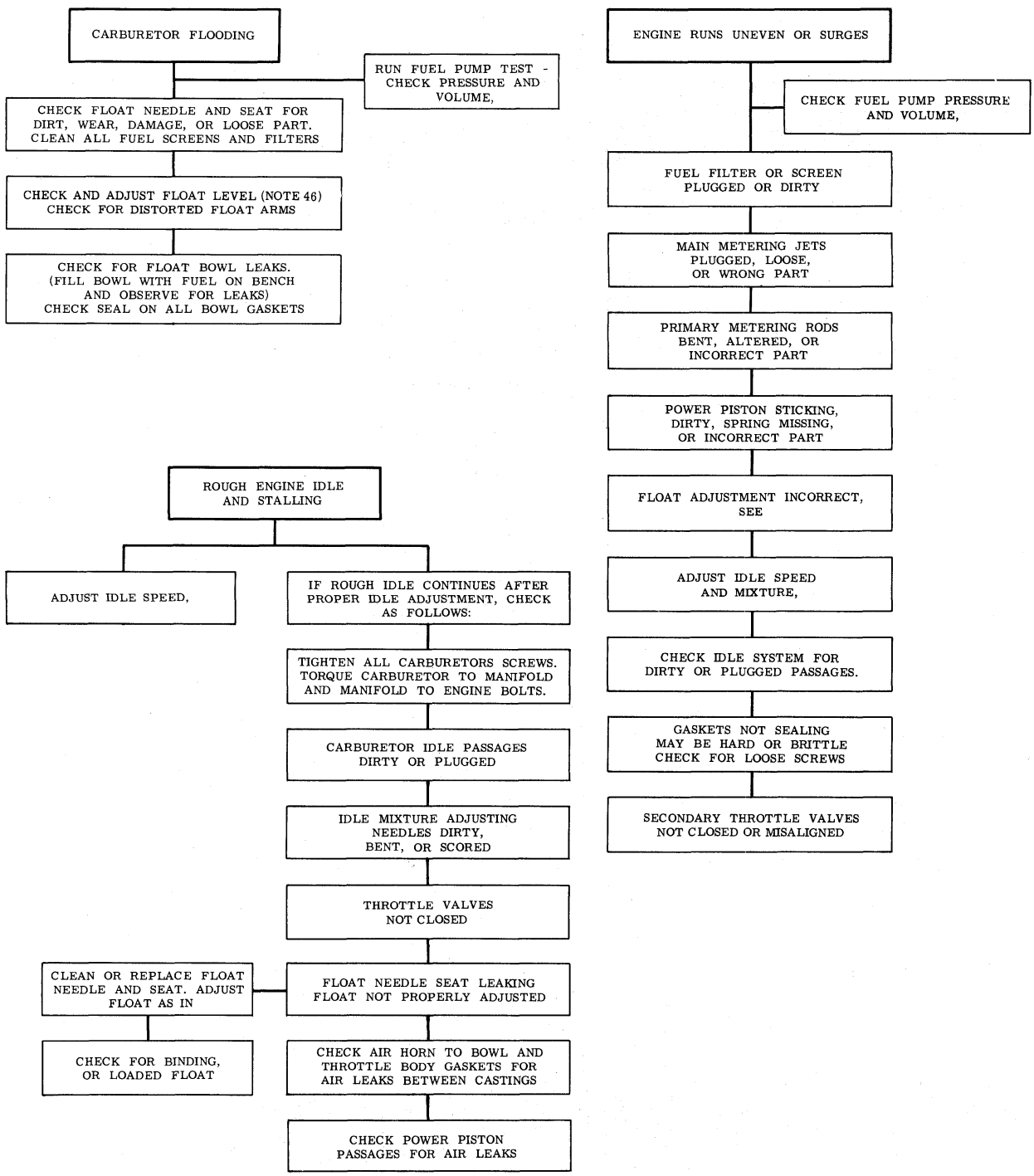


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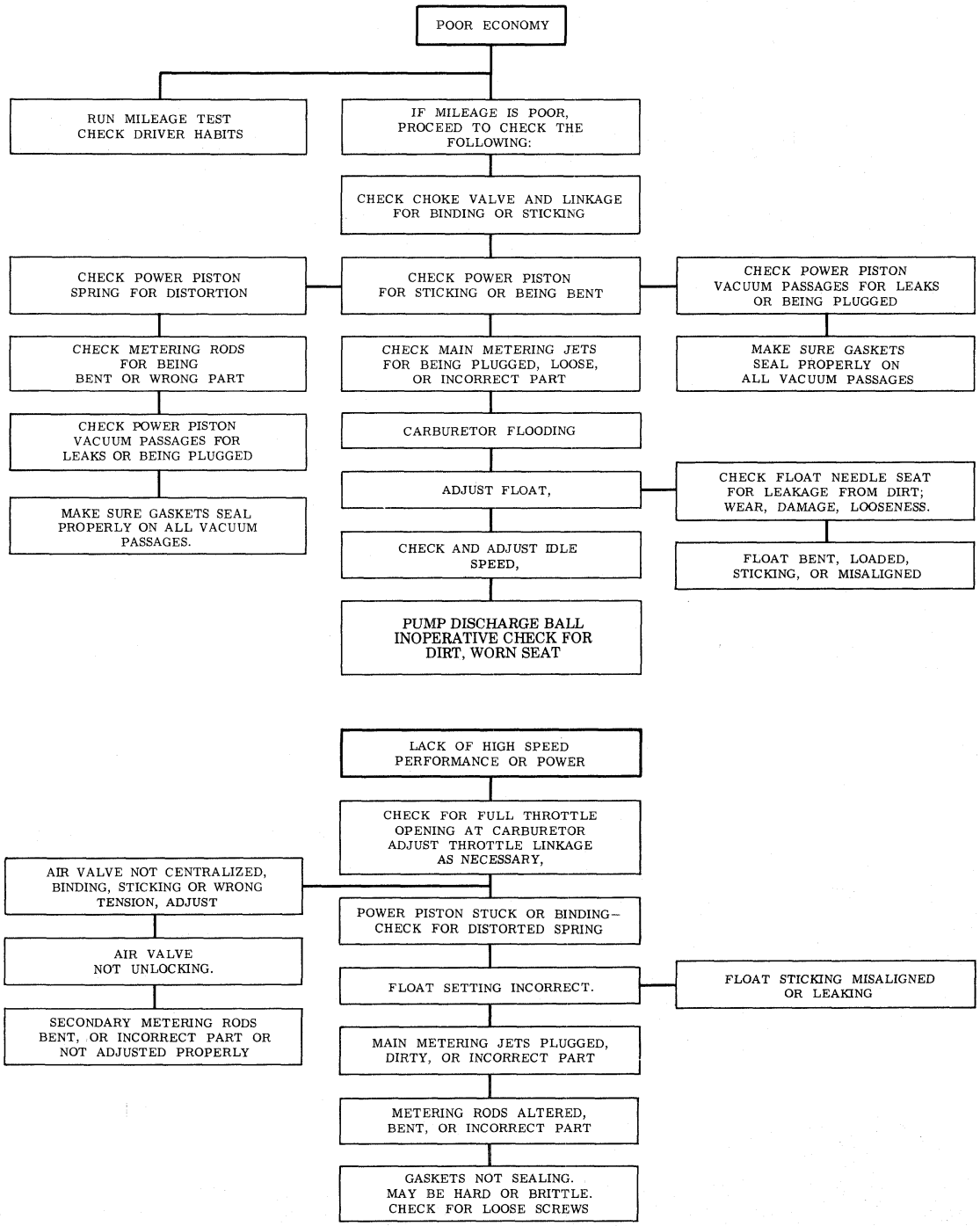




QUADRAJET 4MV
CARBURETOR DIAGNOSIS CHART (Cont'd.)



QUADRAJET 4MV
CARBURETOR DIAGNOSIS CHART (Cont'd.)



ON-CAR SERVICE

FAST IDLE SPEED ADJUSTMENT - EXCEPT EFI

NOTE: Assuming that the engine timing is correct, speed adjustment is made as follows.

1. Disconnect distributor vacuum hose and EGR vacuum hose and plug hoses. Disconnect air leveling compressor hose at air cleaner and plug hose.
2. Connect tachometer, start and warm-up engine to operating temperature in Park with air conditioning off.
3. Open the throttle and raise the fast idle cam to the second, or middle step of the cam.
4. Turn fast idle screw to 1400 rpm on all cars except California and 1500 rpm on California cars.

NOTE: Recheck fast idle speed to specifications listed on underhood tune up label.

5. Reconnect the E.G.R. distributor and air leveling compressor vacuum hoses.

IDLE MIXTURE & SPEED ADJUSTMENT

a. Mixture Adjustment

Idle mixture screws have been preset at the factory and capped. Do not remove the caps during normal engine maintenance.

Before suspecting the carburetor as the cause of poor engine performance or rough idle, check ignition system including distributor, timing, spark plugs and wires. Inspect air cleaner, evaporative emission system, EFE system, PCV system, EGR system and engine compression. Also inspect intake manifold, vacuum hoses and connections for leaks and check torque of carburetor mounting bolts.

In the case of major carburetor overhaul, throttle body replacement or high idle CO as indicated by state or local emission inspection, then idle mixture may be adjusted. Adjusting mixture by other than the following method may violate Federal and/or California or other state or Provincial laws. The following procedure MUST be followed.

Procedure

1. Set parking brake and block drive wheels. Disconnect and plug vacuum hose at parking brake.
2. Remove air cleaner for access to carburetor, but keep vacuum hoses connected. On cars with automatic level control, disconnect and plug vacuum hose to compressor.
3. Disconnect and plug other hoses as directed on Emission Control Information Label under the hood.
4. Engine must be at normal operating temperature, choke open, air conditioning off.
5. Connect an ACCURATE tachometer to engine.
6. Disconnect vacuum advance and plug hose. Check ignition timing. If necessary, adjust to specification shown on Emission Control Information Label. Reconnect vacuum advance.
7. Carefully remove caps from idle mixture screws. Be careful not to bend screws. Lightly seat screws, then back out 2 turns EQUALLY just enough so engine will run.
8. Place transmission in Drive.
9. Back each screw out (richen) 1/8 turn at a time until maximum idle speed is obtained. Then set idle speed screw to 670 rpm on all except California cars and 630 rpm on California cars. Repeat Step 9 to be certain you have maximum idle speed.
10. Turn each screw in (lean) with 1/8 turn increments until idle speed reaches 600 rpm.
11. Reset idle speed to specification shown on Emission Control Information Label.

NOTE: This number may be different than the value shown in step 10.

12. Check and adjust fast idle as described on the Emission Control Information Label.
13. Reconnect vacuum hoses. Install air cleaner.
14. Recheck idle speed. If necessary reset to specification.

b. Idle Speed Adjustment

Normal engine idle speed is adjusted with the idle speed screw located at the throttle lever side of carburetor.

Idle mixture adjustment must be correct before idle speed adjustments can be made. Basic engine timing should be set before idle adjustments. Refer to Engine Timing Page 6D-34.

Speed adjustment is made as follows:

1. Disconnect parking brake hose at vacuum release cylinder and plug hose. Set parking brake and block wheels. Disconnect air leveling compressor hose at air cleaner and plug hose.
2. Connect tachometer, start and warm-up engine to operating temperature in park. Choke should be fully open and cam follower lever completely off steps of fast idle cam.
3. Place transmission selector lever in drive, turn air conditioning off.
4. Adjust idle screw on carburetor to give 600 rpm.

NOTE: Do not depress the service brake when making engine idle speed adjustments. On cars equipped with "Hydro-boost" brake system the engine speed will be decreased by the application of the brakes.

5. Shut off engine. Remove tachometer.
6. Reconnect all disconnected hoses.

c. A/C Idle Speed-Up Solenoid Adjustment - Except Eldorado and Seville

1. With engine at normal operating temperature, block drive wheels, place transmission in Drive.
2. Disconnect A/C compressor wires at compressor and turn A/C to Auto position.
3. Deflect throttle linkage so that solenoid is fully extended.
4. Adjust solenoid to bring engine to 675 rpm.
5. Connect A/C compressor wires.

CARBURETOR REMOVAL AND INSTALLATION

a. Removal

1. Remove air cleaner and disconnect electrical lead to choke.
2. Disconnect hoses from TVS switch and canister from nipples on front of carburetor.
3. Disconnect throttle linkage and cruise control linkage if so equipped.

4. Working at rear of carburetor, remove transmission modulator hose and using a back-up wrench, remove power brake vacuum pipe (except Eldorado).

5. Always remove front vacuum break unit to avoid altering the vacuum break setting when breaking the fuel line nut.

6. Remove fuel line using a back-up wrench or tool J-23443 as required.

7. Remove mounting screws and lift carburetor to a position where PCV hose may be removed and remove carburetor.

8. Discard carburetor gasket.

b. Installation

1. Clean mounting surface of intake manifold and carburetor of any dirt, carbon or gasket material.

2. Place a new carburetor gasket on manifold with side marked "Top" or with manufacturers trade mark facing up.

3. Position carburetor near manifold and connect PCV hose to nipple on the throttle body. Secure with clamp.

4. Position carburetor to manifold and downshift switch and secure with four screws. Tighten screws evenly alternating from front to rear diagonally to 8 foot-pounds in front and 12 foot-pounds in rear.

5. Install fuel line using a tubing wrench.

6. Install front vacuum break unit.

7. Install the following hoses as indicated:

NOTE: Vacuum hose routing is shown in Fig. 6C-13 and 6C-14.

a. TVS hoses to nipples.

b. Canister purge hose to nipple.

c. Transmission modulator hose to nipple.

d. Power brake vacuum pipe fitting (except Eldorado).

NOTE: If inverted flare tube connector in throttle body has been loosened or replaced, do not tighten to greater than 125 inch-pounds as distortion of the throttle body may occur.

8. Connect throttle linkage and return spring. Connect cruise control linkage on cars so equipped.

9. Connect electrical lead to choke coil.

10. Install air cleaner.

CARBURETOR DISASSEMBLY

NOTE: Before performing any service on the carburetor, it is essential the carburetor be placed on a holding fixture such as J-9789-118. Without the use of the holding fixture, it is possible to bend or nick throttle valves.

AIR HORN

Removal

1. Remove upper choke lever from the end of choke shaft by removing retaining screw, Fig. 6C-15. Then rotate upper choke lever to remove choke rod from slot in lever.

2. Remove choke rod from lower lever inside the float bowl casting.

3. Remove vacuum hose from front vacuum break unit.

4. Remove secondary metering rods by removing the small screw in the top of the metering rod hanger. Lift upward on meter-rod hanger until the secondary metering rods are completely out of the air horn. Metering rods may be disassembled from the hanger by rotating ends out of the holes in the end of the hanger, Fig. 6C-16.

5. Using special tool J-25322, drive roll pin (pump lever pivot pin) inward just enough until pump lever can be removed from air horn.

Then remove pump lever from pump rod, Fig. 6C-17. Note location of rod if in inner or outer hole in pump lever.

CAUTION: *Use care in removing small roll pin to prevent damage to pump lever casting bosses in air horn.*

6. Remove nine air horn to bowl attaching screws: two attaching screws are located next to the primary venturi (two long screws, five short screws, and two countersunk screws). Remove secondary air baffle deflector from beneath the two center air horn screws. Remove cover and gasket from beneath front air horn screw, Fig. 6C-18.

7. Remove air horn from float bowl by lifting straight up. The air horn gasket should remain in on the float bowl for removal later.

CAUTION: *When removing air horn from float bowl, use care to prevent bending the small tubes protruding from the air horn. These tubes are permanently pressed into the air horn casting. DO NOT REMOVE.*

AIR HORN

Disassembly

1. If not removed previously, remove front vacuum break bracket attaching screws. The unit may now be removed from the air valve dashpot rod and the dashpot rod from the air valve lever, Fig. 6C-19.

CAUTION: *Do not place vacuum break assembly in carburetor cleaner.*

2. Further disassembly of the air horn is not required or recommended for cleaning purposes. If part replacement is required, proceed as follows:

Remove staking on (2) choke valve attaching screws, then remove choke valve and shaft from air horn.

NOTE: Air valve and air valve shaft should not be removed. However, if it is necessary to replace the air valve closing spring or center plastic eccentric cam, a repair kit is available. (Instructions for assembly are included in the repair kit.

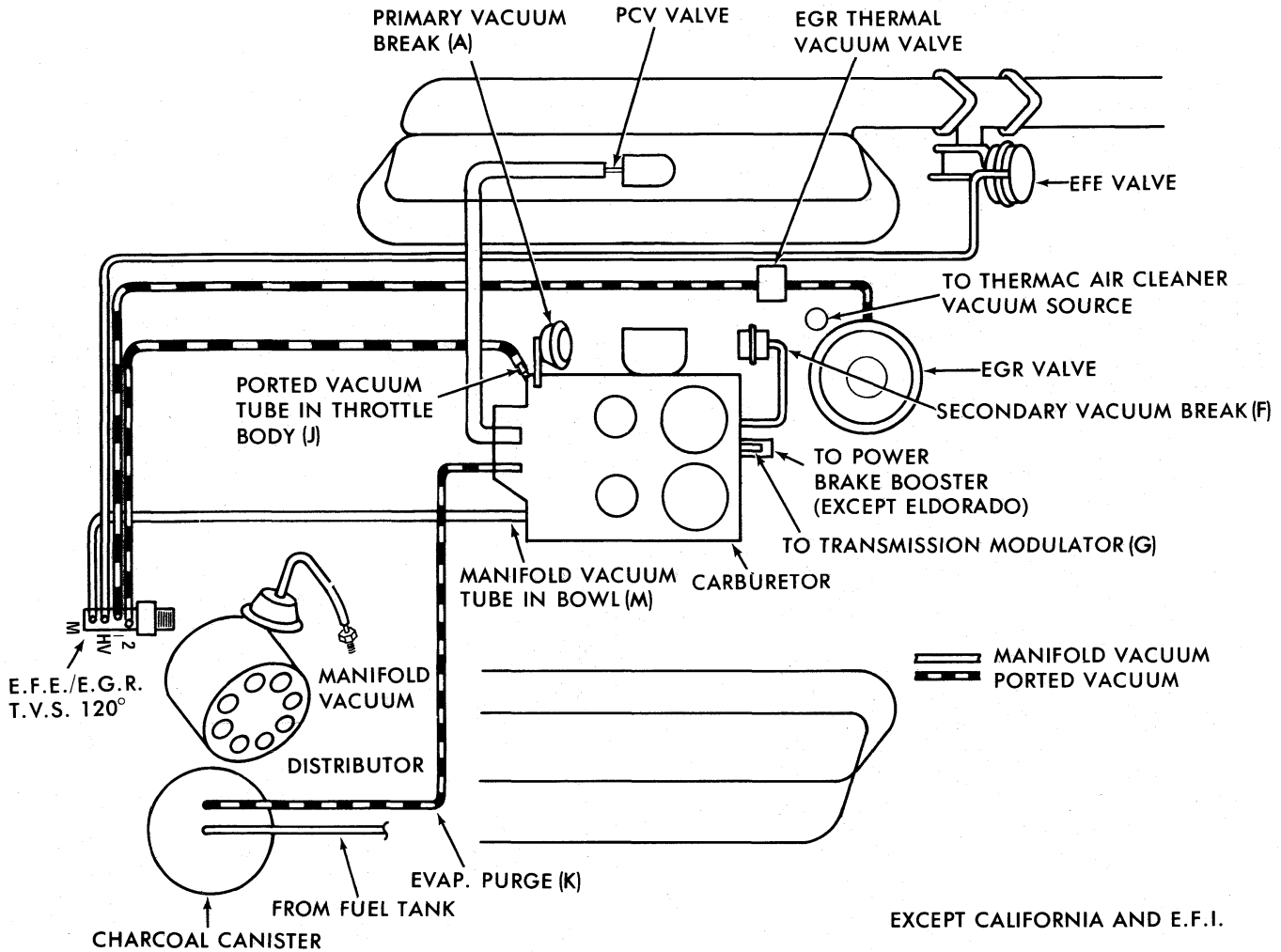


Fig. 6C-13 Vacuum Hose Routing (Except California and E.F.I.)

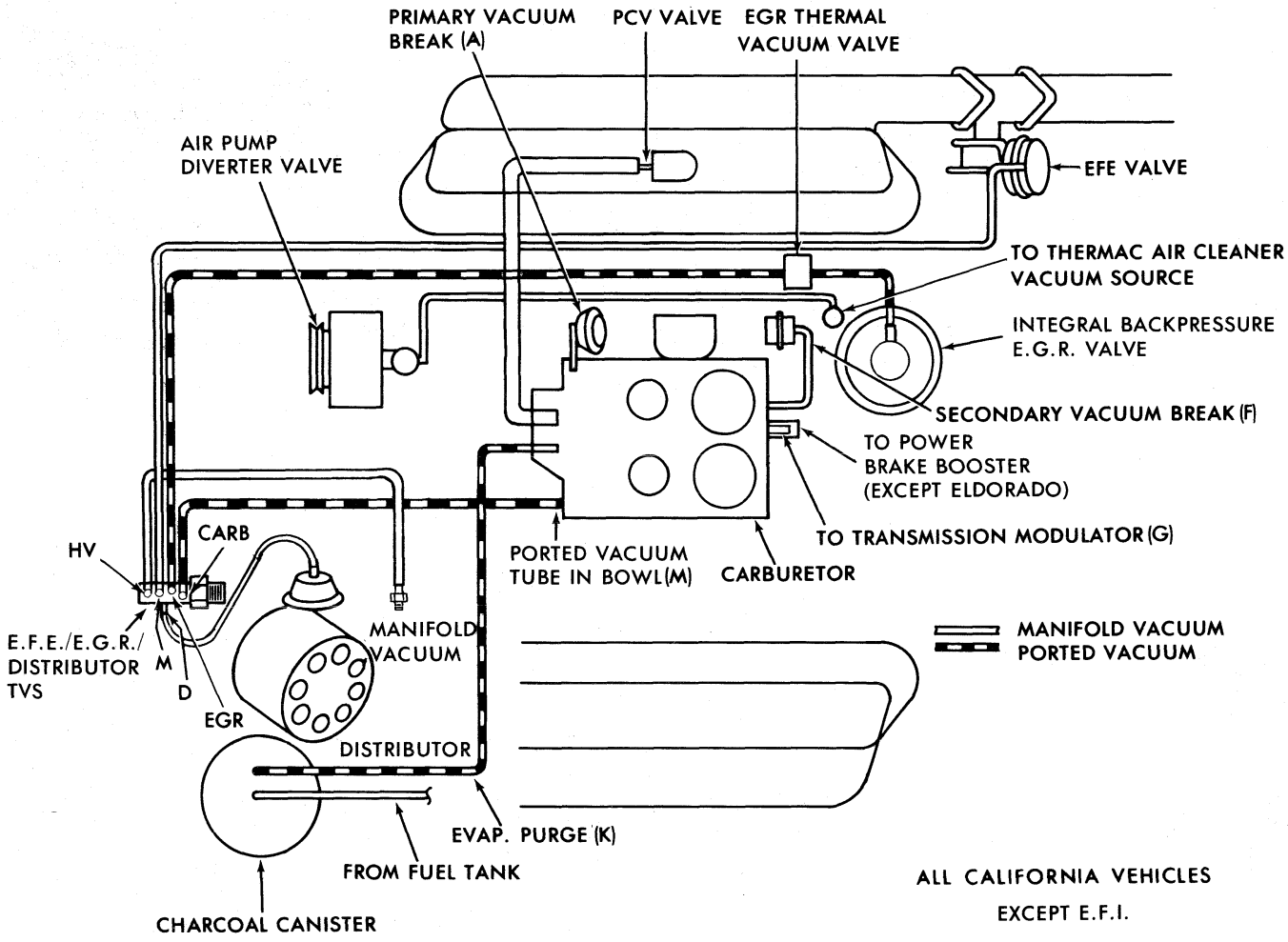


Fig. 6C-14 Vacuum Hose Routing - California (Except E.F.I.)

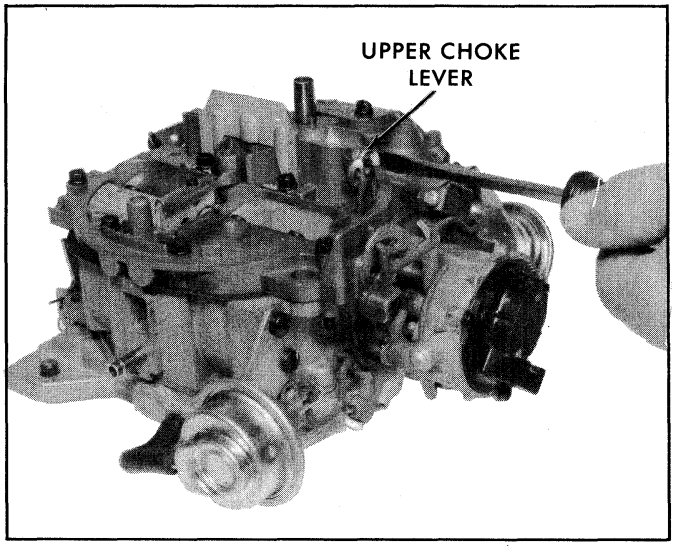


Fig. 6C-15 Choke Lever and Rod

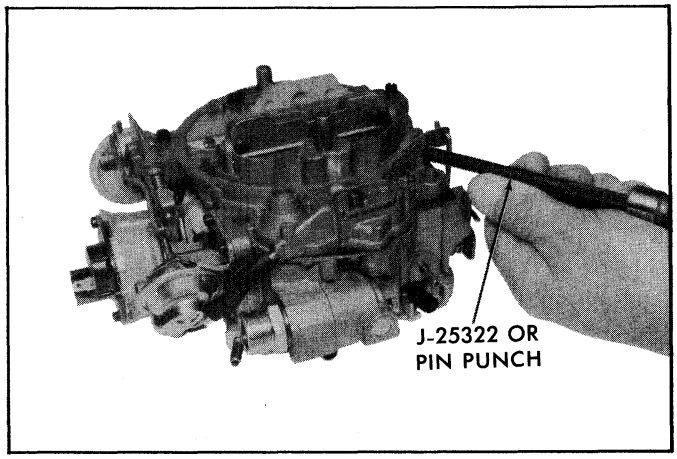


Fig. 6C-17 Pump Lever Pivot Pin

FLOAT BOWL

Disassembly

1. Carefully loosen air horn gasket and lift one corner. Remove pump plunger from pump well, Fig. 6C-20.

2. Remove air horn gasket by lifting tab of gasket from beneath the power piston hanger, being careful not to distort spring holding the main metering rods.

3. Remove pump return spring from pump well.

4. Remove power piston and metering rods by depressing piston stem and allowing it to snap free.

NOTE: The power piston can be easily removed by pressing the piston down and releasing it with a snap. This will cause the power piston spring to snap the piston up against the retainer. This procedure may have to be repeated several times. DO NOT REMOVE POWER PISTON BY USING PLIERS ON METERING ROD HANGER. Remove the power piston spring from the well.

CAUTION: *The A.P.T. metering rod adjustment screw is pre-set at the factory and no attempt should be made to change this adjustment in the field. If float bowl replacement is required during service, the new bowl assembly will be supplied with an adjustment screw which will be pre-set as required.*

5. Remove metering rods from power piston by disconnecting tension spring from top of each rod, then rotate rod to remove from hanger.

CAUTION: *Use care when disassembling rods to prevent distortion of tension spring and/or metering rods. Note carefully position of tension spring for later reassembly, Fig. 6C-22.*

6. Remove plastic filler block over float valve.

7. Remove float assembly and float needle seat and

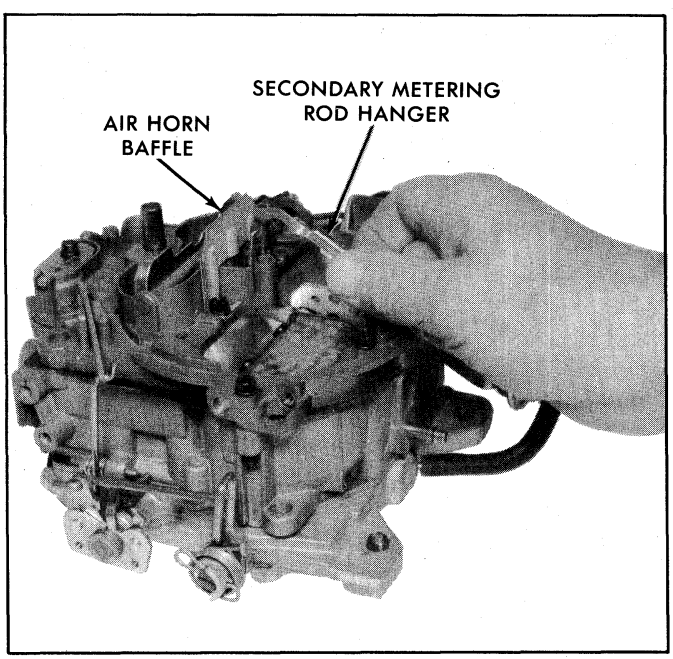


Fig. 6C-16 Secondary Metering Rods

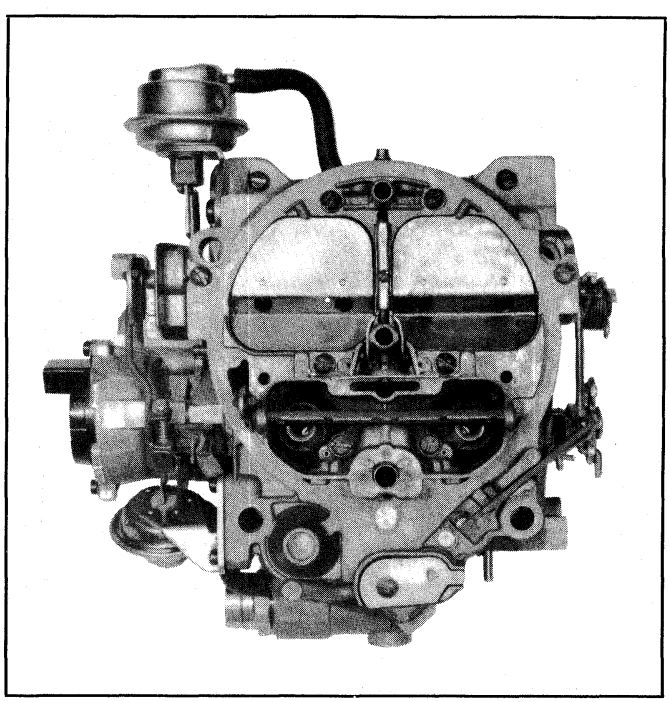


Fig. 6C-18 Air Horn Attaching Screws

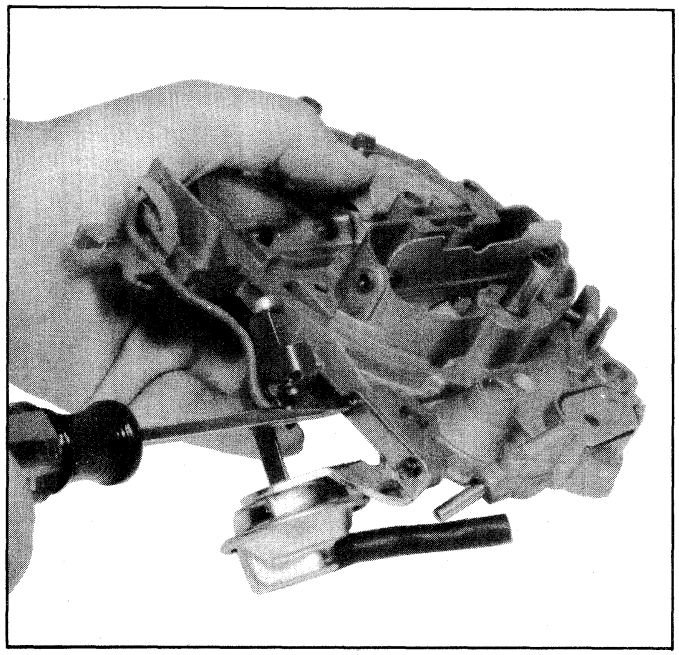


Fig. 6C-19 Front Vacuum Break Removal

gasket using Seat Remover, J-22769.

8. Remove aneroid cavity insert, from float bowl Fig. 6C-23.

9. On M4MEA models, remove two cover screws and carefully lift the aneroid-metering rod assembly from the float bowl, Fig. 6C-24.

CAUTION: *The aneroid-metering rod assembly is extremely fragile. Use care in handling. Do not immerse in carburetor cleaner. The aneroid-metering rod assembly is pre-set at the factory and NO attempt should be made to re-adjust in the field. If replacement of the aneroid-metering rod assembly is necessary, replacement part will include instructions for adjustment.*

10. Remove primary main metering jets only if

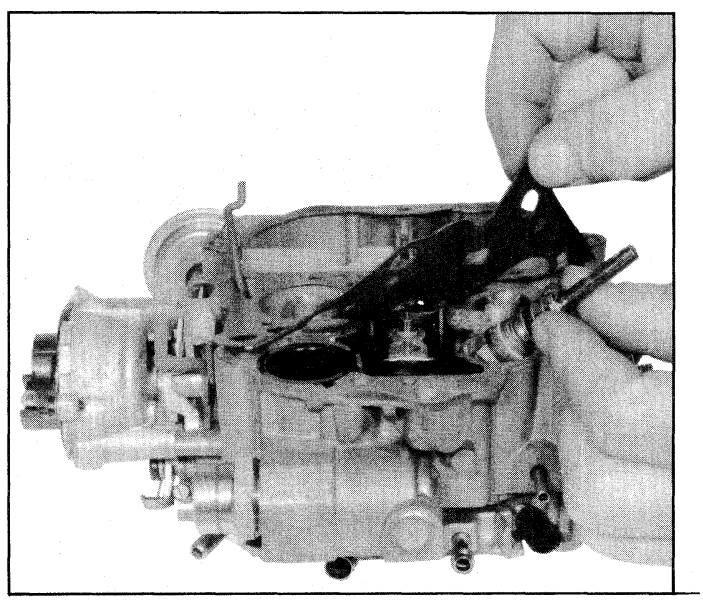


Fig. 6C-20 Removing Accelerator Pump

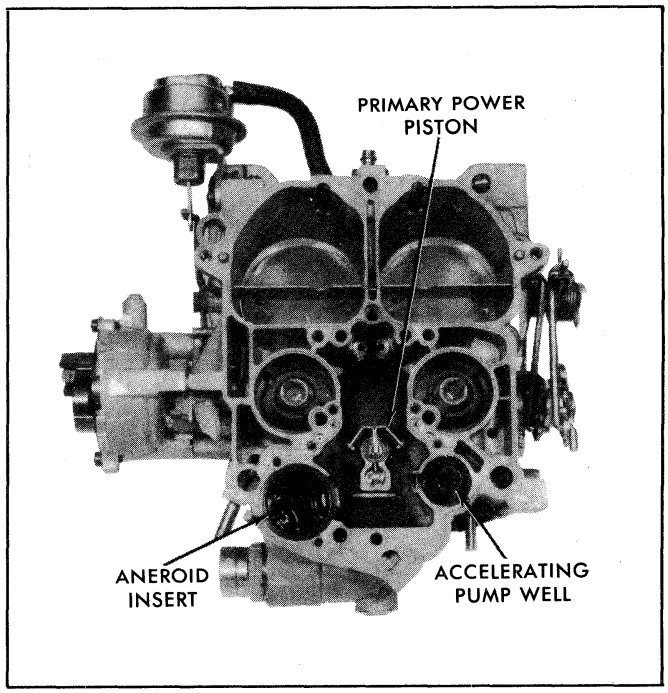


Fig. 6C-21 Float Bowl (M4ME)

necessary, Fig. 6C-27.

NOTE: No attempt should be made to remove the secondary metering jets (metering orifice plates), or the aneroid jet (M4MEA only), Fig. 6C-27. These jets are fixed and, if damaged, float bowl replacement is required).

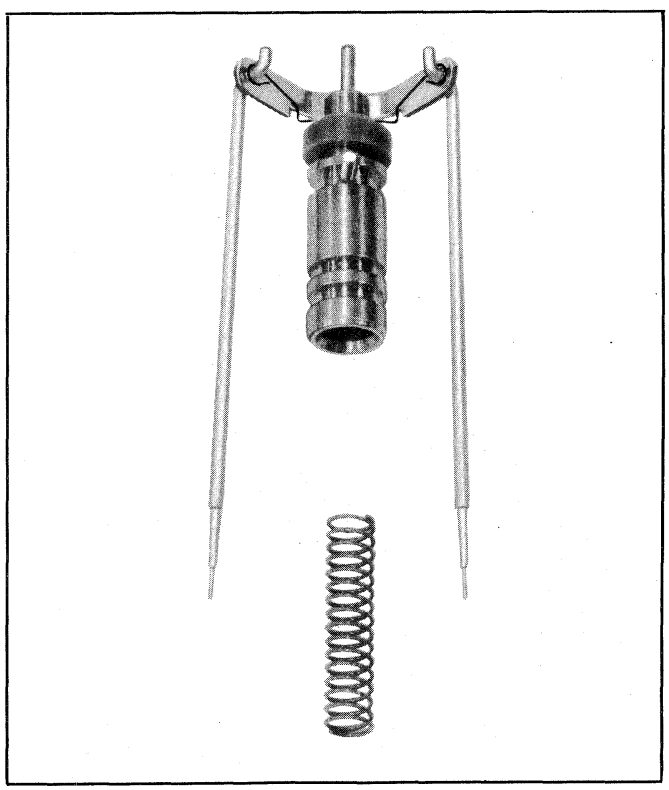


Fig. 6C-22 Metering Rods

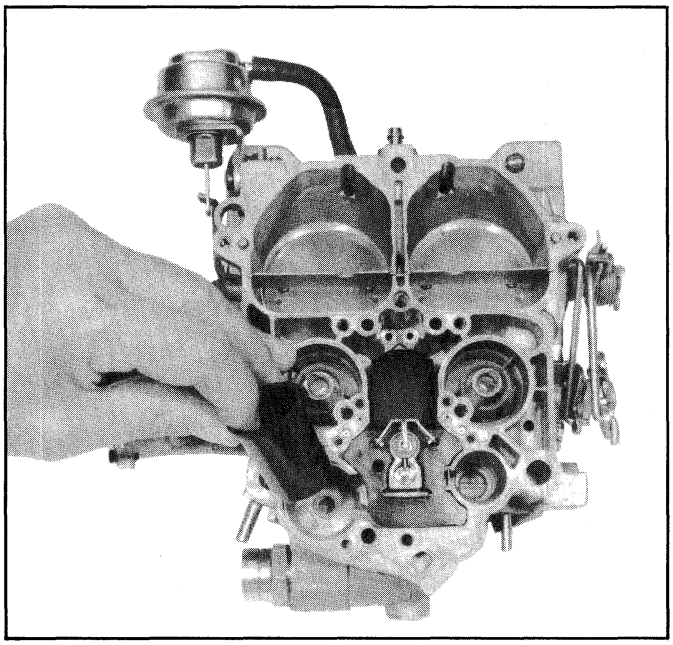


Fig. 6C-23 Aneroid Insert

11. Remove pump discharge check ball retainer and check ball. Fig. 6C-26.

12. If necessary, remove baffle from secondary side of bowl.

13. Remove baffle from side of pump well.

14. Remove hose from rear vacuum break control assembly. Remove two screws from rear vacuum break bracket and rotate the assembly to remove vacuum break rod from slot in plunger head, Fig. 6C-28.

CAUTION: *Do not place vacuum break assemblies in carburetor cleaner.*

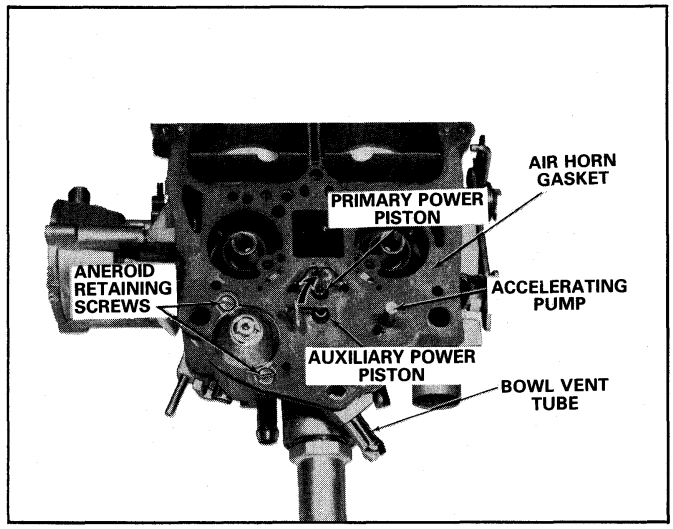


Fig. 6C-25 Float Bowl - (M4MEA)

15. Remove vacuum break rod by holding down on fast idle cam (hot idle position); move end of vacuum break rod away from float bowl then disengage rod from hole in intermediate choke lever.

CHOKE DISASSEMBLY

1. Remove three (3) attaching screws and retainers from electric choke cover and coil assembly. Then pull straight outward and remove electric choke cover and coil assembly from choke housing.

2. Remove choke housing assembly from float bowl by removing retaining screw and washer assembly inside the choke housing, Fig. 6C-29.

The complete choke assembly can be removed from the float bowl by sliding outward, Fig. 6C-30.

3. Remove secondary throttle valve lock-out lever from

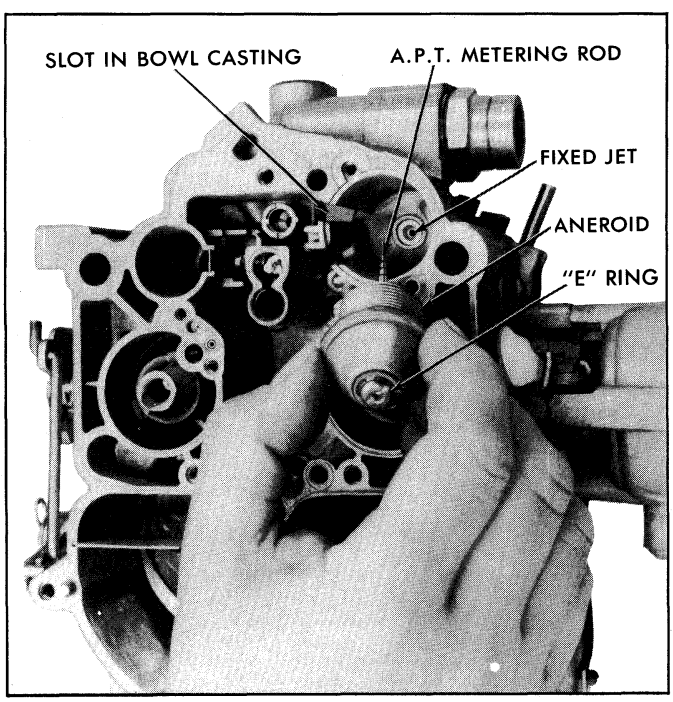


Fig. 6C-24 Aneroid Metering Rod Removal

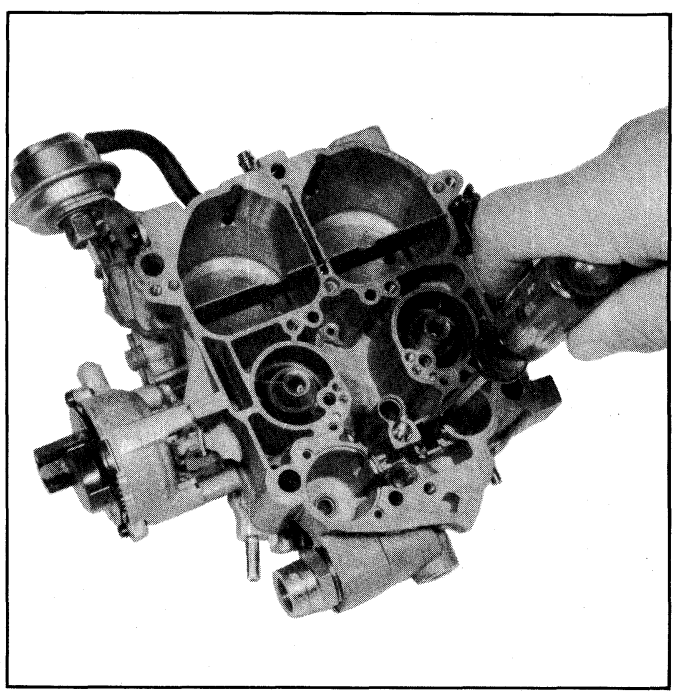


Fig. 6C-26 Pump Discharge Ball Removal

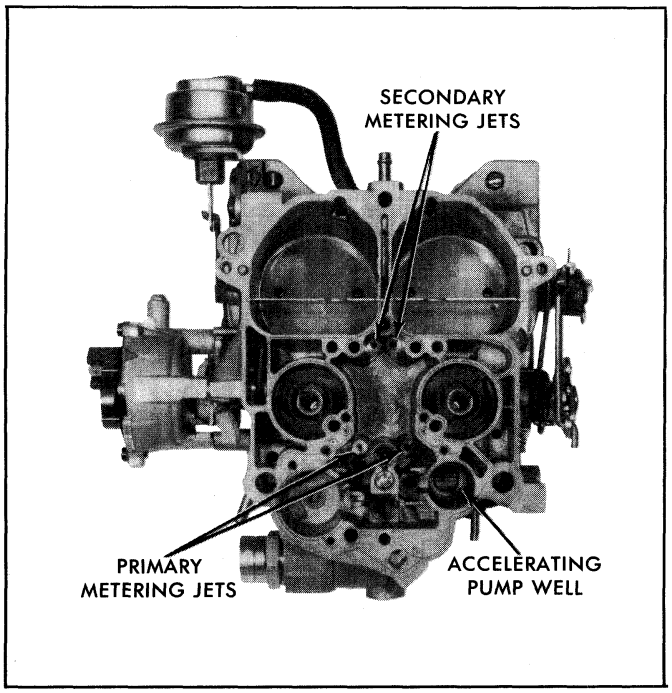


Fig. 6C-27 Metering Jets

float bowl Fig. 6C-30.

4. Remove lower choke lever from inside float bowl cavity by inverting bowl.

5. To disassemble intermediate choke shaft from choke housing, remove coil lever retaining screw at end of shaft inside the choke housing, Fig. 6C-29. Then remove thermostatic coil lever from flats on intermediate choke shaft. Remove intermediate choke shaft from the choke housing by sliding outward. The fast idle cam can now be removed from the intermediate choke shaft.

CAUTION: *Remove the cup seal from the float bowl plastic insert for bowl cleaning purposes. DO NOT ATTEMPT TO REMOVE PLASTIC INSERT.*

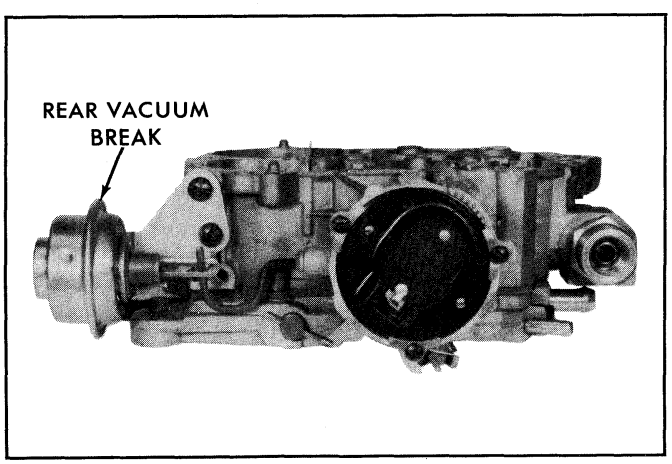


Fig. 6C-28 Rear Vacuum Break

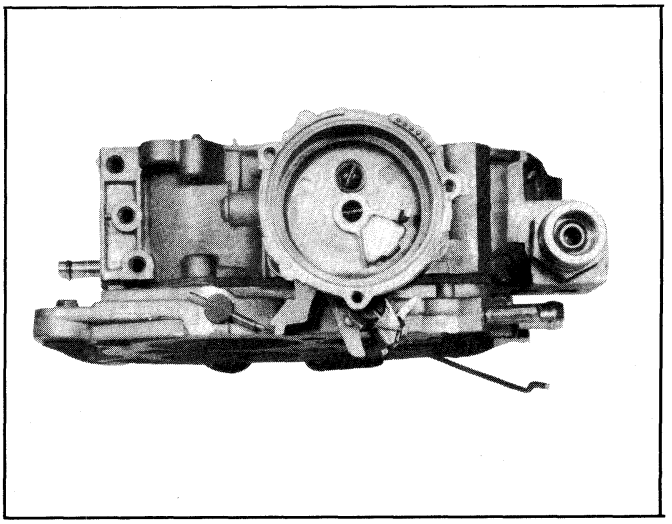


Fig. 6C-29 Choke Housing

REMAINING FLOAT BOWL PARTS

Disassembly

1. Remove fuel inlet nut, gasket, filter and spring, Fig. 6C-31.
2. Remove throttle body by removing throttle body to bowl attaching screws, Fig. 6C-32.
3. Remove throttle body to bowl insulator gasket, Fig. 6C-33.

THROTTLE BODY

Disassembly

1. Remove pump rod from throttle lever.
2. DO NOT REMOVE idle mixture limiter caps, unless it is necessary to replace the mixture needles or normal soaking and air pressure fails to clean the idle passages. If the

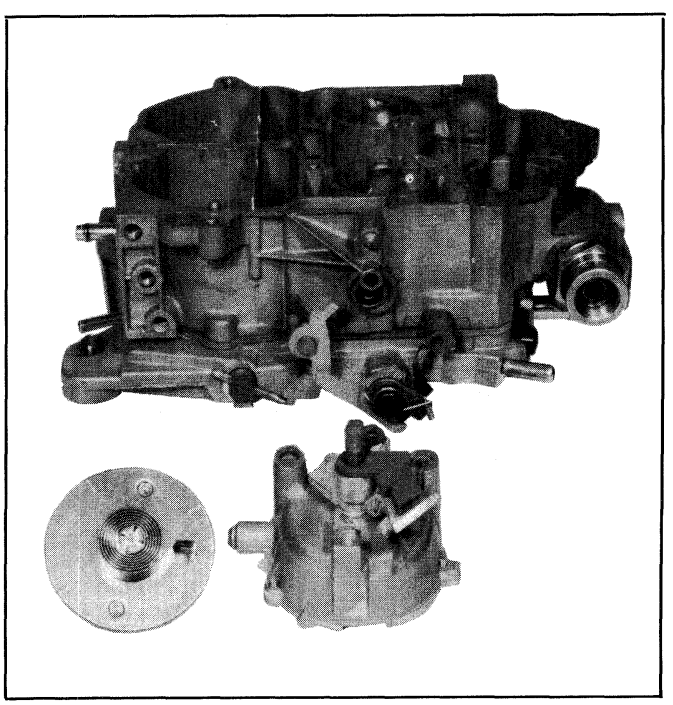


Fig. 6C-30 Choke Assembly

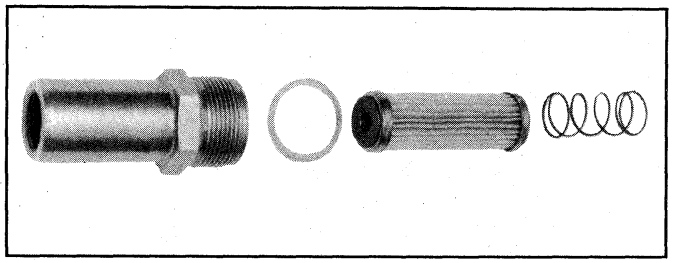


Fig. 6C-31 Fuel Filter

idle mixture needles are removed, adjustment procedures will be covered in the "Carburetor Overhaul Adjustment" chart.

If necessary to remove the idle mixture needle, destroy plastic limiter cap. Do not install a replacement cap as a bare mixture screw is sufficient to indicate that the mixture has been readjusted.

CLEANING AND INSPECTION

The carburetor parts should be cleaned in cold immersion type cleaner.

CAUTION: *The electric choke, rubber parts, plastic parts, diaphragms, pump plungers, should not be put in immersion type cleaner as they will swell, harden or distort.*

The plastic cam on the air valve shaft and bushing in bowl will withstand normal cleaning. Rinse thoroughly after cleaning.

1. Thoroughly clean all metal parts and blow dry with compressed air. Make sure all fuel passages and metering parts are free of burrs and dirt.

2. Check, repair or replace the following parts if the following problems were encountered:

A. Flooding

1. Inspect float needle seat for dirt, deep wear grooves, scores and proper seating.

2. Inspect float, float arms and hinge pin for distortion, binds and burrs. Check float for leaks and/or being loaded (heavier than normal).

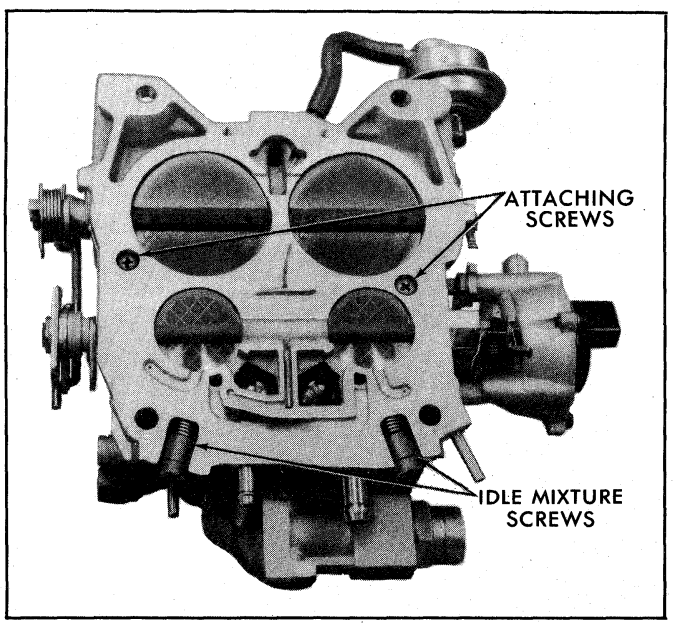


Fig. 6C-32 Removing Throttle Body

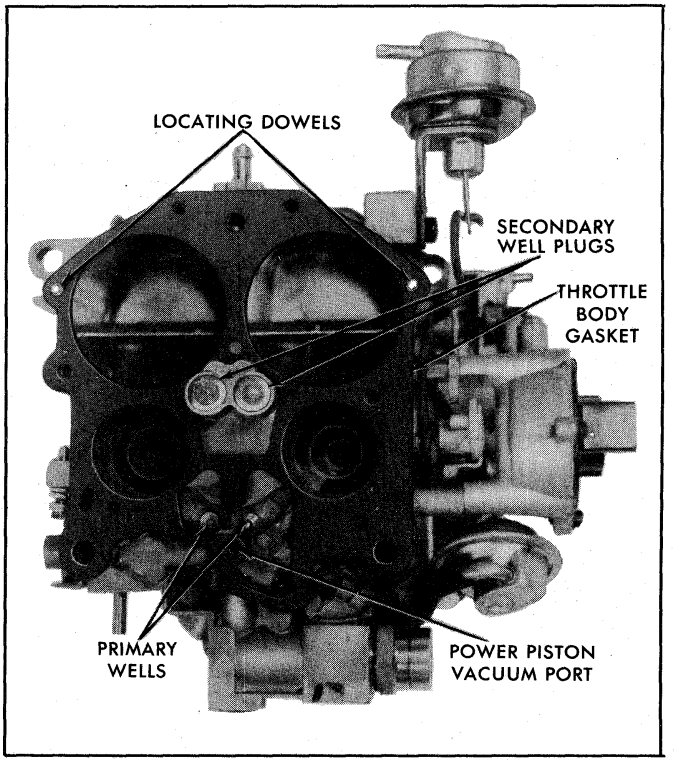


Fig. 6C-33 Removing Throttle Body Gasket

B. Hesitation

1. Inspect pump plunger for cracks, scores or cup, excessive wear. A used pump cup will shrink when dry. Soak in fuel for 8 hrs. before testing if dried out.

2. Inspect pump duration and return spring for being weak or distorted.

3. Check all pump passages and jets for dirt, improper seating inlet or discharge balls, scores in pump well.

4. Check pump linkage for excessive wear, repair or replace as necessary.

C. Hard Starting - Poor Cold Operation

1. Check choke valve and linkage for excessive wear, binds or distortion.

2. Inspect choke vacuum diaphragms for leaks.

3. Clean or replace carburetor filters.

4. Inspect needle for sticking, dirt, etc.

5. Examine fast idle cam for wear or damage.

6. Also check items under "flooding".

D. Poor Performance - Poor Gas Mileage

1. Power piston, power valve, metering rods for dirt, sticking, binding, damaged parts or excessive wear.

2. Check secondary air valve for binds and damage. If air valve is damaged, the air horn assembly must be replaced. A torsion spring kit is available for repairs to air valve closing spring. A new plastic secondary metering rod cam is included in kit.

3. Clean all fuel and vacuum passages in castings.

E. Rough Idle

1. Inspect idle needle for ridges, burrs or being bent.

2. Inspect gasket mating surfaces on castings for damage to sealing beads, nicks and burrs.

3. Clean all idle fuel passages.

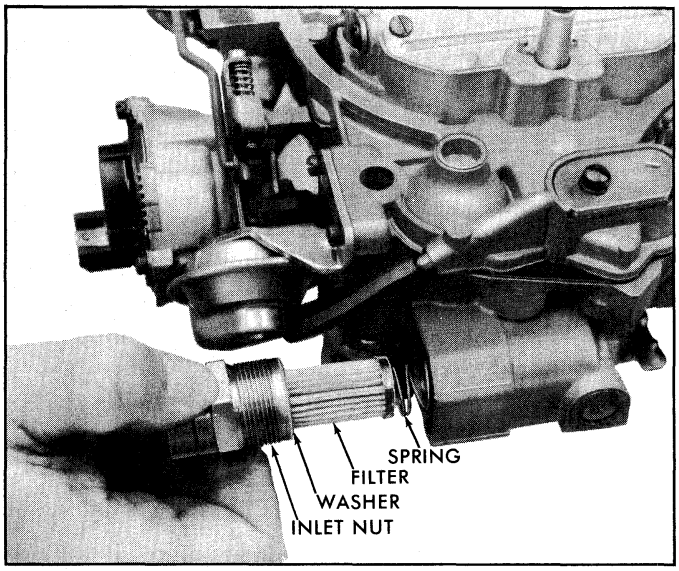


Fig. 6C-34 Fuel Filter Installation

4. Check throttle levers and valves for binds, nicks and other damage.

CARBURETOR ASSEMBLY

THROTTLE BODY

Assembly

1. If removed, install idle mixture needles and springs until seated. Back out the mixture needles 2 turns as a preliminary idle adjustment. Final adjustment must be made on the engine using the procedures described under idle mixture adjustment.

2. Install lower end of pump rod in throttle lever by aligning tang on rod with slot in lever. End of rod should point outwards towards throttle lever.

FLOAT BOWL

Assembly

1. Install new throttle body to bowl gasket over two locating dowels on bowl.

2. Install throttle body making certain throttle body is properly located over dowels on float bowl, then install throttle to bowl screws and tighten evenly and securely, Fig. 6C-32.

3. Place carburetor on proper holding fixture J-9789-118.

4. Install fuel inlet filter spring, check valve filter assembly, new gasket and inlet nut and tighten nut to 18 foot pounds, Fig. 6C-34.

CAUTION: *The fuel inlet check valve filter assembly is to meet motor vehicle safety standards (M.V.S.S.) for roll-over. New service replacement filter includes the check valve.*

NOTE: Ribs on closed end of filter element prevent filter from being installed incorrectly unless forced.

CAUTION: *Tightening beyond specified torque can damage nylon gasket.*

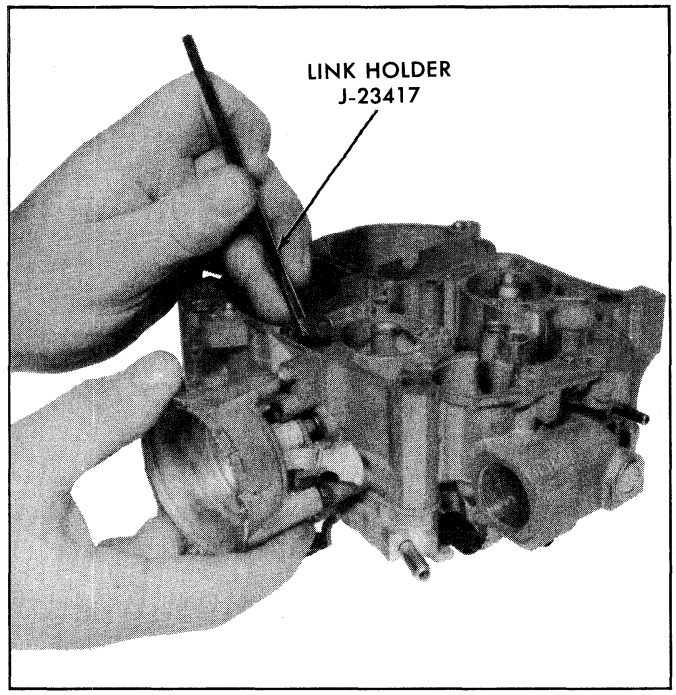


Fig. 6C-35 Choke Lever And Housing

CHOKE HOUSING TO FLOAT BOWL

Assembly

1. Install new cup seal into insert on side of float bowl for intermediate choke shaft. Lip on cup seal faced outward.

2. Install secondary throttle valve lockout lever on boss on float bowl with recess in hole in lever facing bowl, Fig. 6C-30.

3. Install fast idle cam onto the intermediate choke shaft (steps on cam face downward), Fig. 6C-30.

4. Carefully install fast idle cam and intermediate choke shaft assembly in choke housing; then install thermostatic coil lever onto flats on intermediate choke shaft. Inside thermostatic choke coil lever is properly aligned when both inside and outside levers face towards fuel inlet. Install inside lever retaining screw into end of intermediate choke shaft. Tighten securely.

5. Install lower choke rod lever into cavity in float bowl. Install choke housing to bowl sliding intermediate choke shaft into lower choke lever.

NOTE: Tool J-23417 can be used to hold the lower choke lever in correct position while installing the choke housing, Fig. 6C-35.

6. Install choke housing retaining screw and washer and tighten securely.

NOTE: The intermediate choke shaft lever and fast idle cam are in correct relation when the tang on lever is beneath the fast idle cam. Do not install electric choke cover and coil assembly until inside coil lever is adjusted, See Adjustments on Page 6C-25.

COMPLETION OF FLOAT BOWL ASSEMBLY

1. Holding down on fast idle cam (hot idle position), install end of rear vacuum break rod in hole in intermediate choke lever.

2. Install end of vacuum break rod in slot in rear vacuum break plunger head. Then install rear vacuum break control and bracket assembly to float bowl using two (2) attaching

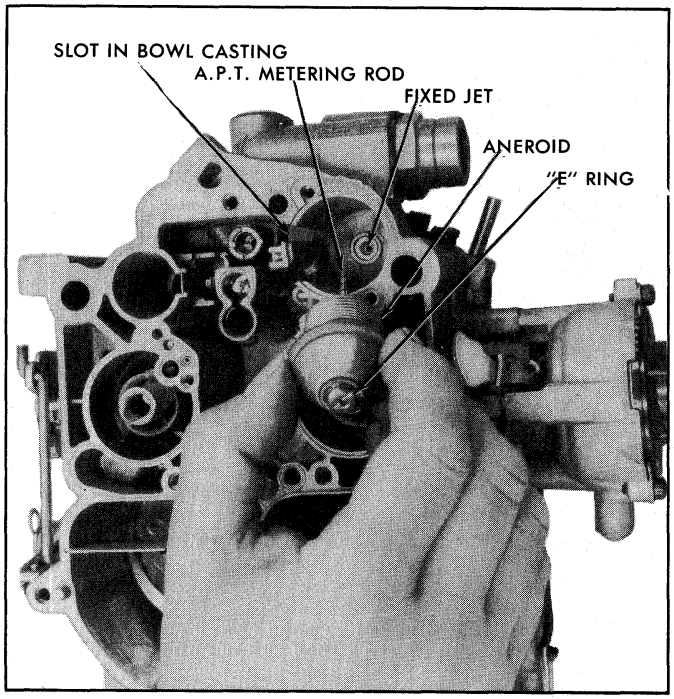


Fig. 6C-36 Aneroid - Metering Rod Replacement

screws. Tighten securely.

NOTE: Do not attach vacuum break hose until after the vacuum break adjustment is completed, See Adjustments on Page 6C-27.

3. If removed, install air baffle in secondary side of float bowl with notches toward the top. Top edge of baffle must be flush with bowl casting.

4. Install baffle in side of pump well with slot towards bottom.

5. Install pump discharge check ball and retainer in passage next to pump well. Tighten retainer securely.

6. Install primary main metering jets, Fig. 6C-27 (if removed).

7. On M4MEA models, carefully install aneroid-metering rod and cover assembly into float bowl aligning tab on cover assembly with slot in float bowl closest to the fuel inlet nut, Fig. 6C-36. Use care installing the metering rod and cover assembly into float bowl to prevent damage to the aneroid or metering rod tip. Install cover attaching screws and tighten securely.

NOTE: The position of the aneroid-metering rod assembly in the fixed jet is extremely critical. The assembly is pre-set at the factory and adjustment in the field should not be attempted unless replacement is necessary. If replacement of the aneroid-metering rod assembly is required, replacement part will include instructions for adjustment.

8. Install new needle seat assembly, with gasket, using Seat Installer J-22769.

9. To make adjustment easier, bend float arm upward at notch in arm before assembly. Install needle by sliding float lever under needle pull clip - correct installation of the needle pull clip is to hook the clip over the edge of the flat float arm facing the float pontoon, Fig. 6C-37. With float lever in pull clip, hold float assembly at toe and install retaining pin toward pump well side.

CAUTION: *Do not install float needle pull clip into holes in float arm.*

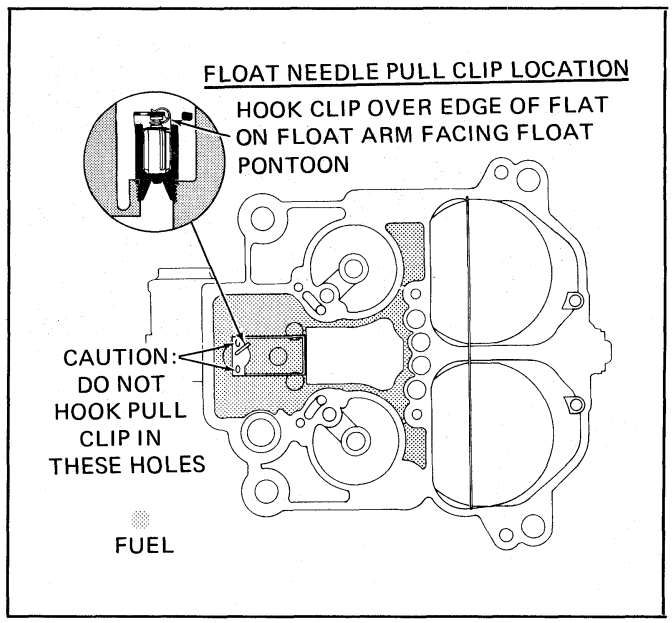


Fig. 6C-37 Float Needle Pull Clip Location

FLOAT LEVEL ADJUSTMENT (SEE ADJUSTMENTS ON PAGE 6C-25) (FIG. 6C-38)

NOTE: To make adjustment easier, bend float arm upward at notch in arm before assembly).

a. Hold float retainer firmly in place.

b. Push float down lightly against needle.

c. With adjustable T-scale, gauge from top of float bowl casting (air horn gasket removed) to top of float at toe-gauging point 3/16" back from toe, See insert — Fig. 6C-38.

d. Bend float arm as necessary for proper adjustment by pushing on pontoons.

e. Visually check float alignment after adjustment.

10. Install plastic filler block over float needle, pressing downward until properly seated.

11. Install power piston spring in power piston well. If main metering rods were removed from hanger, reinstall

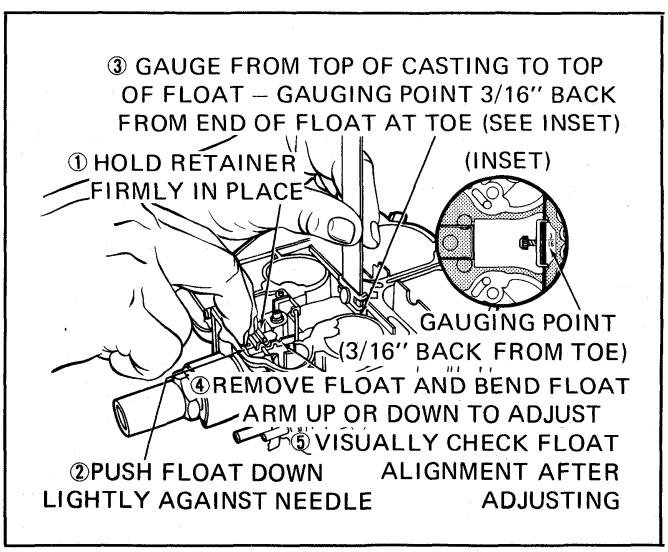


Fig. 6C-38 Float Level Adjustment

making sure tension spring is connected to top of each rod, Fig. 6C-22. Install power piston assembly in well (aligning pin on piston with slot in well) with metering rods properly positioned in metering jets.

Press down firmly on plastic power piston retainer to make sure the retainer is seated in recess in bowl and the top is flush with the top of the bowl casting. If necessary, using a drift punch and small hammer, tap retainer lightly in place.

12. Install pump return spring in pump well.

13. Install air horn gasket by carefully sliding tab of gasket around main metering rods and beneath the power piston hanger. Position gasket over the two dowel pins on the float bowl.

14. Carefully lift one corner of the air horn gasket and install pump plunger in the pump well by pushing the plunger to the bottom of the well against return spring tension. While holding in this position, align pump plunger stem with hole in gasket and press gasket in place.

AIR HORN

Assembly

1. If removed, install choke shaft, choke valve, and two attaching screws. Tighten screws secruely and stake lightly in place.

NOTE: Check choke valve for freedom of movement and proper alignment before staking screws in place.

AIR HORN TO BOWL

Installation

1. Holding down on air horn gasket at pump plunger location, carefully lower air horn assembly onto float bowl making sure that the bleed tubes, accelerating well tubes, pull over enrighment tubes, and pump plunger stem are positioned properly through the holes in the air horn gasket.

CAUTION: *Do not force the air horn assembly onto the bowl but rather lightly lower in place.*

2. Install two long air horn screws, five short screws, and two countersunk screws into primary venturi area. The gasket and cover are retained by screw No. 5 and the secondary air baffle by screws No. 3 and 4. All air horn screws must be tightened evenly and securely. See Fig. 6C-39 for proper tightening sequence.

3. Install front vacuum break diaphragm rod into the slot in lever on the end of the air valve shaft. Then install the other end of rod into hole in the vacuum break diaphragm plunger. Install front vacuum break control and bracket assembly to air horn using two retaining screws through the bracket. Tighten screws securely.

NOTE: Do not attach vacuum break hose until vacuum break adjustment is completed, See Adjustments on Page 6C-27.

4. Connect upper end of pump rod to pump lever by placing rod in specified hole in lever. Align hole in pump lever with hole in air horn casting using J-25322. Using small screwdriver, push pump lever roll pin back through casting until end of pin is flush with casting bosses in air horn, Fig. 6C-40.

CAUTION: *Use care installing the small roll pin to prevent damage to pump lever casting bosses.*

5. Install two secondary metering rods into the secondary metering rod hanger (upper end of rods point toward each other). Install secondary metering rod holder, with rods, onto air valve cam follower. Install retaining screw and tighten securely, Fig. 6C-16. Work air valves up and down several times to make sure they are free in all positions.

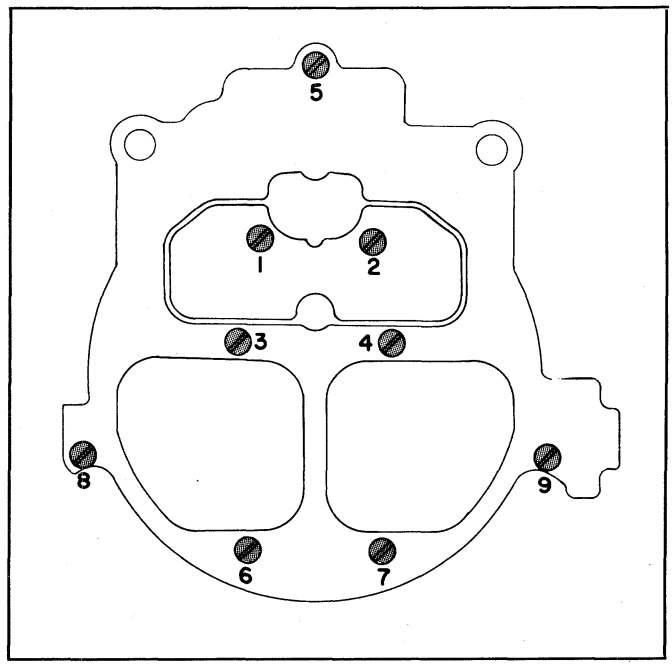


Fig. 6C-39 Air Horn Screws Tightening Sequence

6. Connect choke rod into lower choke lever inside bowl cavity; then install choke rod into slot in upper choke lever and retain the choke lever to the end of the choke shaft with attaching screw. Tighten securely. When properly installed the lever will point to the rear of the carburetor and the number on the lever will face outward, Fig. 6C-15. Make sure that the flats on the end of the choke shaft align with flats in the choke lever.

7. The front and rear vacuum break units, fast idle cam (choke rod), and inside thermostatic choke coil lever must

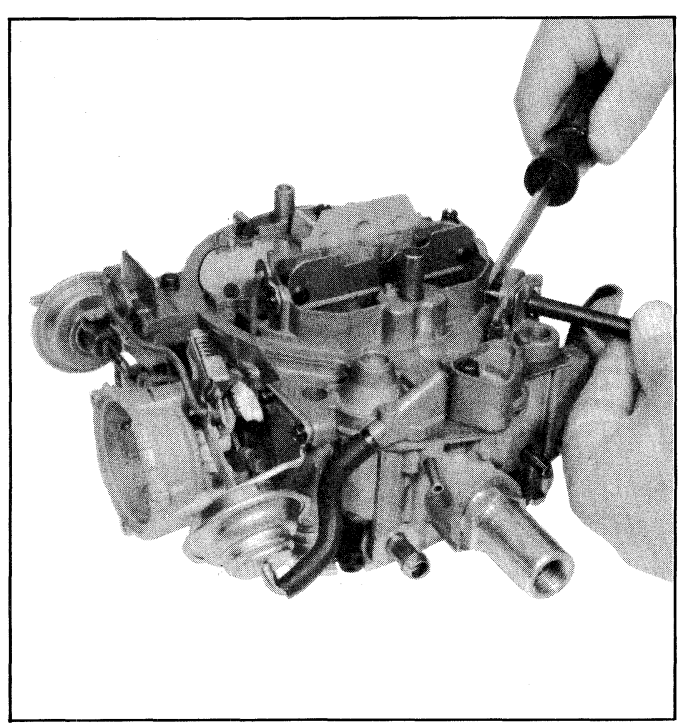


Fig. 6C-40 Installing Pump Lever Pivot Pin

be adjusted properly before installing the electric choke thermostatic coil and cover assembly. Refer to the Adjustment Procedures on Page 6C-25.

8. After the vacuum break, fast idle cam (choke rod), and inside thermostatic coil lever are adjusted, the electric thermostatic coil and cover assembly should be installed and the cover assembly rotated counterclockwise toward the closed choke valve position. Align scribe mark on cover with the specified notch on housing (See Electric Choke Coil Adjustment on Page 6C-27.

CAUTION: *Do not install a choke cover gasket between the electric choke assembly and the choke housing.*

Install three cover retainers and screws and tighten securely.

9. After making vacuum break settings, connect the front and rear vacuum break hoses.

FUEL FILTER AND PUMP GENERAL DESCRIPTION

Fuel filter, Fig. 6C-46, element of pleated paper, is located in the carburetor fuel inlet. Elements are placed in the inlet hole with the gasket surface outward. A spring holds the element outward, sealing it by compressing a gasket surface against the inlet fitting. If the element should ever become plugged the engine will stop. An engine stoppage caused by a plugged filter element will be preceded by a hesitation or sluggish operation.

The carburetor inlet fuel filter should be replaced every 15,000 miles or 12 months.

After assembling any filter element in the carburetor, always start the engine and check for leaks in the fuel line and fittings before installing the air cleaner.

FUEL TANK FILTER

A woven plastic filter is located on the lower end of the fuel pickup pipe in the gas tank, Fig. 6C-47. This filter prevents dirt from entering the fuel line and also stops water unless the filter becomes completely submerged in water. This filter is self cleaning and normally requires no maintenance. Fuel stoppage at this point indicates that the gas tank contains an abnormal amount of sediment or water; the tank should therefore be removed and thoroughly cleaned.

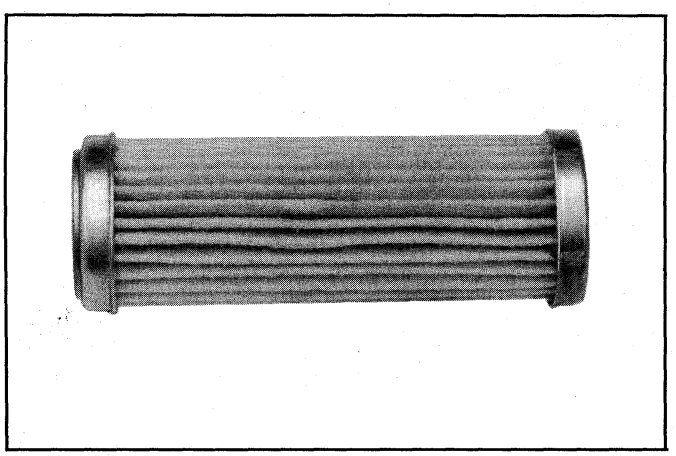


Fig. 6C-46 Fuel Filter

Fuel Pump

The fuel pump, Fig. 6C-48, is mounted on the left front of the engine and incorporates a large fuel reservoir. The pump rocker arm is driven by an eccentric bolted to the camshaft. Fuel is drawn into the fuel pump on the upward stroke of the diaphragm as the rocker arm is moved downward by the cam eccentric working against the force of the spring. The diaphragm is forced downward by the spring during the delivery stroke of the pump, and exerts pressure on the fuel equal to the spring load as the eccentric travels to minimum stroke. This design provides a smooth, even flow of fuel to the carburetor.

Most engine operating conditions do not require a full travel of the diaphragm in the fuel pump. Whenever this condition occurs, an overriding spring keeps the rocker arm in contact with the cam eccentric at all times while the diaphragm displaces fuel equal to engine demand.

The fuel pump is a sealed unit and is serviced only as an assembly.

All cars use a fuel pump with a bypass passage that continually returns part of the fuel to the fuel tank. This bypass also returns fuel vapors that may form in the lines or pump under high operating temperatures.

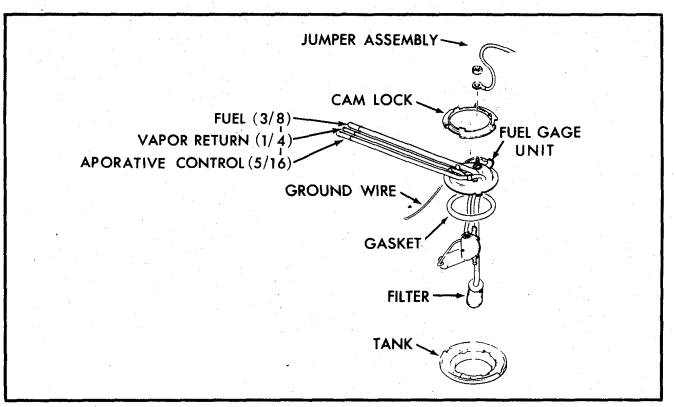
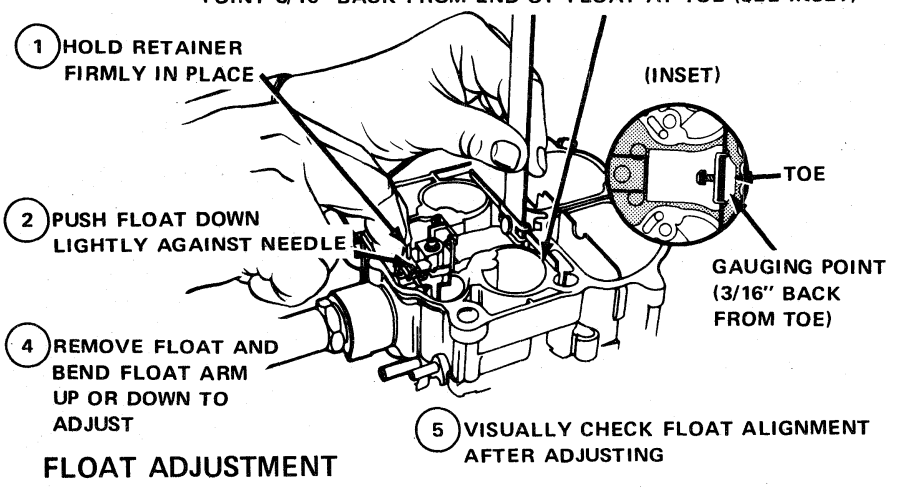


Fig. 6C-47 Fuel Tank Filter

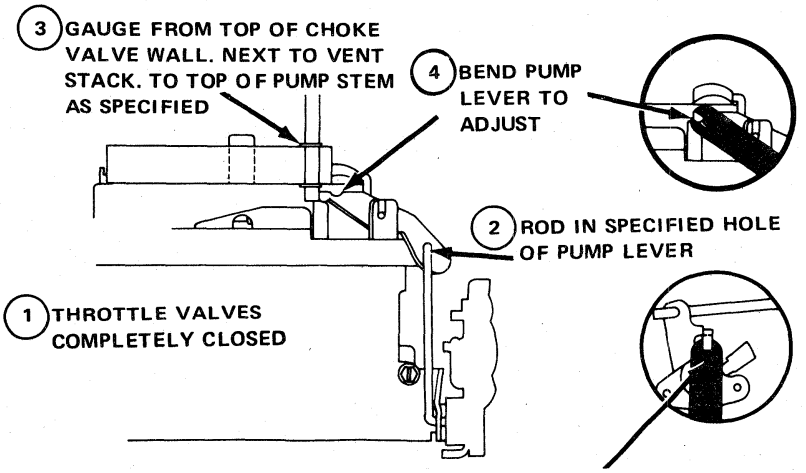
1



FLOAT ADJUSTMENT

CARB. NO.	GAUGE
ALL	13/32"

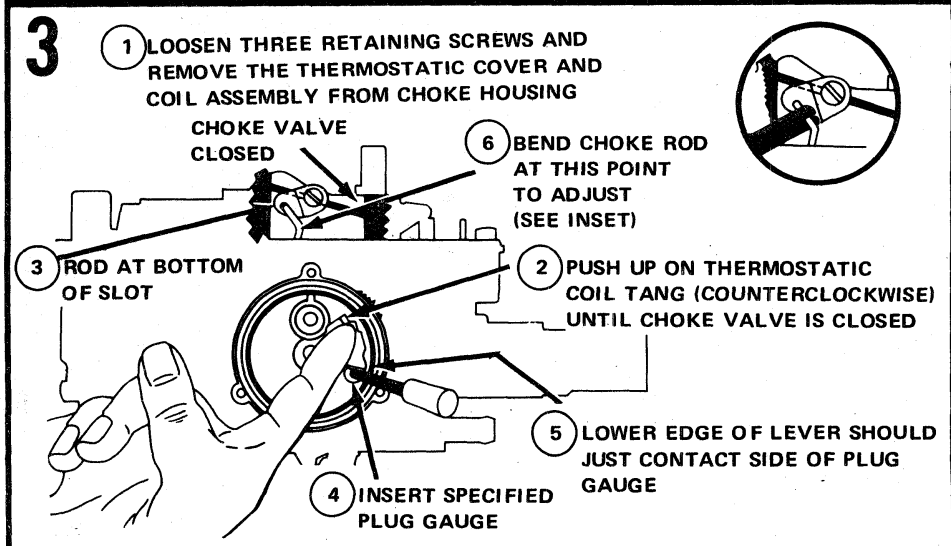
2



PUMP ADJUSTMENT

CARB. NO.	GAUGE	HOLE LOC.
17057230	7/16"	OUTER
17057231	3/8"	
17057232	3/8"	OUTER
17057233	3/8"	
17057530	7/16"	OUTER
17057533	7/16"	

3

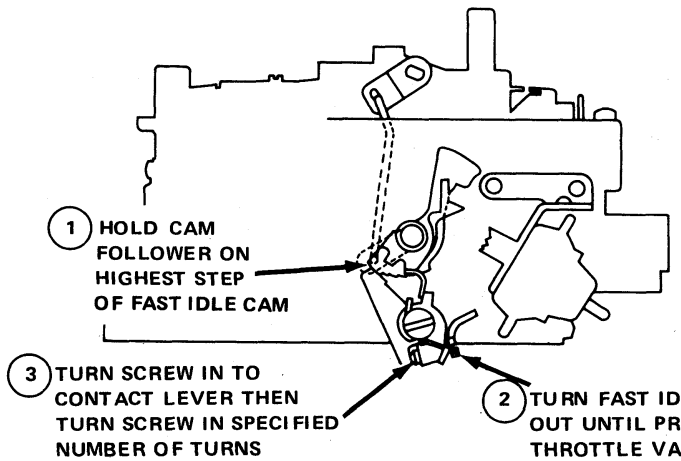


CHOKE COIL LEVER ADJUSTMENT

CARB. NO.	PLUG GAUGE
ALL	.120"

Fig. 6C-41 Carburetor Overhaul Adjustments (1)

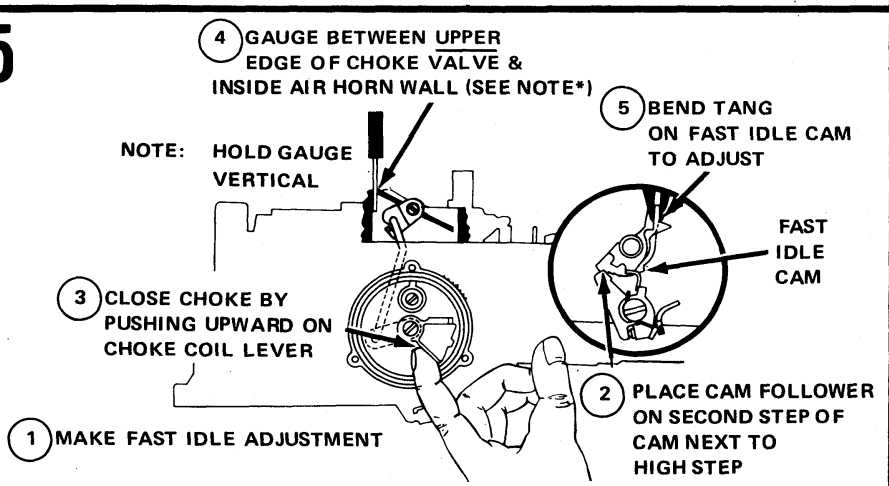
4



FAST IDLE ADJUSTMENT

CARB. NO.	NO. TURNS
17057230	2
17057231	2
17057232	2
17057233	2
17057530	2-1/4
17057533	2-1/4

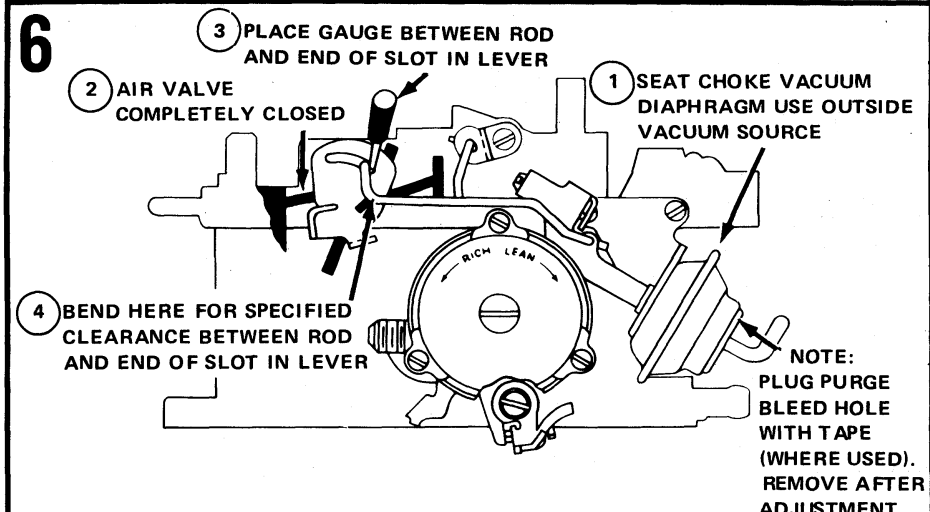
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CHOKE ROD (FAST IDLE CAM) ADJUSTMENT

CARB. NO.	PLUG GAUGE	ANGLE GAUGE
ALL	.080"	

6

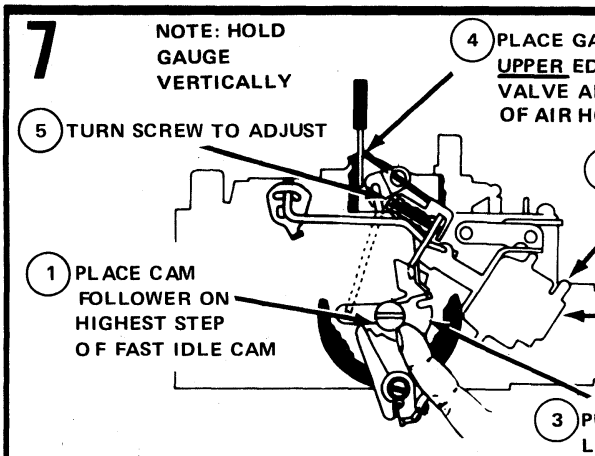


AIR VALVE ROD ADJUSTMENT

CARB. NO.	PLUG GAUGE
ALL	.030"

Fig. 6C-42 Carburetor Overhaul Adjustments (2)

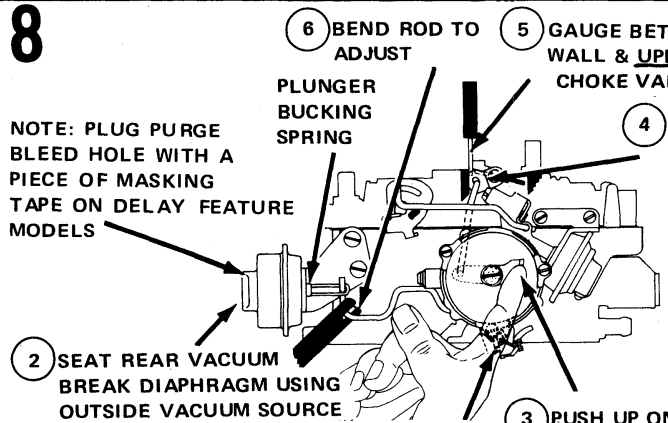
7



FRONT VACUUM BREAK ADJUSTMENT

CARB. NO.	PLUG GAUGE	ANGLE GAUGE
17057230	.140"	
17057231	.140"	
17057232	.140"	
17057233	.140"	
17057530	.150"	
17057533	.150"	

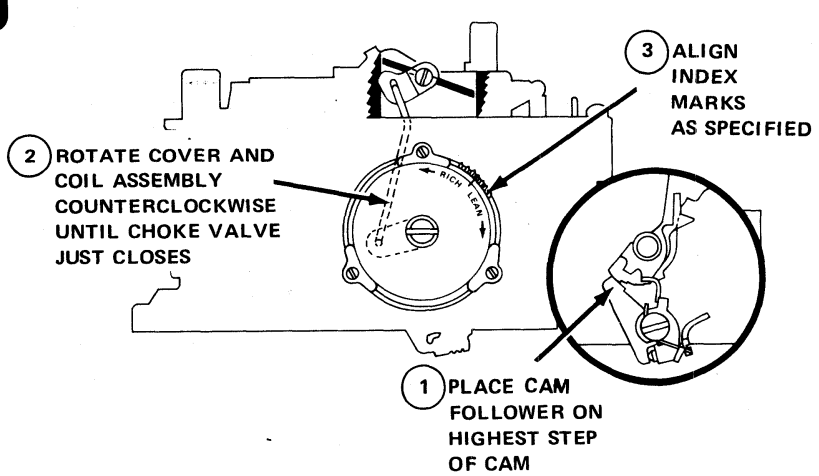
8



REAR VACUUM BREAK ADJUSTMENT

CARB. NO.	PLUG GAUGE	ANGLE GAUGE
17057230	.120"	
17057231	.140"	
17057232	.120"	
17057233	.140"	
17057530	.150"	
17057533	.150"	

9

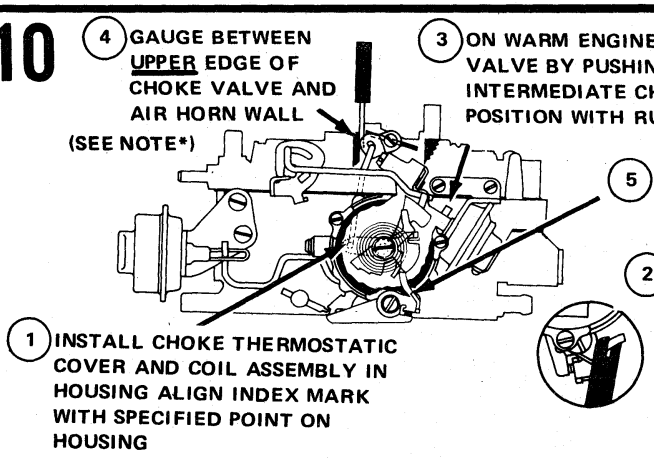


AUTOMATIC CHOKE COIL ADJUSTMENT

CARB. NO.	INDEX MARK	
ALL	2 NOTCHES RICH	

Fig. 6C-43 Carburetor Overhaul Adjustments (3)

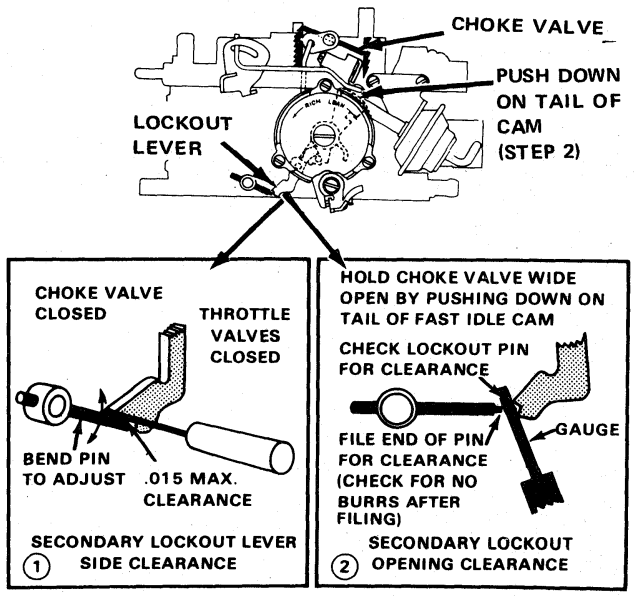
10



UNLOADER ADJUSTMENT

CARB. NO.	PLUG GAUGE	ANGLE GAUGE
ALL	.230"	

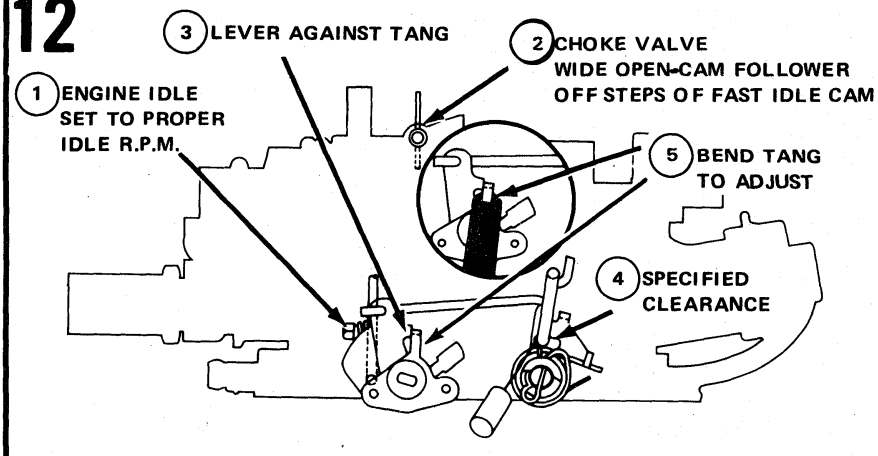
11



SECONDARY LOCKOUT ADJUSTMENT

CARB. NO.	PLUG GAUGE	
ALL	.015"	

12

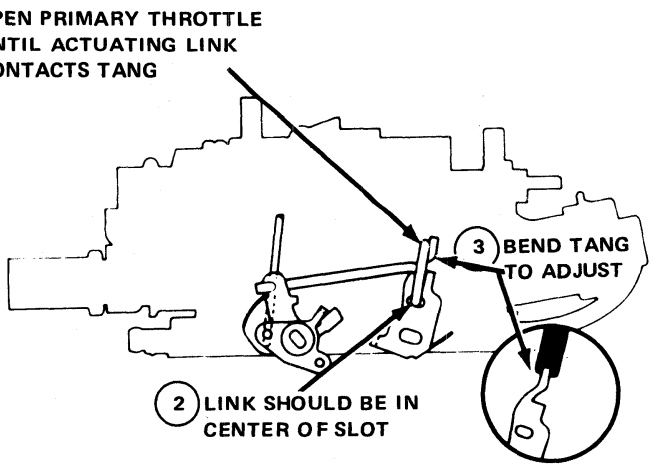


SECONDARY CLOSING ADJUSTMENT

CARB. NO.	PLUG GAUGE	
ALL	.020"	

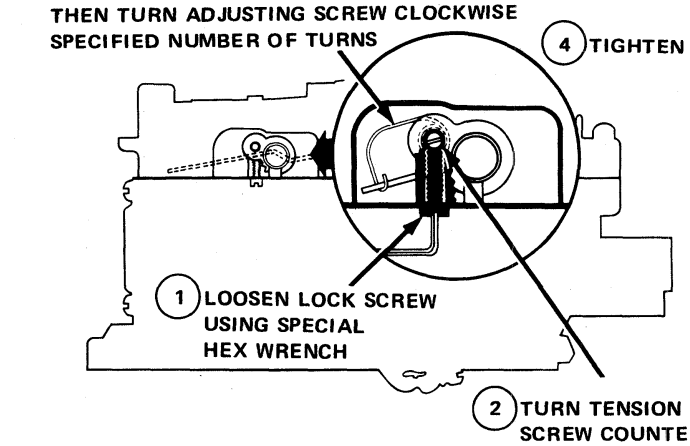
Fig. 6C-44 (M4ME) Carburetor Overhaul Adjustments (4)

13



SECONDARY OPENING ADJUSTMENT

14

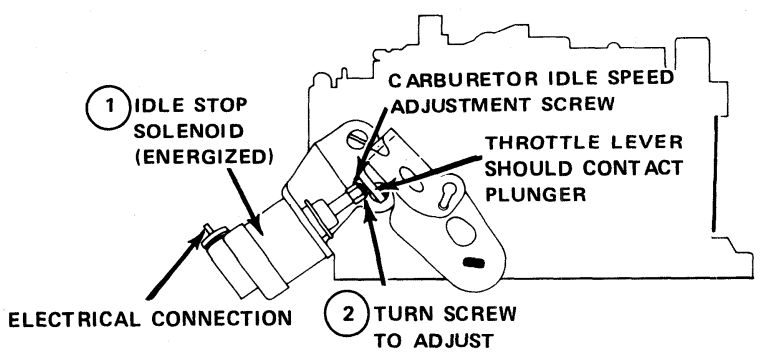


AIR VALVE SPRING ADJUSTMENT

CARB. NO.	NO TURNS
ALL	1/2

15

NOTE: USE CARBURETOR LOW IDLE SPEED SCREW TO SET ENGINE RPM – SHUT DOWN ONLY (SEE DECAL)



IDLE SPEED ADJUSTMENT

CARB. NO.	NO TURNS
17057230 17057232 17057530	RPM 675

Fig. 6C-45 Carburetor Overhaul Adjustments (5)

a. Low Pressure Complaint

Check fuel pump pressure by connecting an accurate pressure gauge to the fuel line at carburetor level. Never replace a fuel pump without first making that simple check.

b. Not Enough Fuel Flow Complaint

When an engine has a "starving-out" condition, the problem is not necessarily that the fuel pump is not pumping enough fuel. Many times the "starving-out" condition is actually due to a weakness in the ignition system, since these two troubles are very hard to separate. Even when an engine is starving for fuel, the cause is more likely to be a plugged fuel filter or a restricted fuel line than a malfunctioning fuel pump.

ON-CAR SERVICE

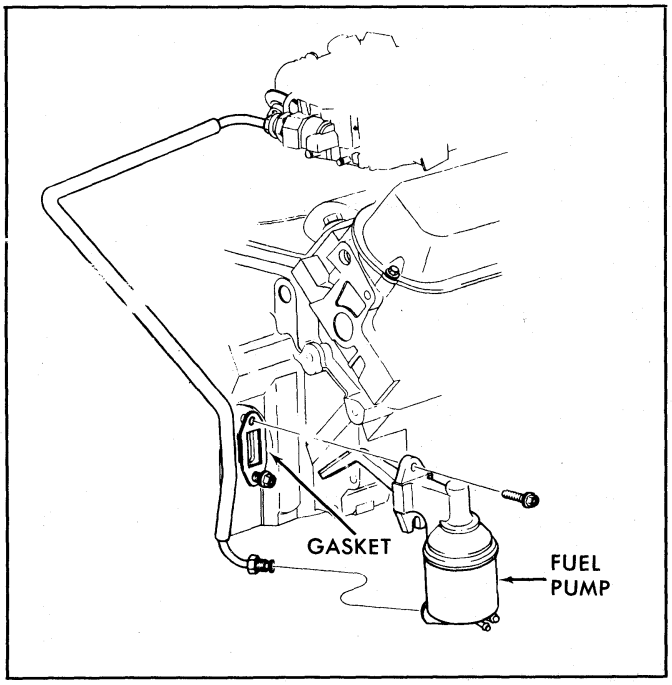


Fig. 6C-48 Fuel Pump - Installation (Except E.F.I.)

FUEL PUMP INSPECTION

If the fuel system is suspected of delivering an improper amount of fuel to the carburetor, it should be inspected and tested in the car, as follows:

Inspection of Fuel System

1. Make certain that there is gasoline in the tank.

2. With the engine running, inspect for leaks at all gasoline feed hose connections from fuel tank to carburetor. Tighten any loose connections. Inspect all hoses for flattening or kinks which would restrict the flow of fuel. Air leaks or restrictions on suction side of mechanical fuel pump will seriously affect pump output.

3. Inspect for leaks at fuel pump diaphragm flange.

4. Disconnect feed pipe near carburetor. Disconnect HEI connector at distributor so that engine can be cranked without firing. Place suitable container at end of pipe and crank engine a few revolutions. If no gasoline, or only a little flows from pipe, the feed line is clogged or fuel pump is inoperative. Before condemining the fuel pump, disconnect feed line at both ends and blow through it with air hose to make certain that fuel pump is operating within specifications.

Fuel Pump Pressure Test

1. Disconnect gasoline line near carburetor and connect a suitable pressure gage.

2. Start engine and check pressure with engine running at slow idle speed. Fuel pump pressure should be as specified at the end of this section. Squeeze off vapor return hose so that an accurate reading can be obtained.

3. If fuel pump pressure is below minimum, pump must be replaced.

Fuel Pump Flow Test

1. Disconnect fuel line from carburetor. Run fuel line into a suitable measuring container.

2. While observing the sweep second hand of a clock or watch, run the engine at idle until there is one pint of fuel in the container. One pint should be pumped in 30 seconds or less.

3. If flow is below minimum, check for restriction in the line.

Fuel Pump - Fig. 6C-48

a. Removal

1. Raise car.

2. Disconnect fuel line from tank (fuel pump inlet) at fuel pump and plug line. Hold a cloth around pump connections to absorb any fuel that leaks out.

3. Remove vapor return hose from fitting on fuel pump and plug hose.

4. Disconnect fuel-pump-to-carburetor line (fuel pump outlet) and position out of way.

5. Remove mounting screws from upper and lower flanges.

6. Tipping pump upward, pull pump straight outward and remove from car.

b. Installation

1. Clean mounting flange and place a new gasket in position. Use cement to hold gasket in position.

2. Crank engine until fuel pump eccentric is at low point of contact with fuel pump arm.

3. Position pump on engine. Loosely install two washer head screws.

4. With mounting screws loose, lift up on pump. Tighten screws to 13 foot-pounds.

5. Connect fuel line from carburetor to outlet fitting on pump and tighten securely.

6. Unplug fuel line from fuel tank, attach line to pump inlet and secure with clamp.

7. Install vapor return hose on fitting in fuel pump and secure with clamp.

8. Lower car and run engine to check for leaks in the pump area.

FUEL TANK AND FUEL LINES

GENERAL DESCRIPTION

The fuel tank is located behind the rear axle and mounted to the underbody with two steel straps. The fuel filler neck is located behind the rear license plate and is an integral part of the fuel tank except on the Commercial chassis where the tank and filler neck are joined together by a hose.

The approximate 1977 fuel tank capacities are as follows:

Series	U.S. Gal.	Imp. Gal.	Litres
DeVilles, Brougham and Commercial Chassis	24½	20½	92.7
Eldorado	27½	23	104.1
Seville	21	17½	79.5

The fuel tank filler neck incorporates a restrictor to prevent filling the tank with leaded fuel.

The restrictor, Fig. 6C-49, has an opening sized to allow entry of unleaded fuel filler nozzle and to prevent insertion of a leaded gasoline filler nozzle. When the unleaded fuel nozzle is inserted in the restrictor, the spring valve is pushed aside to allow full fuel flow.

In an emergency situation, small amounts of leaded fuel may be added. However, the restrictor and spring valve prevent filling in the normal manner.

Except in extreme emergencies, leaded gasoline should not be used as it will render the catalytic material ineffective.

NOTE: Cadillacs built for operation in foreign countries do not incorporate the restricted fillerneck described above.

All Cadillac vehicles are equipped with a system to prevent evaporation of fuel vapors from the tank. Complete information on this system is found on Page 6C-36.

The threaded filler cap has a ratchet tightening device which reduces chances of improper installation and would prevent sealing fuel vapors.

The filler neck has an internal thread. The cap contains a plastic center extension which has corresponding threads and acts as a guide when inserted into the filler neck. As the cap is turned a large "O" ring is seated upon the filler neck flange. The upper portion of the plastic extension has two spring arms that slide in and out of ratchet cavities in the steel outer cap. After the seal and flange contact, the ratchet produces a loud clicking noise indicating that the seal has been set.

NOTE: If this cap requires a replacement, only a cap with these same features should be used. Failure to use the correct cap can result in a serious malfunction of the system.

The filler cap is a pressure-vacuum (PV) type. For a complete description of the fuel tank vent system, refer to Emission Control Systems.

The tank unit for the fuel gage is mounted near the top center of the fuel tank. It contains the float unit, which is connected to the gage unit on the instrument panel by one wire, with another wire to ground. The fuel outlet line is integral with the tank float unit assembly. It has a special plastic filter (water separator) on the inlet end. The filter has a self-cleaning action, provided by the sloshing action of the gasoline.

The fuel outlet line is attached to the right hand pipe (3/8 dia.) of the gage assembly on the top center of the tank and extends along the inside of the left frame side rail except Eldorado and the inside of the right frame side rail on Eldorado to the fuel pump, Fig. 6C-50 and 6C-51.

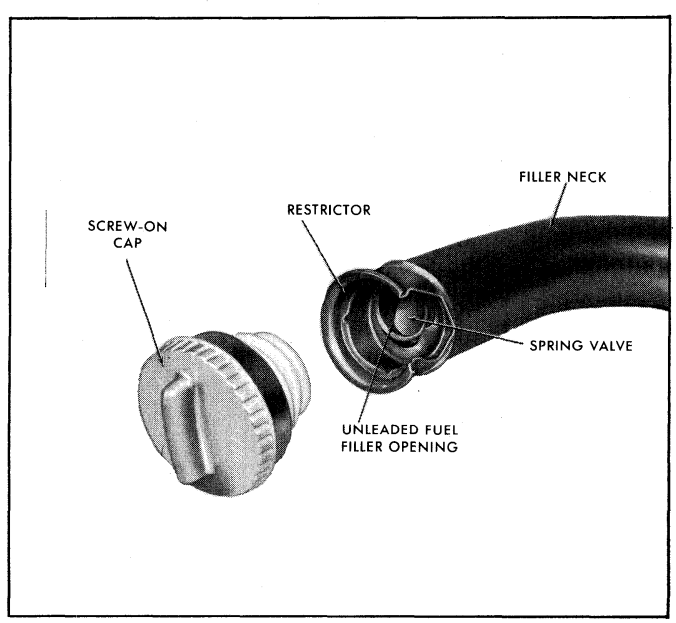


Fig. 6C-49 Fuel Tank Filler Neck

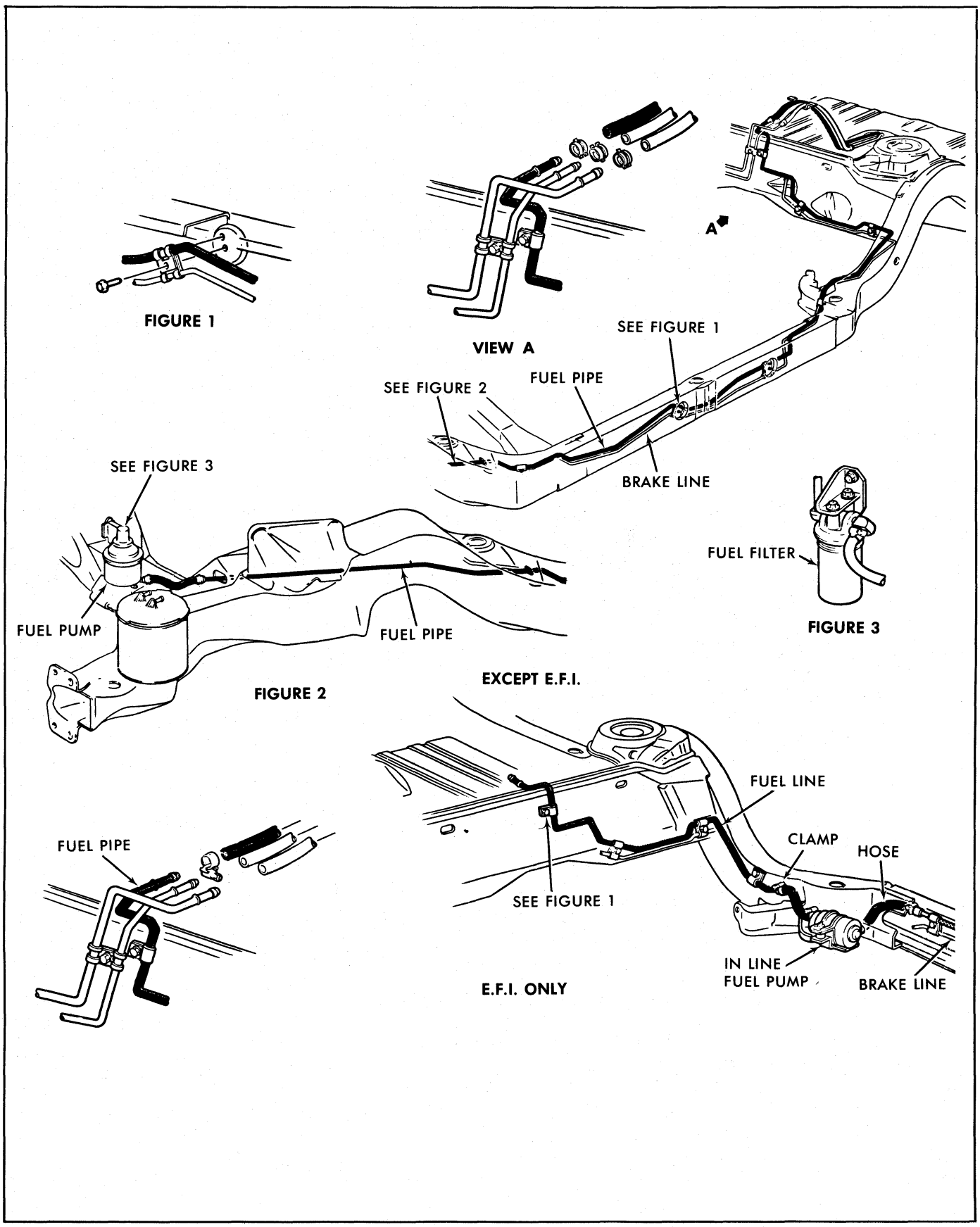


Fig. 6C-50 Fuel Lines - Except Eldorado and Seville

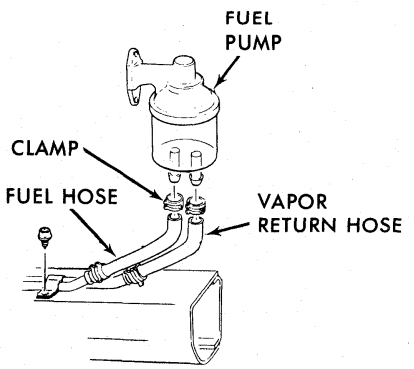


FIGURE 1

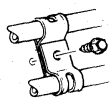
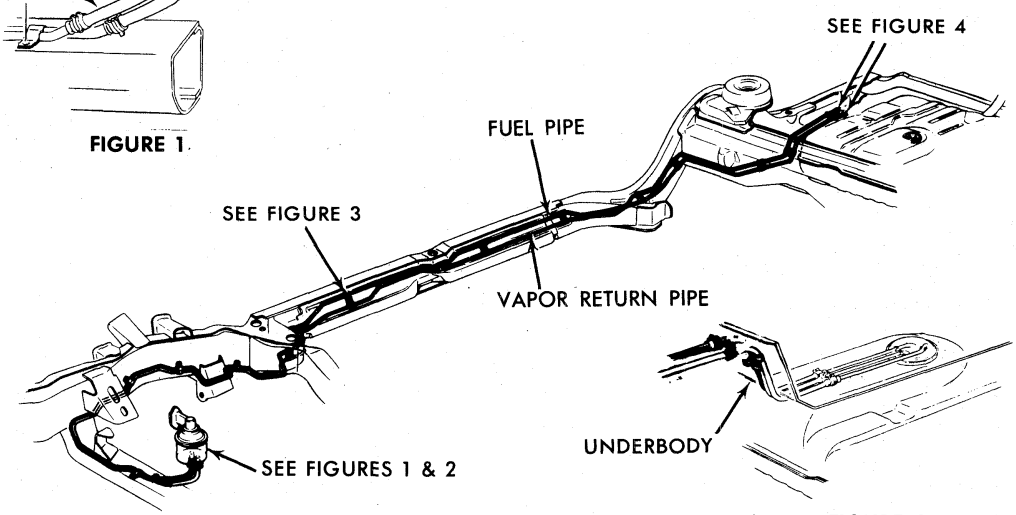


FIGURE 3



EXCEPT E.F.I.

FIGURE 4

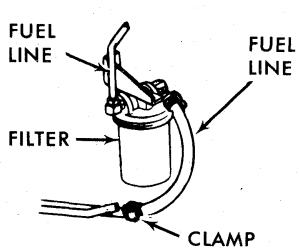
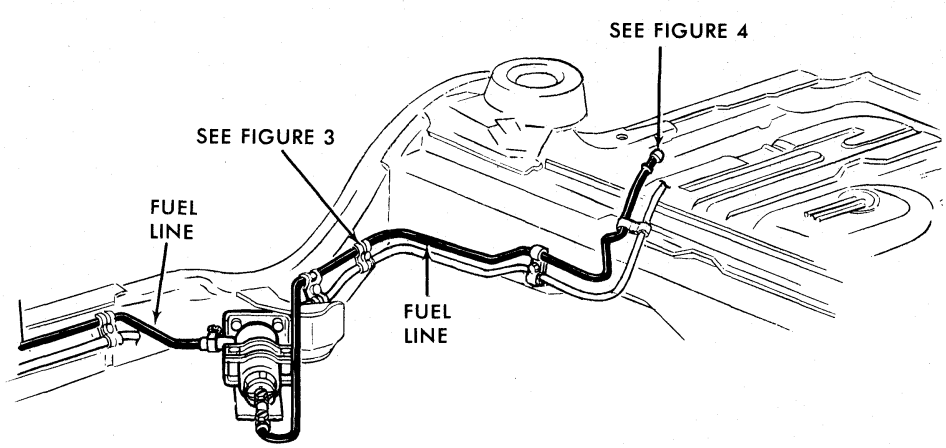


FIGURE 2



E.F.I. ONLY

Fig. 8C-51 Fuel Lines and Tank - Eldorado

ON-CAR SERVICE

Storage Precautions

Whenever a car is to be put in storage for 30 days or longer, certain precautions should be observed. For complete details see General Information Section 0.

WARNING: THE FOLLOWING PROCEDURES SHOULD BE ADHERED TO WHEN DRAINING AND REMOVING A FUEL TANK.

- **BE SURE TO DISCONNECT BATTERY CABLES BEFORE DRAINING.**
- **PLACE "NO SMOKING" SIGNS AND A CO2 FIRE EXTINGUISHER AT WORK AREA. WEAR SAFETY GLASSES AND SIPHON INTO A SUITABLE EXPLOSIVE PROOF CONTAINER.**

Fuel Tank

a. Removal

1. Disconnect battery, open fuel tank filler door and disconnect sending unit (tan) feed wire.
2. Drain fuel from tank by siphoning as described on Page 6C-35.
3. Raise car.
4. Remove screw securing ground wire to cross member.
5. Disconnect fuel, vapor return and evaporative loss control system lines at front of tank. Plug all disconnected lines.
6. Support tank with jack and wood block and remove one screw from each side securing fuel tank support straps to body.
7. Lower jack with fuel tank and remove tank.

b. Installation

1. Position tank to underbody; position fuel tank support straps under tank and loosely install screws securing straps to body.
2. Secure ground wire to rear cross member.
3. Tighten tank strap screws until bottomed. Torque to 25 ft. lbs. (34N·m).
4. Connect fuel, vapor return and evaporative loss control system lines.
5. Lower car.
6. With fuel filler door open, connect sending unit (tan) feed wire.
7. Replace fuel drained from tank.

Fuel Tank Strap

a. Removal

1. Raise car and support tank.
2. Remove screw securing strap to body at front of tank.
3. Remove torx screw securing strap to body at rear of tank using Tool J-24392 or No. 30 torx bit.
4. Remove strap.

b. Installation

1. Install strap in hanger at rear of tank.
2. Secure strap to body with one torx screw using Tool J-24392 or No. 30 torx bit.
3. Secure other end of strap to body at front of tank with one screw.
4. Lower car.

Fuel Line and Tank Cleaning

Occasionally it may be necessary to clean out fuel line and tank to remove foreign particles from system. Frequent replacement of fuel filters and excessive deposits of dirt in the fuel inlet strainer are indications that this may be necessary.

a. Fuel Line

To clean out fuel line, disconnect line at fuel pump, filter, or fuel rail and at fuel tank, blow compressed air through the line in direction opposite to fuel flow, and reconnect line.

b. Fuel Tank

For cleaning fuel tank, tank must be removed from car and flushed out to remove all foreign materials. Fuel strainer also should be inspected and replaced if necessary.

NOTE: If trouble is due to contaminated fuel or foreign material that has been put into the tank, it can usually be cleaned. If tank is rusted internally, it should be replaced.

1. Disconnect battery and HEI feed wires.
2. Drain fuel tank by siphoning as described on Page 6C-35.
3. Remove fuel tank as described.
4. Locate tank away from heat, flame, or other source of ignition. Remove fuel gage unit from tank using Tool J-24187, and inspect condition of filter. If filter is contaminated, a new filter should be installed upon reassembly.
5. Complete draining of tank by rocking it and allowing fuel to run out tank unit hole.
6. Purge fuel tank with steam or running hot water for at least five minutes.

Pour water out of tank unit hole (rock tank to assure complete removal of water).

NOTE: This procedure will not remove fuel vapor. Do not attempt any repair on tank or filler neck where heat or flame is required.

7. Disconnect inlet fuel line at pump and use air pressure to clean fuel line and vapor return line. Apply air pressure through line in the direction opposite to normal fuel flow.
8. Use low air pressure to clean pipes on tank unit.
9. Install new filter on fuel gage unit, if required. Using Tool J-24187, install fuel gage unit with new gasket into tank. Install tank as described on Page 6C-34. Connect tank unit wires and all fuel lines.
10. Disconnect fuel line at carburetor or fuel rail, connect a hose to fuel line and insert other end of hose into a one gallon fuel can.
11. Connect battery cable. Make sure HEI feed wires are disconnected.
12. Put six gallons of clean fuel in tank and operate starter to pump two quarts of fuel into fuel can. This will purge fuel pump. On EFI cars turn key on and off several times (pump will only operate for 1 second unless engine is cranked.
13. Remove hose and connect fuel line to carburetor or fuel rail.
14. Connect HEI feed wires.

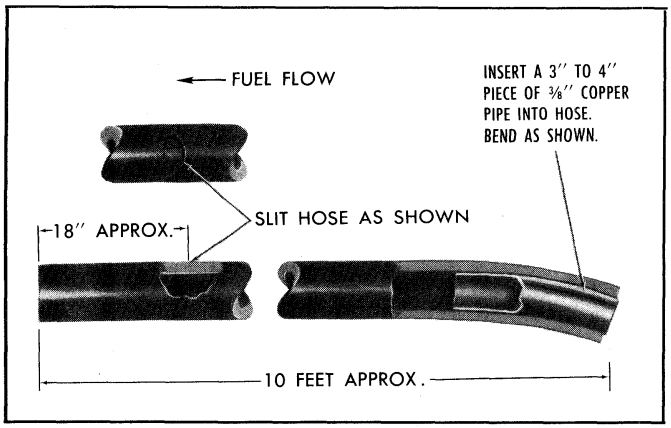


Fig. 6C-52 Fuel Drain Hose

Draining Fuel Tank

1. Using approximately 10 feet of 3/8" I.D. Hose, cut a slit 18" from one end. Make the slit towards the short end, Fig. 6C-52.

2. Insert a 4" piece of 3/8" copper line into the opposite end of the hose.

3. Using a long screw driver to hold the fuel tank restrictor open, insert the copper line end of the hose into the tank with natural curl of hose pointed down until the end rests on the bottom of the tank.

NOTE: Difficulty may be experienced inserting the hose through the holes in the tank baffle. By turning the hose from side to side, continue inserting the hose through the baffle to the bottom of the tank, Fig. 6C-53.

NOTE: Tank can be siphoned more rapidly by raising the car one foot higher in the rear than the front.

4. Insert an air hose into the slit. A short blast of air will cause the fuel to flow.

Fuel Tank Float Unit

a. Removal

1. Remove fuel tank as described on Page 6C-34.

2. Remove locknut securing fuel gage tank unit and remove wire from tank unit.

3. Install Fuel Tank Sending Unit Remover and Installer, J-24187, on cam locking ring so that tool engages three tabs on ring, Fig. 6C-54.

4. Install ratchet and turn counterclockwise to disengage locking ring from fuel tank. Remove tool and lift unit from tank.

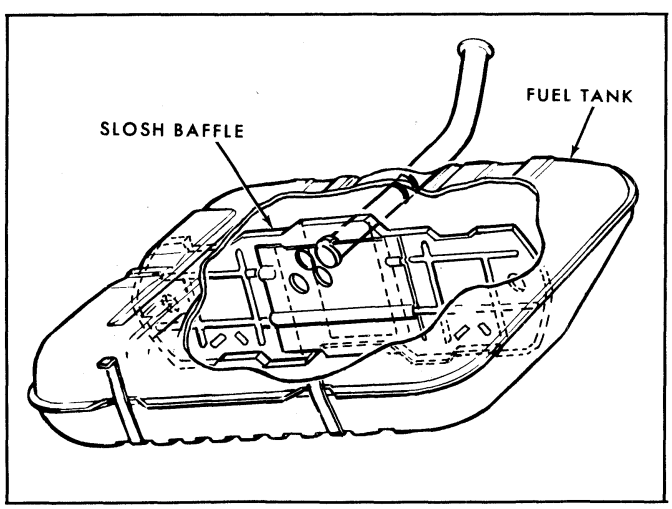


Fig. 6C-53 Fuel Tank (Except E.F.I.)

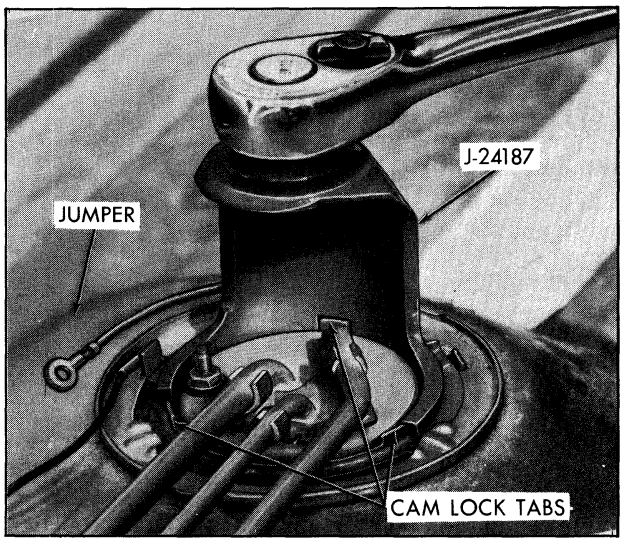


Fig. 6C-54 Removing and Installing Fuel Tank Sending Unit

b. Installation

1. Install gage tank unit in fuel tank, using new gasket.

2. Install Fuel Tank Sending Unit Remover and Installer, J-24187, engaging three tabs on cam locking ring.

3. Turn locking ring clockwise until ring is fully engaged in fuel tank, then remove tool.

4. Connect fuel gage wire to gage tank unit and secure with attaching locknut.

5. Install fuel tank as described on Page 6C-34.

Fuel Line

a. Removal

1. Raise car.

2. Remove clamps securing flexible fuel hose to fuel tank outlet and to fuel pump and disconnect lines at these points.

3. Tie a five foot length of cord to the flexible fuel hoses for installation purposes. (Cord will be used to pull lines during installation and are left with car after lines are removed).

4. Plug hoses to prevent fuel loss.

5. Remove clips securing fuel line to right frame side rail.

6. Carefully remove fuel lines from car, leaving cord in place on car.

7. Remove clamps securing flexible fuel hose to fuel pipe and separate.

b. Installation

1. Connect flexible fuel hose to steel fuel pipe and secure with clamps. Hoses should overlap steel line at least one inch.

2. Position fuel pipe to surface of right frame side rail and secure with clips.

3. Tie cords left in car to ends of flexible hose and carefully pull fuel lines to tank and engine.

4. Remove cords.

5. Unplug lines.

6. Connect flexible hose at tank and engine and secure with clamps.

7. Lower car.

FUEL LINE REPAIR

1. Do not use rubber hose within 4" of any part of the exhaust system.

2. In repairable areas, cut a piece of fuel hose 4" longer than portion of line removed.

3. Slide clamps onto pipe and push hose 2" onto each portion of fuel pipe. Tighten clamps on each side of repair.

EVAPORATIVE EMISSION CONTROL SYSTEM GENERAL DESCRIPTION

EVAPORATIVE EMISSION CONTROL SYSTEM (EEC)

A fuel tank evaporative emission control system (E.E.C.), Fig. 6C-56 and 57, is used to prevent emission of fuel vapors from the vehicle fuel system. This is accomplished by venting the fuel tank through a canister containing charcoal.

The fuel tank dome, Fig. 6C-56 and 57, collects vapors and allows them to pass into a line connected to the charcoal canister, Fig. 6C-55, which is mounted on the left rear of the radiator cradle. The canister absorbs fuel vapors in a bed of activated charcoal and retains them until the canister is purged or cleared by air drawn through the bottom of the canister into the carburetor. The absorbing occurs when the vehicle is parked and the purging or cleaning of the charcoal bed occurs when the engine is operated.

The only service normally required for the E.E.C. system is to replace the filter located in the bottom of the canister each 24 months or 30,000 miles. More frequent replacement of the element may be necessary if the vehicle is frequently driven in dusty areas.

CAUTION: *The hoses used in this system are specially manufactured and if replacement becomes necessary it is important to use only hose marked "EVAP" or "GM-6107-M, GM-6147 or 6131M" on the hose.*

ON-CAR SERVICE

VAPOR CANISTER (Except Eldorado and Seville)

a. Removal

1. Remove air inlet hose from duct on radiator cradle and position air hose out of way.

2. Remove two hoses from top of canister, Fig. 6C-55.

3. Remove two screws at base of canister and remove canister leaving clips in place, Fig. 6C-56.

4. Remove canister filter element by squeezing out from under retainer bar, Fig. 6C-58.

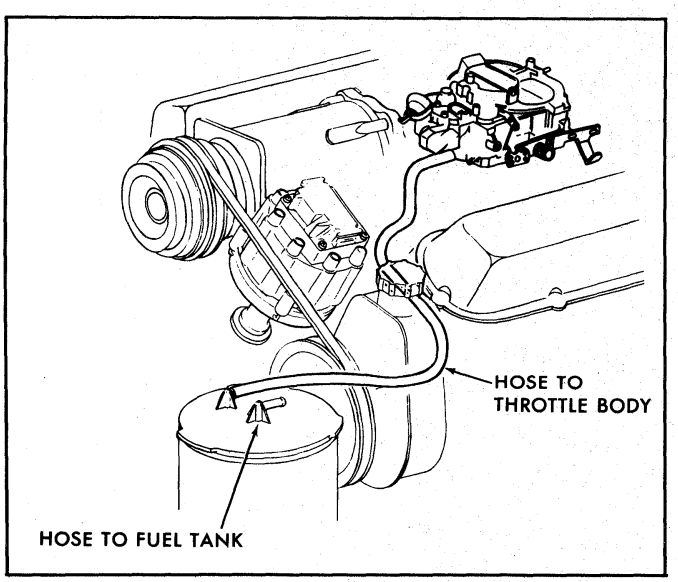


Fig. 6C-55 Evaporative Canister Hoses

b. Installation

1. Squeeze element under retainer and position evenly around entire bottom of canister. Tuck edges under lip of canister.

2. Position canister to radiator cradle and secure with two screws through clips, Fig. 6C-56.

3. Install two hoses to top of canister, Fig. 6C-55.

4. Install air inlet hose to duct.

Evaporative Control System Vapor Storage Canister - Eldorado - Fig. 6C-56

a. Removal

1. Remove two hoses from top of canister. Canister is located on back of radiator cradle just to the left of the radiator.

2. Remove one screw holding canister strap type bracket to radiator cradle.

3. Remove strap and canister from position on cradle.

b. Installation

1. Position canister on bracket behind radiator cradle with two fittings on top facing towards engine.

2. Secure strap around canister with one screw.

3. Connect two hoses to top of canister; small diameter hose to carburetor, large diameter hose to tank.

Evaporative Control System Vapor Canister - Seville – Fig. 6C-57

a. Removal

1. Remove ALC compressor as described in Section 3D.

2. Remove air inlet hose from duct on radiator cradle and remove duct.

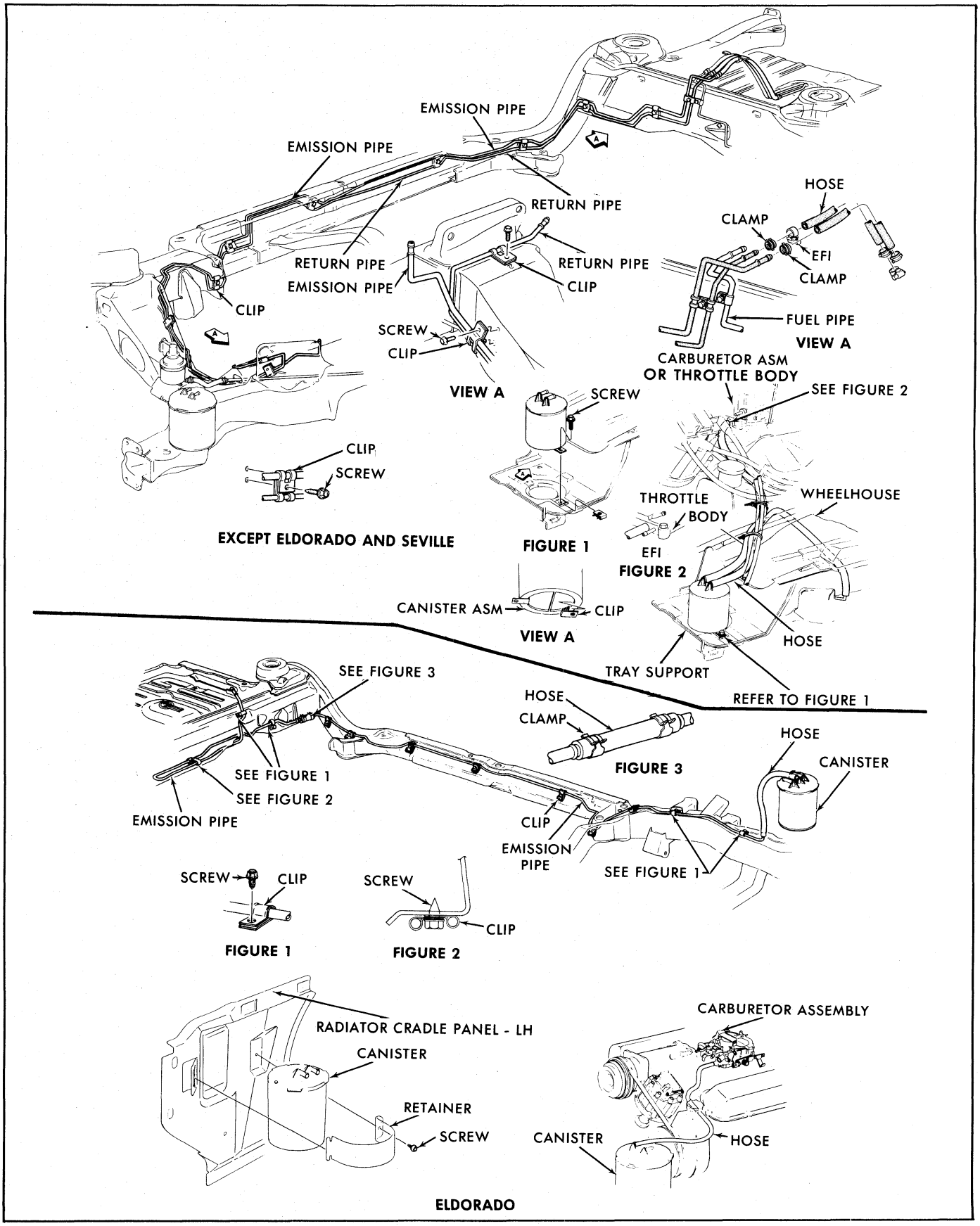


Fig. 6C-56 Evaporative Control System - Except Seville

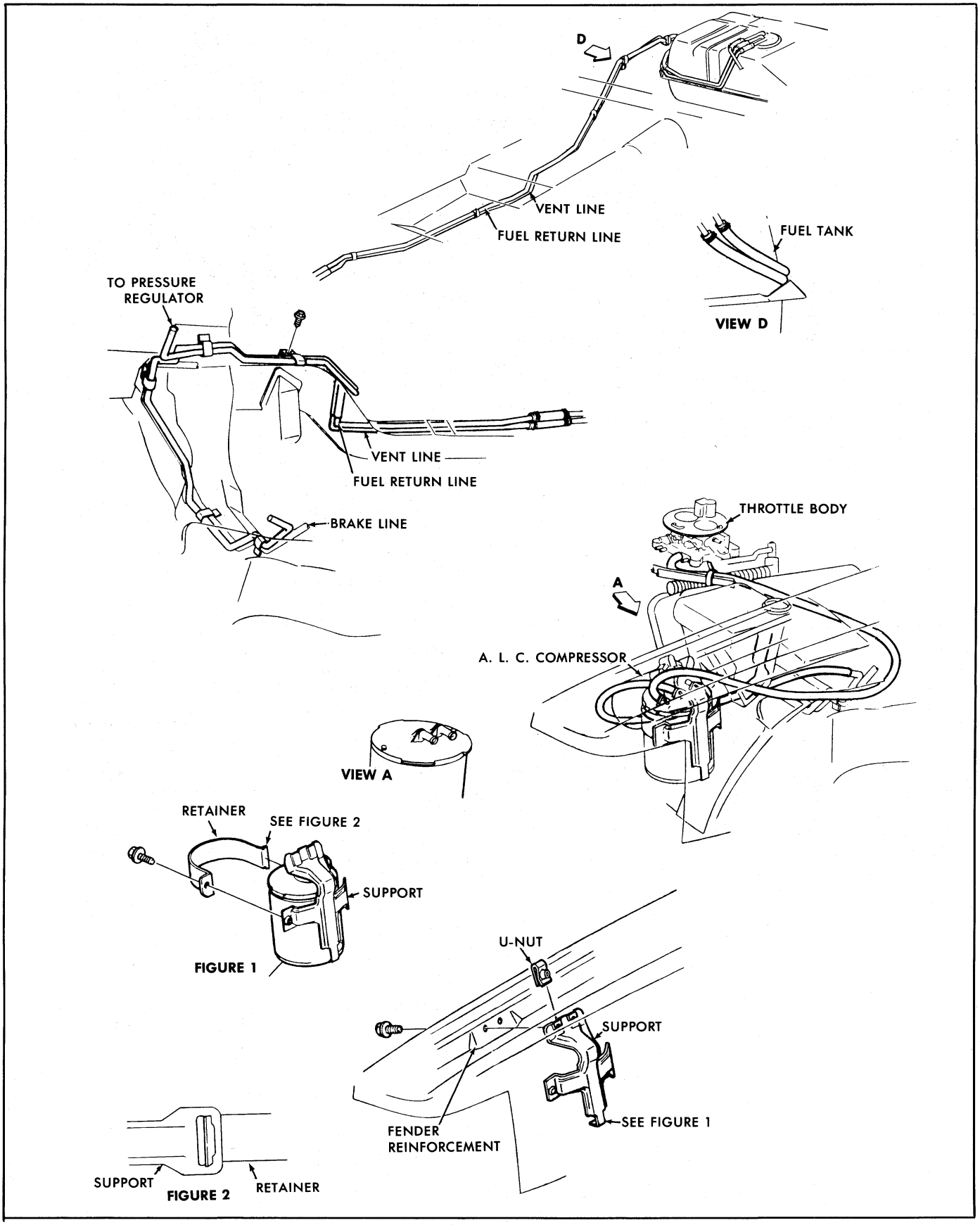


Fig. 6C-57 Evaporative Control System - Seville

3. Remove two hoses from top of canister, Fig. 6C-55.
4. Remove one screw securing canister retainer to support, Fig. 6C-57.

b. Installation

1. Position canister to support and install retainer. Secure with one screw.
2. Connect hoses to canister as shown in Fig. 6C-55.
3. Install air inlet duct and hose.
4. Install ALC compressor as described in Section 3D.

Evaporative Control System Vapor Storage Canister Filter (Fig. 6C-58)

a. Removal

1. Remove canister from position on radiator cradle.
2. Remove filter element by squeezing out from under retainer bar, Fig. 6C-58.

b. Installation

1. Squeeze element under retainer bar and position evenly around entire bottom of canister. Tuck edges under lip of canister.
2. Install canister in position on raidiator cradle.

EVAPORATIVE EMISSION CONTROL SYSTEM EEC HOSES SERVICE APPLICATIONS

Because of the specific nature of the materials and lengths of EEC fuel hoses, it is important that only recommended and specified EEC fuel hoses, cut to the proper lengths, be used in service replacements.

Part No.	Spec.
943 2787	6107 M
943 2875	6107 M
943 2963	6107 M
943 6421	6147 M
943 6580	6147 M

Hose materials are designed to withstand the effects of gasoline and ambient termpatures. Hose lengths are important because original hose routings should be closely followed for optimum hose retention and durability. Deviation from specified hoses is not acceptable.

The chart below is provided to assure proper service hose usage. Hoses with part numbers listed in the chart, meet material requirements.

The hoses mentioned below are replaceable with properly cut lengths of the following bulk hoses or equivalent hoses which conform to appropriate G.M. Spec.

NOTE: As indicated in chart, 6107 M type hose may be replaced with 6147 M type hose, but 6147 M hose may NOT be replaced with 6107 M type hose.

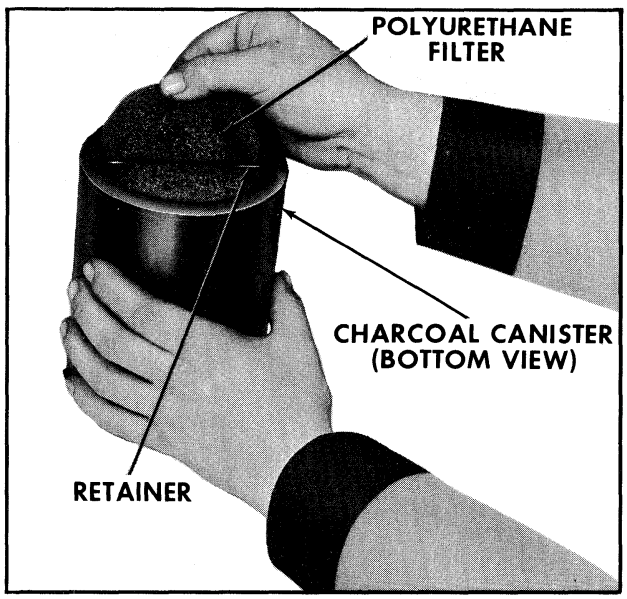


Fig. 6C-58 Removing Canister Filter

Application	Except Eldorado and Seville	Eldorado	Seville
Vapor line (tank to chassis)	(5/16" x 15.5") 943,2740 or 9436421 Or Equivalent	(5/16" x 19") 9432907 or 9436421 Or Equivalent	(5/16" x 5") 9432713 or 9436421 Or Equivalent
Rear canister pipe to front pipe (Eldorado only)	None	(5/16" x 3") 9437349 or 9436421 Or Equivalent	None
Vapor line (frame to body)	None	None	(5/16" x 7") 9432716 or 9436421 Or Equivalent
Vapor line (chassis to canister)	(5/16" x 28") 9437435 or 9436421 Or Equivalent	(5/16" x 12") 9437352 or 9436421 Or Equivalent	(5/16" x 32") 9437353 or 9436421 Or Equivalent
Canister to throttle body	(1/4" x 26") 9437435 Or Equivalent	(1/4" x 26") 9437060 Or Equivalent	(1/4" x 58") 9437354 Or Equivalent

The above mentioned hoses are replaceable with properly cut lengths of the following bulk hoses or equivalent hoses which conform to appropriate G.M. Spec.

THROTTLE LINKAGE
GENERAL DESCRIPTION

The accelerator control system is cable type. There are no linkage adjustments check for correct opening and closing positions by operating accelerator pedal. If any binding is present, check routing of cable. If throttle fails to return to idle check for floor mat bunched up under pedal.

THROTTLE LINKAGE CABLE

Refer to Fig. 6C-59 through 6C-61 for removal and installation of accelerator control cable.

Throttle Linkage Adjustment - Except EFI, Eldorado and Seville

Throttle linkage adjustment is obtained by turning the attaching connector Fig. 6C-59 in or out until the throttle lever begins to move.

Throttle Linkage Adjustment EFI - Except Eldorado and Seville

Adjust throttle linkage by moving bracket Fig. 6C-59 rearward until throttle lever begins to open or maximum rearward movement is achieved.

Throttle Linkage Adjustment - Eldorado

Adjust throttle linkage by moving adjusting bracket, Fig. 6C-60, full forward.

Throttle Linkage Adjustment - Seville

Move adjusting bracket, Fig. 6C-61, rearward until throttle lever begins to open or maximum rearward movement is achieved.

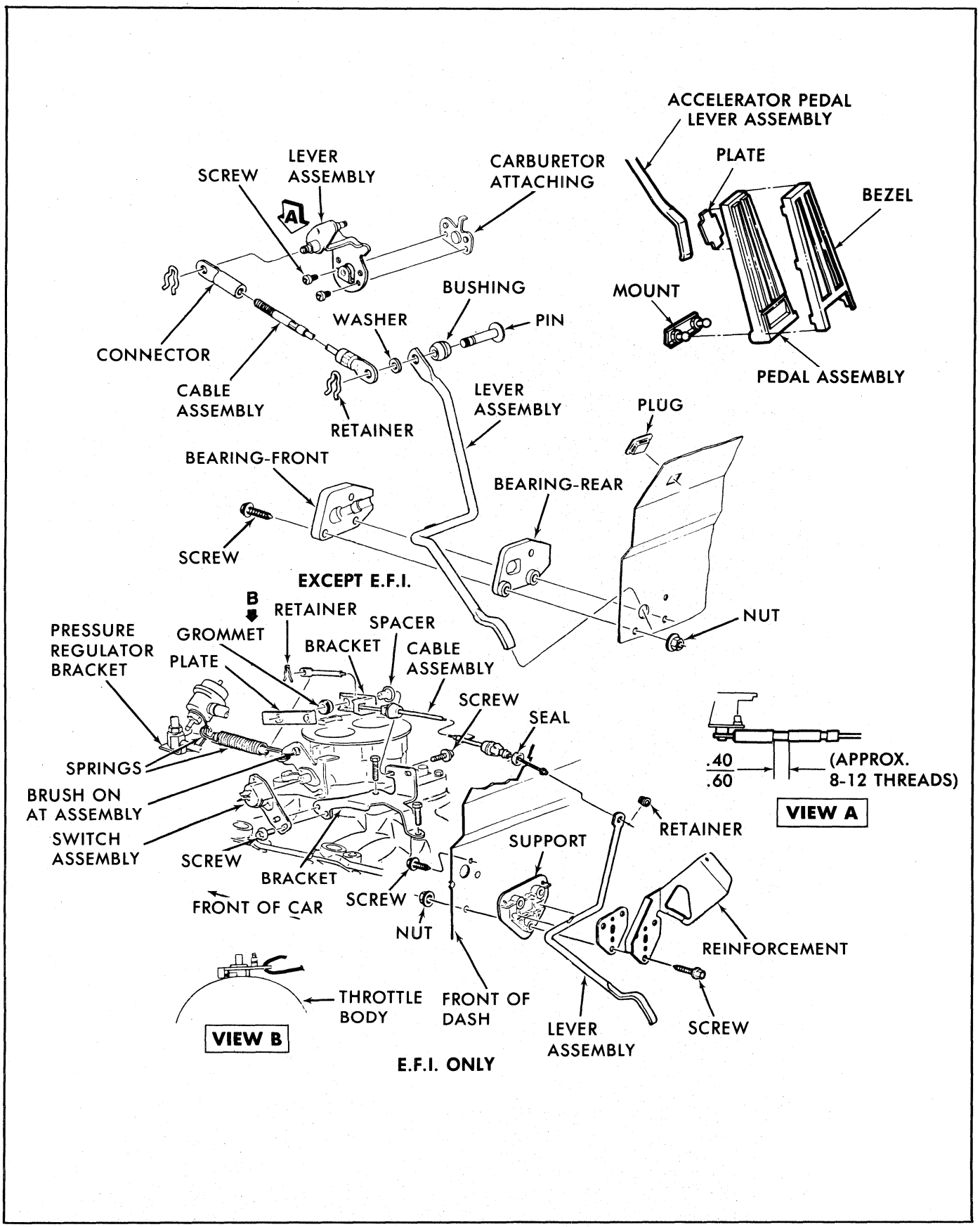


Fig. 6C-59 Accelerator and Throttle Linkage - Except Eldorado and Seville

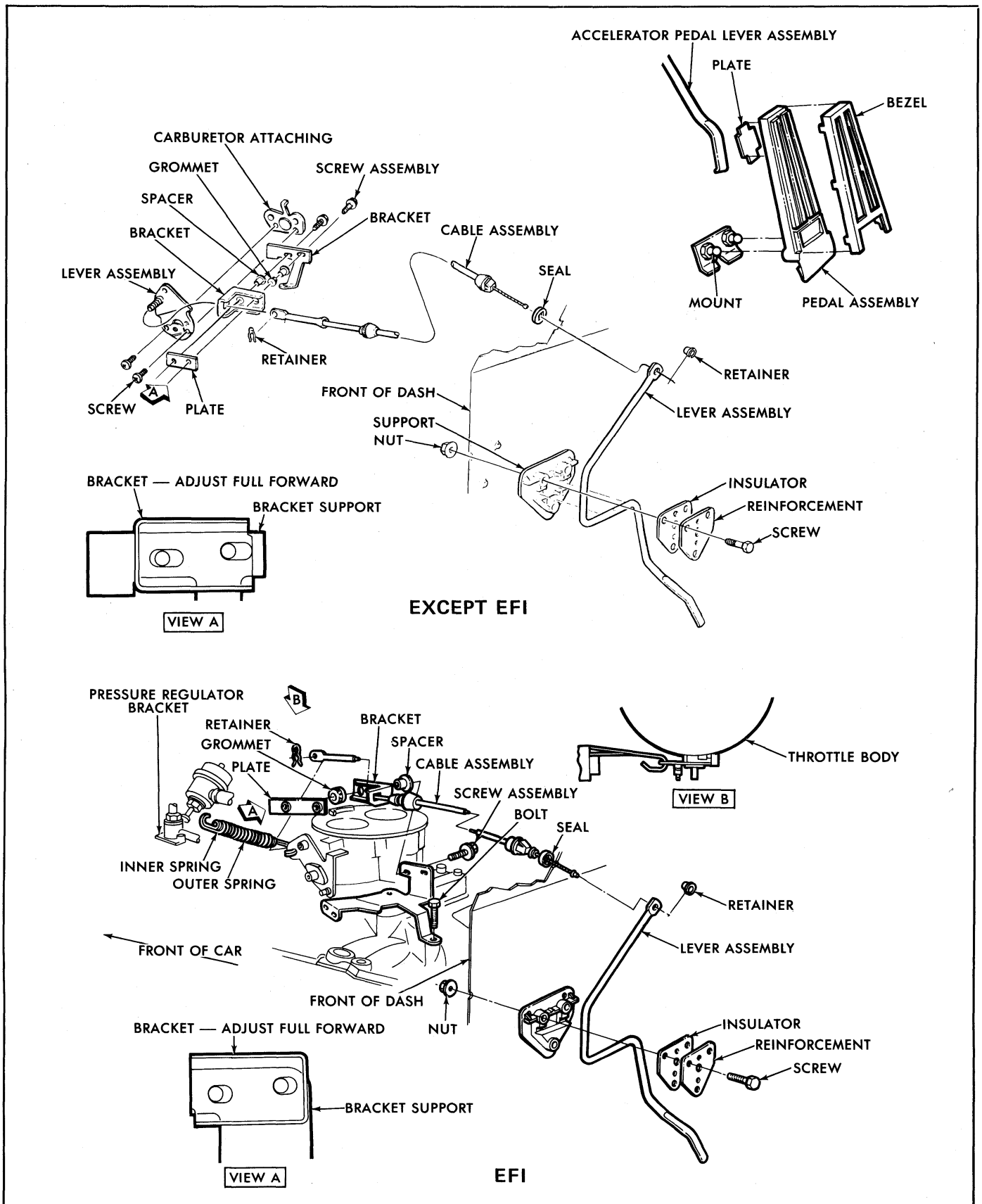


Fig. 6C-60 Accelerator and Throttle Linkage - Eldorado

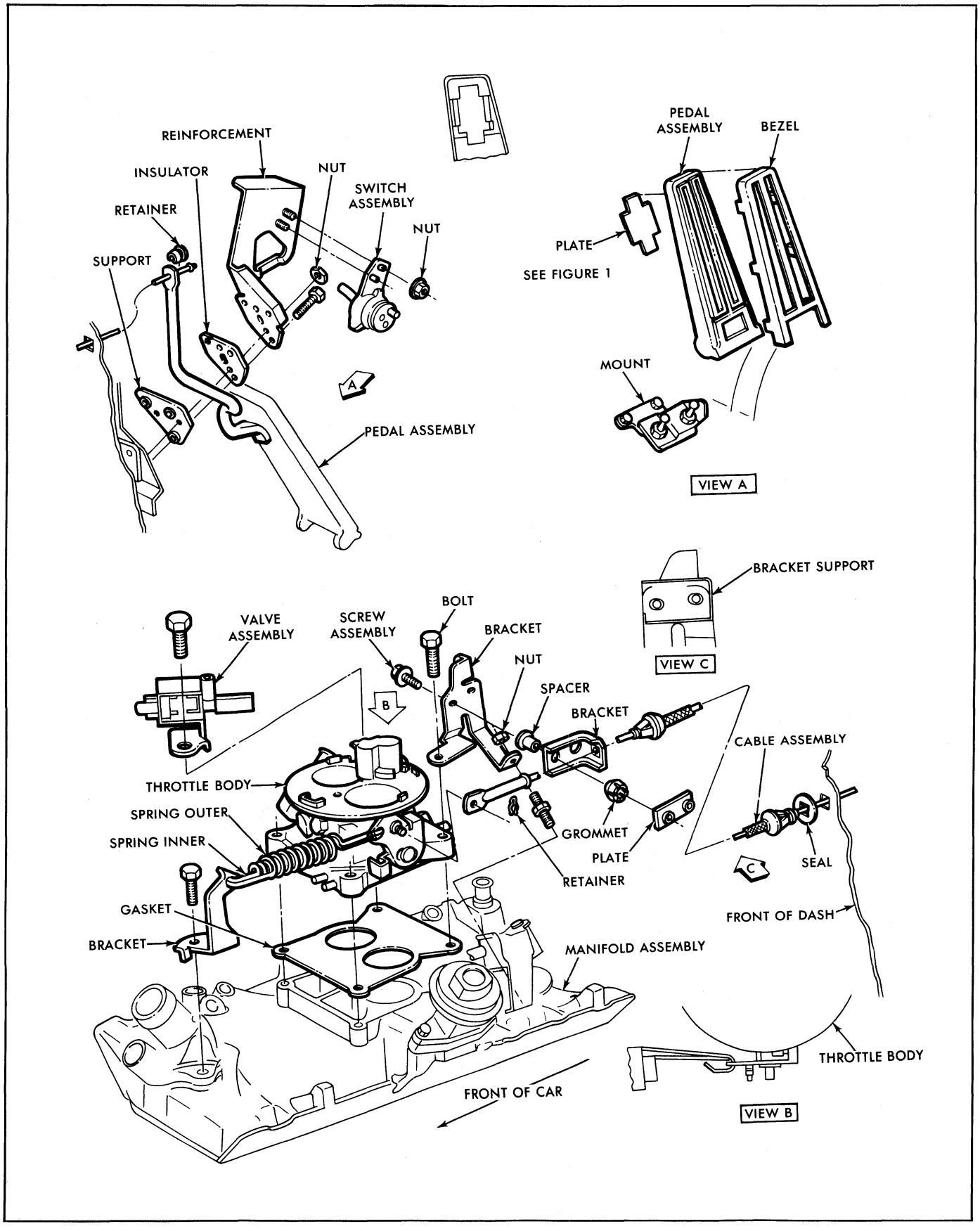


Fig. 6C-61 Accelerator and Throttle Linkage - Seville

ADJUSTMENT SPECIFICATIONS

	High Altitude	Exc. Calif. Vehicles	Calif. Vehicles
Air Valve			
Dashpot	.030"	.030"	.030"
Wind Up	1/2 Turn	1/2 Turn	1/2 Turn
Choke Coil Lever	.120"	.120"	.120"
Choke Rod Cam	.080"	.080"	.080"
Choke Setting	2 Notches Rich	2 Notches Rich	2 Notches Rich
Curb Idle-RPM (In Drive, A/C Off)	600	600	600
Idle Solenoid RPM In Drive, A/C On — Except Eldorado, Seville and EFI	675	675	675
Fast Idle-RPM (In Park) (A/C Off) Distributor Vacuum Off E.G.R. Vacuum Off			
Second of Three Steps	1400	1400	1500
Float Level	13/32"	13/32" Exc. Eld. 17/32" Eld.	13/32"
Pump Rod Adjustment	3/8" All	7/16 Exc. Eld. 3/8" Eld.	7/16 All
Location	Outer Hole	Outer Hole	Outer Hole
Secondary Closing	.020"	.020"	.020"
Secondary Lockout			
Lever Clearance	.015"	.015"	.015"
Opening	.015"	.015"	.015"
Unloader	.230"	.230"	.230"
Vacuum Break			
Front	.140"	.140"	.150"
Rear Except Eldorado	.120"	.120"	.150"
Eldorado	.140"	.140"	.150"

1977 CARBURETOR APPLICATION CHART

Carburetor Number	Series	Application
17057230 17057231	All Except Eldorado Eldorado	Except California Vehicles
17057530 17057533	All Except Eldorado Eldorado	California Vehicles
17057232 17057233	All Except Eldorado Eldorado	Except California with High Altitude Option

FUEL PUMP SPECIFICATIONS

NOTE: Testing to be done with entire car at room temperature.

Fuel pressure at idle speed ..... .5-1/4 to 6-1/2 psi
Fuel pump discharge per stroke at cranking speed ..... 28 cc. Minimum
Fuel pump discharge in 17 strokes at cranking speed ..... 1 pint Minimum

TORQUE SPECIFICATIONS

Material Number	Application	Thread Size	Torque
260-M	Carburetor to Intake Manifold Screw (Rear)	5/16-18	12 ft. lbs.
260-M	Carburetor to Intake Manifold Screw (Front)	5/16-18	8 ft. lbs.
280-M	Fuel Pump to Cylinder Block Screw	5/16-18	13 ft. lbs.

NOTE: Refer to back of manual, Page 10-1, for bolt and nut markings and steel classifications.

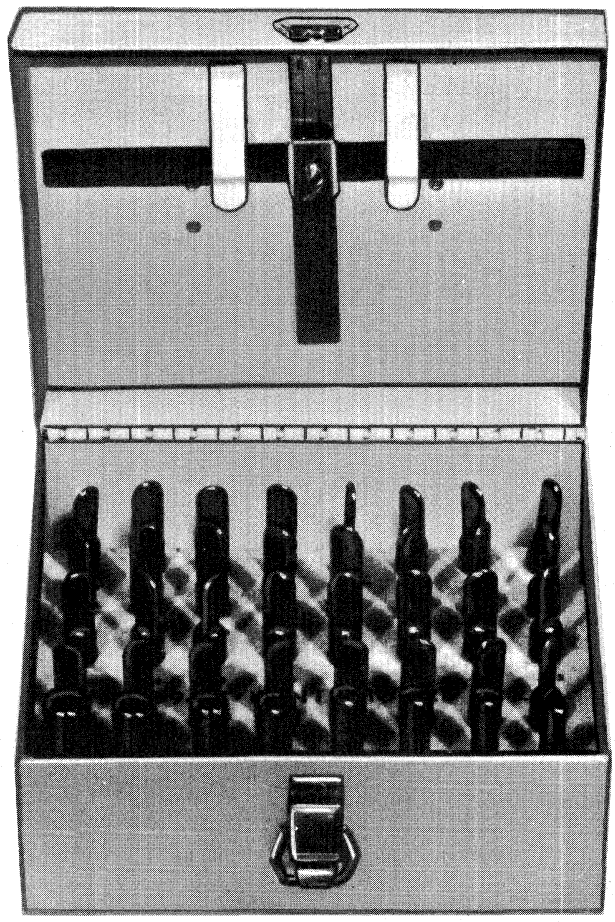


Fig. 6C-62 Special Tools

Key	Tool Number	Name
A	J-9789-01	Universal Gage Set

ELECTRONIC FUEL INJECTION GENERAL DESCRIPTION

Electronic Fuel Injection (EFI) provides a means for fuel distribution and for control of engine exhaust emissions within the required limits by precisely controlling the air/fuel mixture for combustion. This is accomplished by monitoring selected engine operating conditions, and electronically metering the fuel requirements to meet those conditions.

EFI basically involves electrically actuated fuel metering valves which, when actuated, spray a predetermined quantity of fuel into the engine. These valves or injectors, Fig. 6C-63 are mounted in the intake manifold with the metering tip pointed toward the head of the intake valve. This arrangement is commonly known as port injection. The injector opening is timed in accordance with the engine frequency so that the fuel charge is in place prior to the intake stroke for the cylinder.

Gasoline is supplied to the inlet of the injectors through the fuel rail at high enough pressure to obtain good fuel atomization and to prevent vapor formation in the fuel system during extended hot operation. When the solenoid operated valve are energized the injector metering valve (pintle) moves to the full open position and since the pressure differential across the valve is constant, the fuel quantity is

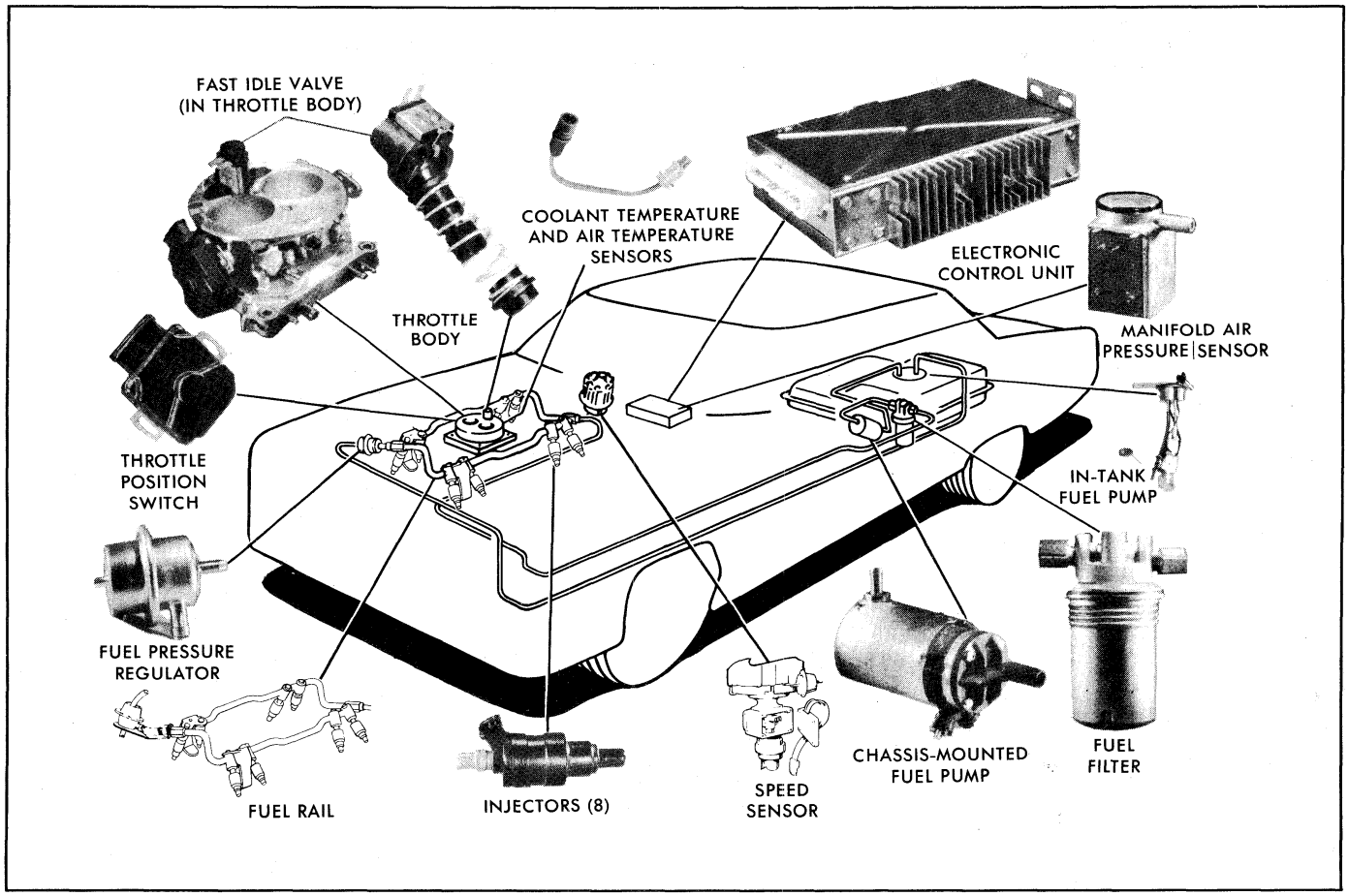


Fig. 6C-63 EFI System Installation - Typical

changed by varying the time that the injector is held open.

The injectors could be energized all at one time (called simultaneous injection) or one after the other in time with the opening of each intake valve (called sequential injection) or they can be energized in groups.

The Cadillac EFI System is a two-group system where the eight injectors are divided into two groups of four each. Cylinders 1, 2, 7 and 8 form group 1 while group 2 consists of cylinders 3, 4, 5 and 6. All four injectors in a group are opened and closed simultaneously while the groups operate alternately.

The amount of air entering the engine is measured by monitoring the intake manifold absolute pressure, the inlet air temperature, and the engine speed (in rpm). This information, allows the electronic control unit (ECU) to compute the flow rate of air being inducted into the engine, and consequently, the flow rate of fuel required to achieve the desired air/fuel ratio for the particular engine operating condition. Each of the groups are activated once for every revolution of the camshaft and two revolutions of the crankshaft.

The input/output block diagram shown in Fig. 6C-64 represents Cadillac's two group EFI system. In this system, the prevailing engine conditions are monitored with sensors and provide information to the Electronic Control Unit (ECU). The ECU converts the multi-variable input information into an injector pulse width which opens the injectors for the proper duration and at the proper time with respect to the cylinder firing sequence.

The object of the ECU is to calculate fuel requirements for the engine for various combinations of inputs from the sensors to determine an injector pulse width to provide accurate control of the air/fuel ratio.

System Description

The EFI System is comprised of four major subsystems: 1) Fuel Delivery, 2) Air Induction, 3) Sensors, and 4) Electronic Control Unit. The function of these separate subsystems is integrated into the system operation.

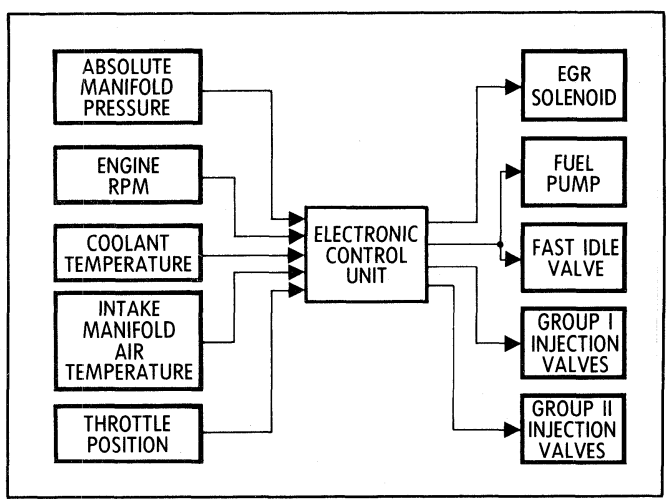


Fig. 6C-64 Functional Block Diagram

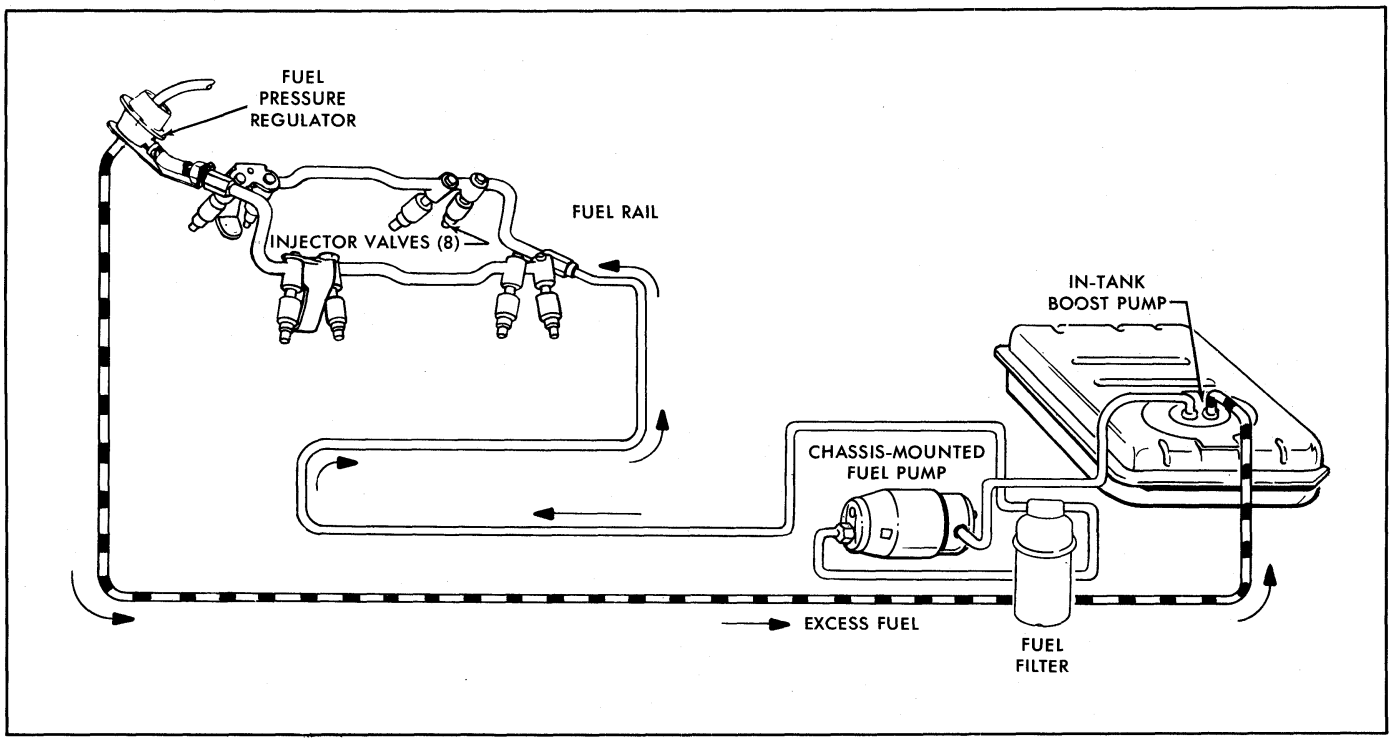


Fig. 6C-65 Fuel Delivery System

Fuel Delivery Subsystem

The fuel delivery system, Fig. 6C-65, includes an in-tank boost pump, a chassis-mounted constant-displacement fuel pump, a fuel filter, the fuel rails, one injector for each cylinder, a fuel pressure regulator, and supply and return lines. The fuel pumps are activated by the electronic control unit (ECU) when the ignition is turned on and the engine is cranking or operating. (If the engine stalls or if the starter is not engaged, the fuel pumps will deactivate in approximately one second). Fuel is pumped from the fuel tank through the supply line and the filter to the fuel rails. The injectors supply fuel to the engine cylinders in precisely timed bursts as a result of electrical signals from the ECU. Excess fuel is returned to the fuel tank.

The fuel delivery system components are as follows:

a. Fuel Tank

The fuel tank incorporates a reservoir directly below the sending unit-in-tank pump assembly. The "bath tub" shaped reservoir is used to insure a constant supply of fuel for the in-tank pump even at low fuel level and severe maneuvering conditions. The fuel returned to the tank by the fuel pressure regulator is directed into the reservoir as an additional means of keeping the pump intake below the fuel level.

b. In-Take Boost Pump

Two electric fuel pumps are used with the EFI system. Located inside the fuel tank and an integral part of the fuel gage tank unit, the in-tank pump, Fig. 6C-66, is used to supply fuel to the chassis-mounted pump and to prevent vapor lock on the suction side of the system.

The chassis-mounted and in-tank fuel pumps are electrically connected in parallel to the ECU and are protected by a 10 amp. in-line fuse located in the harness near the ECU or by the 20 amp. EFI fuse in the fuse panel on "C" cars.

c. Chassis-Mounted Fuel Pump

The Chassis-Mounted Fuel Pump; Fig. 6C-65, is a constant-displacement, roller-vane pump driven by a 12 volt motor. The pump incorporates a check valve to prevent back-flow. This maintains fuel pressure in the fuel rail when the pump is off. The pump has a flow rate of 33 gallons per hour under normal operating conditions (39 PSI). An internal relief valve provides over-pressure protection by opening at an excessive pressure (55-95 PSI). The pump mounting is shown in Figs. 6C-125 thru 6C-127.

d. Fuel Filter

The Fuel Filter, Fig. 6C-65, consists of a casing with an internal paper filter element capable of filtering foreign particles down to the 20 micron size. The filter element is a throwaway type and should be replaced as described in the Vehicle Maintenance Schedule. The filter is mounted to the frame near the left rear wheel on "K" cars and in place of the mechanical fuel pump on "C" and "E" cars.

e. Fuel Pressure Regulator

The Fuel Pressure Regulator contains an air chamber and fuel chamber separated by a spring-loaded diaphragm. The air chamber is connected by a hose to the throttle body assembly. The pressure in this chamber is identical to the pressure of the intake manifold. The changing manifold pressure and the spring, control the action of the diaphragm valve, opening or closing an orifice in the fuel chamber, (Excess fuel is returned to the fuel tank). This regulator, being connected to the fuel rail and intake manifold, maintains a constant 39 psi differential across the injectors.

The fuel pressure regulator is mounted on the fuel rail toward the front of the engine, Fig. 6C-65.

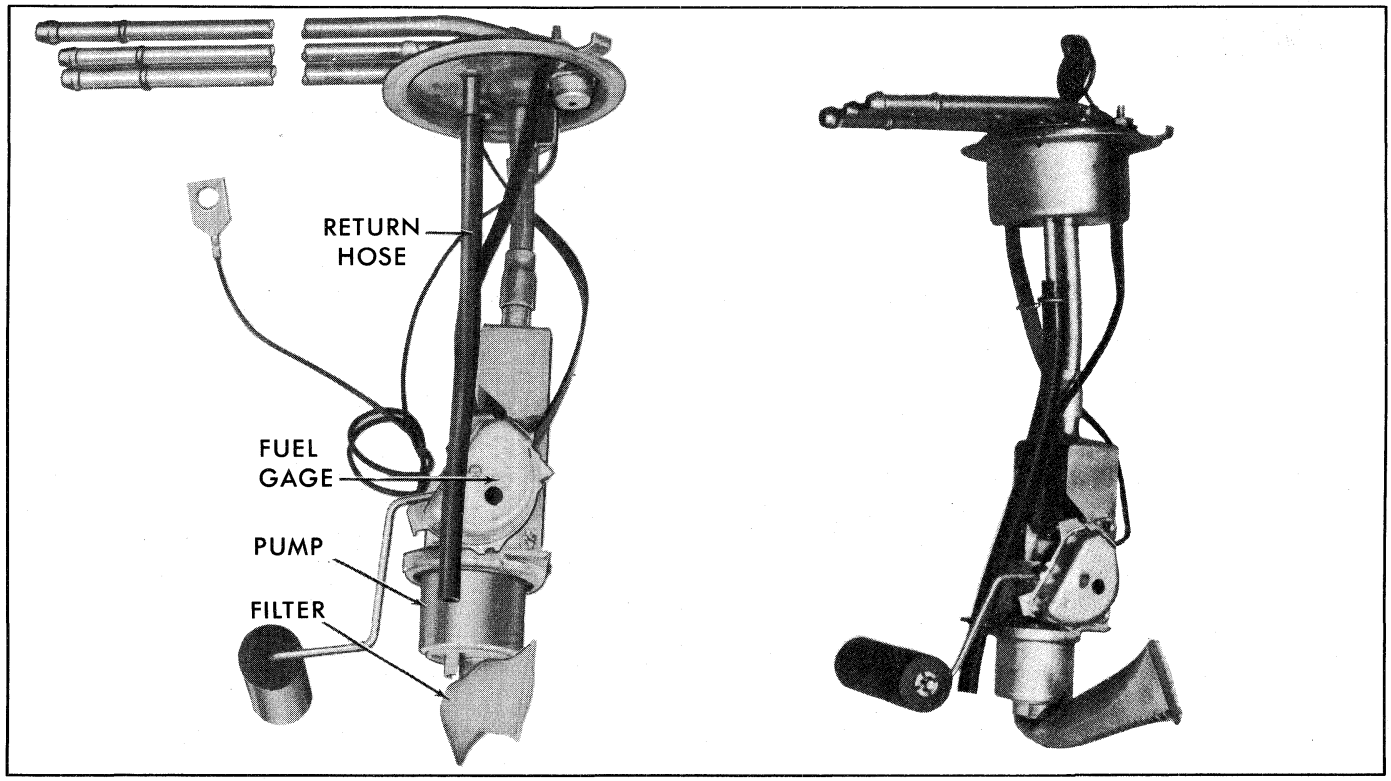


Fig. 6C-66 In-Tank Fuel Pumps

f. Injection Valve

The Injection Valve is a solenoid operated pintle valve that meters fuel to each cylinder. Based upon a pulsed signal from the electronic control unit, the valve opens for the proper time interval (pulse-width) to deliver the exact amount of fuel required. When energized, the valve sprays the fuel in fine droplets. When de-energized, it prevents further fuel flow to the engine. Handling of the injection valve requires special care to avoid possible damage to the metering tip. The injection valves are color coded green and are located on the intake manifold above the intake valve for each cylinder, Fig. 6C-65.

Air Induction Subsystem

The Air Induction subsystem, Fig. 6C-67, consists of the throttle body assembly, fast idle valve assembly, and intake manifold.

Air for combustion enters the throttle body and is distributed to each cylinder through the intake manifold. The primary air flow rate is controlled by the throttle valves which are connected to the accelerator pedal linkage. An adjustable idle by-pass air passage is incorporated within the throttle body that allows a regulated amount of air to by-pass the throttle valves and provide idle speed adjustment. The throttle blades are also pre-set slightly open when the throttle lever is resting against the stop. This adjustment is not to be altered.

Additional air for cold starts and warm-up is provided through an electrically controlled fast idle valve, which is incorporated in the top of the throttle body.

The air induction system components are as follows:

a. Intake Manifold

The intake manifold, Fig. 6C-68 differs from a carburetor manifold in the following ways:

1. Only air is distributed to the intake port through the intake manifold.
2. The manifold contains a port above each cylinder for injection valve installation. The fuel is injected directly toward the top of the cylinder intake valve.
3. A threaded hole is provided for the air temperature sensor.
4. No exhaust heat passage is used. The exhaust passages from the right cylinder head are used only for EGR.

b. Throttle Body

The Throttle Body, Fig. 6C-67, consists of a housing with two bores and two shaft mounted throttle valves connected to the vehicle accelerator pedal by mechanical linkage. Fittings are incorporated to accommodate vacuum connections. The end of the throttle shaft opposite from the accelerator lever controls the throttle position switch (described below under Engine Sensors). An adjustable set screw on the front of the throttle body enables adjustment of warm engine idle speed. Turning the screw clockwise restricts the air flow passing through the idle air channel, lowering the engine speed (rpm). Turning the screw counterclockwise permits a greater air flow, thereby increasing the engine idle speed.

A large port on top of the throttle body contains the fast idle valve.

c. Fast Idle Valve

The Fast Idle Valve, Fig. 6C-69, consists of a plastic body that houses an electric heater, a spring and plunger, and a thermal sensitive element.

The device is installed in the top of the throttle body.

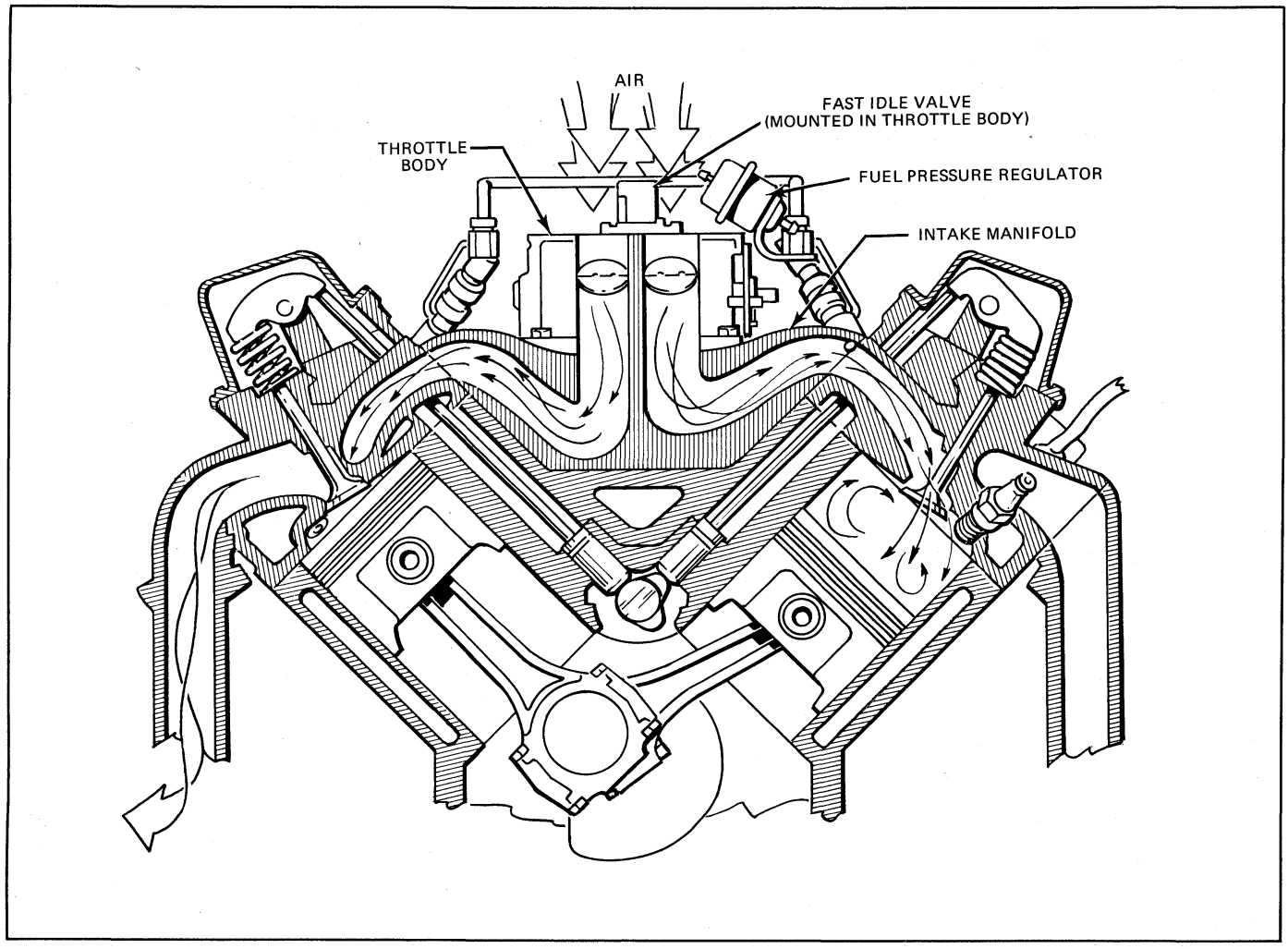


Fig. 6C-67 Air Induction System

Electrically, it is connected to the fuel pump circuit through the electronic control unit. When the cold engine is started, the open valve allows supplemental air to bypass the throttle. The heater warms the thermal element which expands, forcing the spring and plunger toward the orifice, reducing the supplemental air flow thus reducing the engine speed to the normal level. The fast idle valve will have no further affect after the thermal element reaches approximately 140°F. The rate of valve closure is a function of time and temperature. The warmer the ambient temperature, the faster the valve will close, reducing the engine idle speed. At 68°, the valve will close in approximately 90 seconds; and -20 degrees, the valve will require approximately 5 minutes to close.

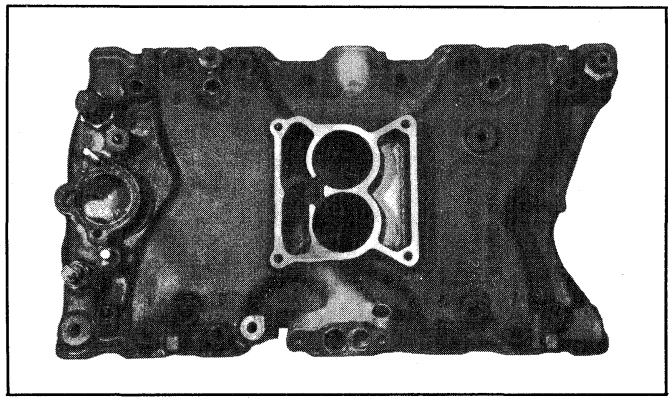


Fig. 6C-68 Intake Manifold Seville

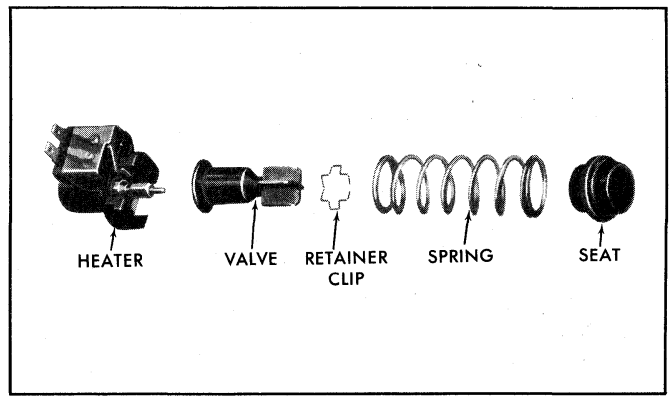


Fig. 6C-69 Fast Idle Valve

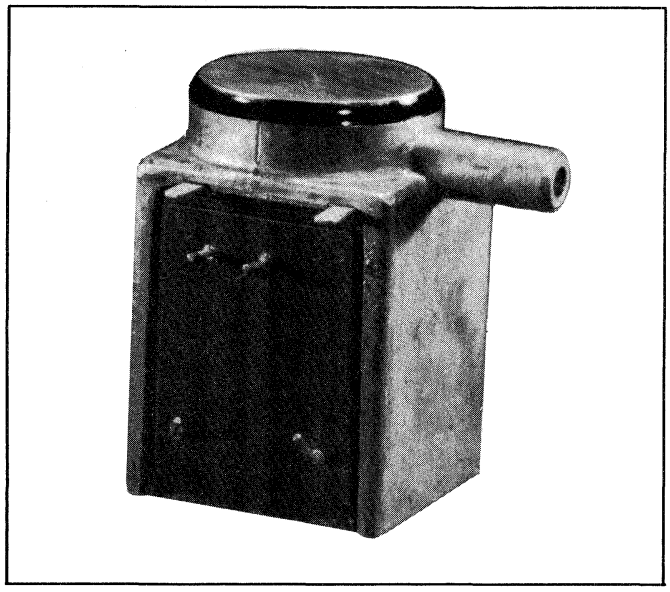


Fig. 6C-70 Map Sensor

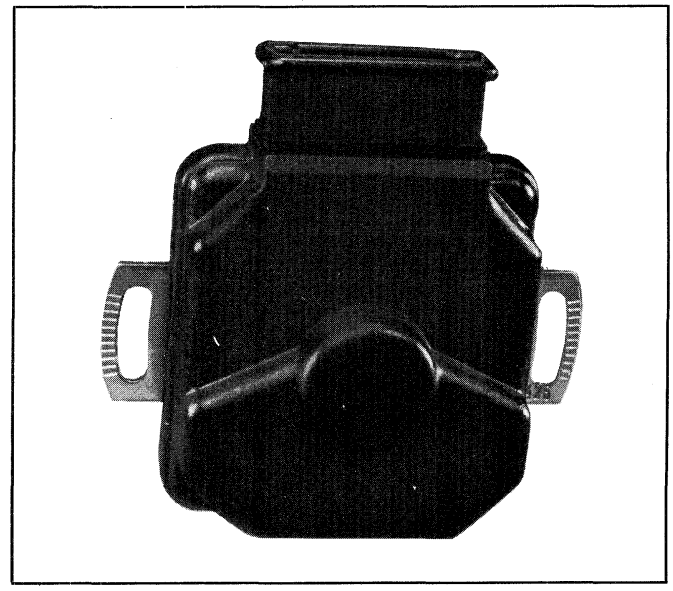


Fig. 6C-71 Throttle Position Switch

Engine Sensors

The sensors are electrically connected to the Electronic Control Unit and all operate independently of each other. Each sensor transmits a signal to the ECU, relating a specific engine operating condition. The ECU analyzes all the signals and transmits the appropriate commands.

The sensors are as follows:

a. Manifold Absolute Pressure Sensor

The Manifold Absolute Pressure (MAP) Sensor, Fig. 6C-70, monitors the changes in intake manifold pressure which result from engine load, speed and barometric pressure variations. These pressure changes are supplied to the electronic control unit circuitry in the form of electrical signals. The sensor also monitors the changes in the intake manifold pressure due to changes in altitude. As intake manifold pressure increases, additional fuel is required. The MAP sensor sends this information to the ECU so that the pulse width will be increased. Conversely as manifold pressure decreases the pulse width will be shortened.

The sensor is mounted within the electronic control unit. A manifold pressure line, routed with the engine harness, connects it to the front of the throttle body.

b. Throttle Position Switch

The Throttle Position Switch, Fig. 6C-71, is mounted to the throttle body and connected to the throttle valve shaft. Movement of the accelerator causes the throttle shaft to rotate (opening or closing the throttle blades). The switch senses the shaft movement and position (closed throttle, wide open throttle, or position changes), and transmits appropriate electrical signals to the electronic control unit. The electronic control unit processes these signals to determine the fuel requirement for the particular situation.

c. Temperature Sensors

The Temperature Sensors, Fig. 6C-72, (Coolant and Air) are comprised of a coil of high temperature nickel wire sealed into an epoxy case, and molded into a brass housing with two wires and a connector extending from the body. The resistance of the wire changes as a function of temperature. Low temperature provides low resistance and as temperatures increase, so does resistance. The voltage drop across each sensor is monitored by the ECU.

The Air Temperature Sensor is located on the intake manifold and is connected to the engine harness. The Coolant Temperature Sensor is located in a coolant passage at the left front of the intake manifold on Seville and on the right side of the block, below the thermostat on all other cars.

Both temperature sensors are identical and completely interchangeable.

d. Speed Sensor

The Speed Sensor, Fig. 6C-73, is incorporated within the ignition distributor assembly (HEI). It consists of two components. The first has two reed switches mounted to a plastic housing. The housing is affixed to the distributor shaft housing. The second is a rotor with two magnets, attached to and rotating with the distributor shaft.

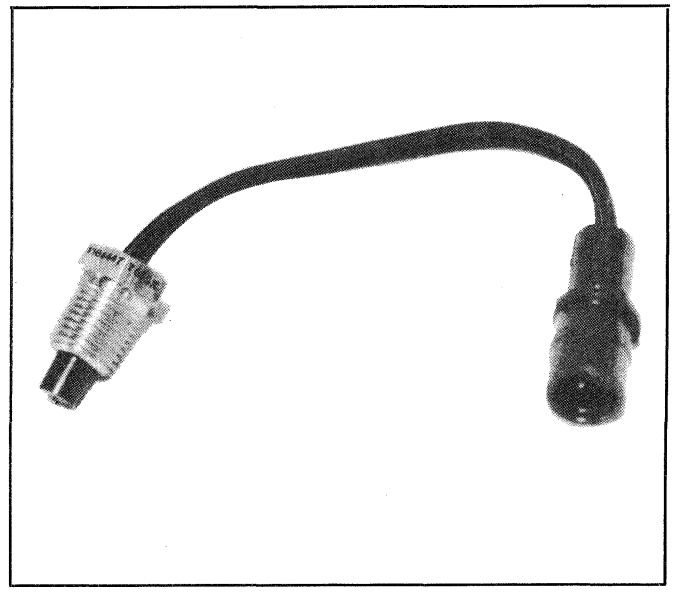


Fig. 6C-72 Temperature Sensor

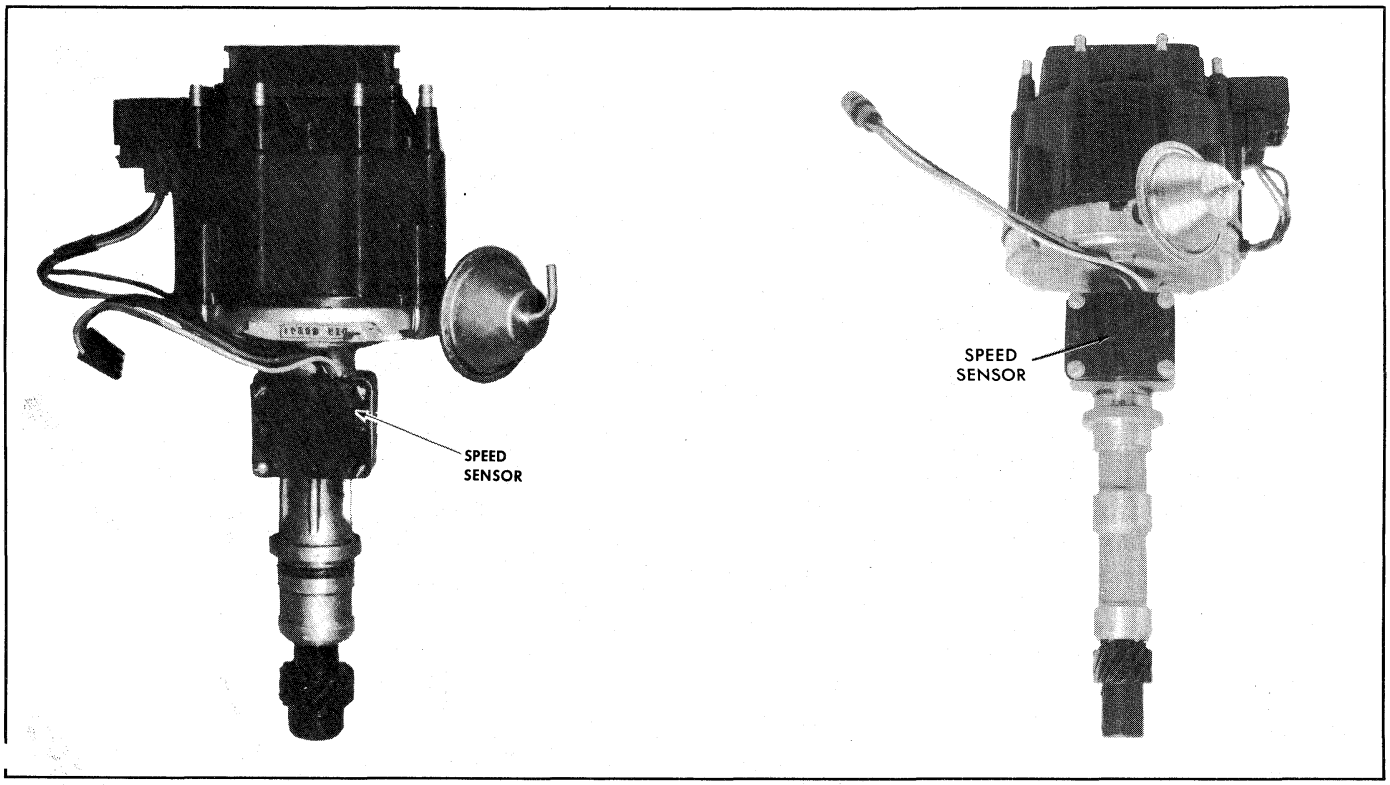


Fig. 6C-73 Fuel Injection Distributors

The rotor rotates past the reed switches causing them to open and close. This provides two types of information: synchronization of the ECU and the proper injector group with the intake valve timing (phasing); and engine rpm for fuel scheduling.

Electronic Control Unit

The Electronic Control Unit, Fig. 6C-74, is a preprogrammed analog computer consisting of custom electronic circuits housed in a steel case. The unit is located in front of the heater case, directly below the radio within the passenger compartment on Seville and behind the instrument panel at the right end on all other cars. Differently calibrated ECU's are used for each body style and sales application and should not be interchanged. The ECU is electrically connected to the vehicle power supply and the other EFI components by a harness that is routed through the firewall.

The ECU receives power from the vehicle battery when the ignition is set to the ON or CRANK position. During cranking and engine operation, the following events occur.

The following information is received from the EFI sensors:

Engine Coolant Temperature
Intake Manifold Air Temperature
Intake Manifold Absolute Pressure
Engine Speed and Firing Position
Throttle Position and Change of Position

The following commands are transmitted by the ECU:

Electric Fuel Pump Activation
Fast Idle Valve Activation
Injection Valve Activation
EGR Solenoid Activation
Vacuum Retard Solenoid Activation (California Seville and Eldorado only)

The desired air/fuel ratios for various driving and atmospheric conditions are designed into the ECU. As the above signals are received from the sensors, the ECU processes the signals and computes the engines fuel requirements. The ECU issues commands to the injection valves to open for a specific time duration. The duration of the command pulses varies as the operating conditions change. All injection valves in each group open simultaneously upon command.

The EFI System is activated when the ignition switch is turned to the ON position. The following events occur at the moment:

1. The Electronic Control Unit (ECU) receives vehicle battery voltage.
2. The Fuel Pumps are activated by the ECU. (The

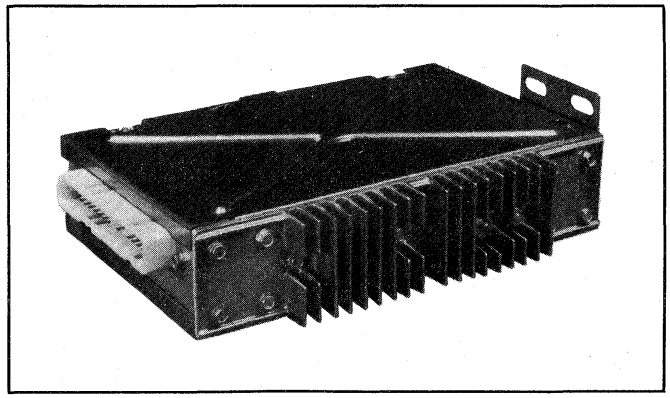


Fig. 6C-74 Electronic Control Unit

pumps will operate for approximately one second only, unless the engine is cranking or running).

3. All engine sensors are activated and begin transmitting signals to the ECU.

4. The electrically heated Fast Idle Valve is activated. (The Fast Idle Valve is connected to the Fuel Pump electrical circuit and like the fuel pumps, will only be activated for approximately one second unless the vehicle is cranking or running. This action is controlled by the ECU).

5. The EGR solenoid is activated to block the vacuum signal to the EGR valve at coolant temperatures below 110°F to 130°F depending upon application.

6. On California Seville and Eldorado the vacuum retard solenoid is activated to route vacuum to the retard side of the vacuum advance can. This is accomplished at the same temperature as the EGR activation and uses the same signal.

The following events occur when the engine is started:

1. The Fuel Pumps are activated for continuous operation.

2. The heater element of the Fast Idle Valve is activated for continuous operation.

3. The Throttle Body air-bypass controls the air flow to the intake manifold with the throttle valves closed. When the vehicle accelerator is depressed, the throttle valves open, creating an air flow similar to a carburetor.

4. The Fuel Pressure Regulator maintains the fuel pressure in the Fuel Rail (Injector inlet) at 39 psi higher than the intake manifold air pressure by returning excess fuel to the fuel tank.

5. The following signals from the primary sensors are continuously received and processed by the Electronic Control Unit.

a. Engine Coolant Temperature

b. Intake Manifold Air Temperature

c. Intake Manifold Absolute Air Pressure

d. Engine Speed and firing position

e. Throttle Position changes or W.O.T. position

6. The ECU outputs electrical signals alternately to each injector group precisely controlling the opening and closing time (pulse width) to deliver fuel to the engine.

DIAGNOSIS

Relationship Between Electronic Fuel Injection and Carburetor Components

The primary functional relationship of the carburetor and electronic fuel injection system components are identified below. The relationships while not directly interchangeable with regard to performance and resulting behavior, may prove valuable for diagnosis purposes.

Carburetor Vehicles	EFI Vehicles
Accelerator Pump	Throttle Position Switch
Fast Idle Cam	Electric Fast Idle Valve
Float	Fuel Pressure Regulator
Power Valve/ Metering Rods	Manifold Absolute Pressure Sensor
Metering Jets and Idle Fuel System	Injection Valves, ECU

TESTING ELECTRONIC FUEL INJECTION USING ANALYZER J-25400

EFI diagnosis is described in detail in a separate publication titled "Cadillac Fuel Injection Diagnosis". The procedures in the diagnosis manual require the use of Analyzer J-25400 for testing of specific components as described below.

a. Visual Inspection

The following visual inspections should be performed prior to testing.

1. Visually check all wiring harness connections for:

a. Loose or detached connectors.

b. Broken or detached wires.

c. Terminals not completely seated in connector housing.

d. Partially broken or frayed wires at terminal connection.

e. Shorting between wires.

f. Excessive corrosion.

2. Visually check all vacuum lines (idle by-passage on top of throttle body may be plugged with a clean shop towel to make it easier to hear vacuum leaks):

a. To insure all lines are securely connected to their proper fittings, Fig. 6C-75 through 6C-77.

b. For broken, pinched or cracked lines.

3. Visually check fuel lines for:

a. Leakage.

b. Kinks in rubber and steel fuel lines.

b. Connecting Analyzer

1. Depress Analyzer Switch #1 (OFF).

2. Turn Car Ignition Switch OFF.

3. Set Parking Brake ON.

4. Set Transmission in PARK.

5. Select analyzer overlay J-25400-11 and place it on the analyzer panel retaining it in place.

6. Turn analyzer fuel pump switch OFF.

NOTE: This requires removal of the ECU on "C" cars. On Eldorado, the connection is made at the jumper harness and also interfaces with two other single wire connectors, see Fig. 6C-79.

CAUTION: *Do not connect the ECU side of harness J-25400-13 to the ECU at this time as damage to the analyzer may result.*

8. Connect analyzer ground lead to a good ground.

NOTE: Car electrical equipment could interfere with correct operation of the EFI Analyzer. Therefore, it is important that all of this equipment is OFF during testing. This includes lights, buzzers, electric motors, etc. Doors should be kept closed to deactivate interior lighting, buzzers, and seat solenoids.

9. Push ENRICHMENT SWITCH on extender box to ALL OTHER TESTS position.

10. POWER TO TESTER light should be ON indicating power to analyzer. If light fails to come on, check ground connection. If ground is OK check fusible link at generator BAT terminal, 10 amp in-line fuse in car harness (all except "C" car) or the 20 amp EFI fuse ("C" car only) and 5 amp fuse in analyzer extender box, Fig. 6C-81.

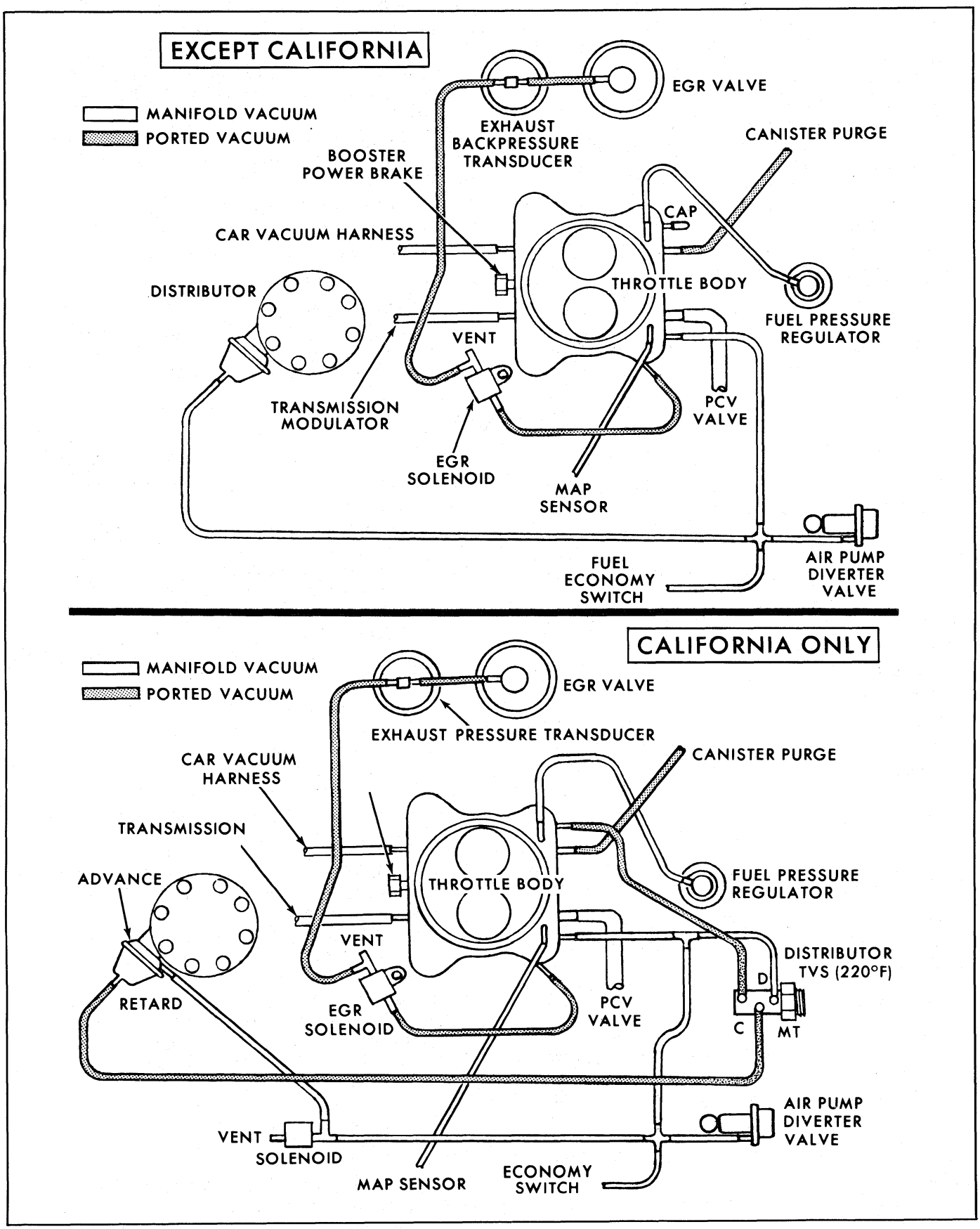


Fig. 6C-75 Vacuum Hose Routing - Seville

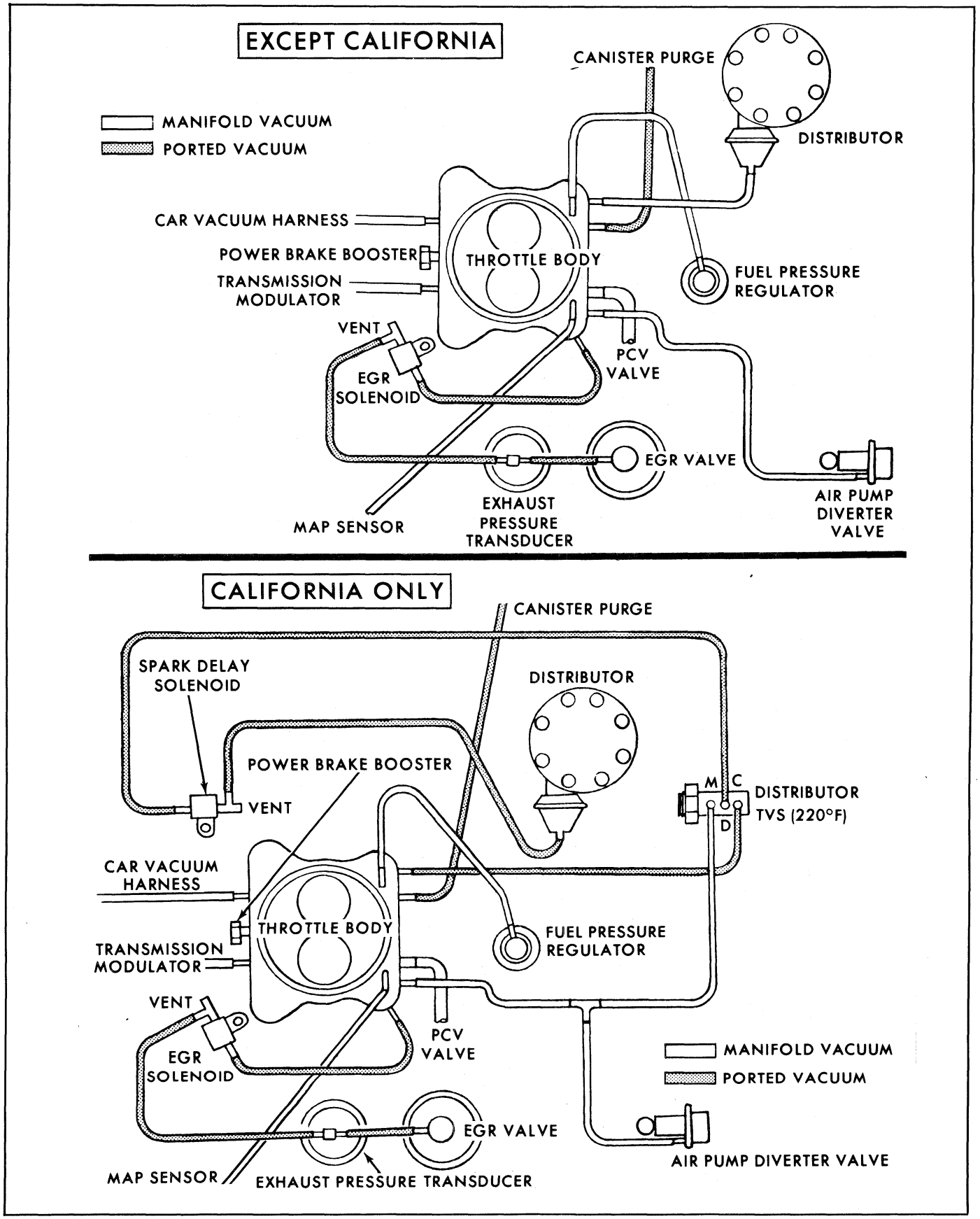
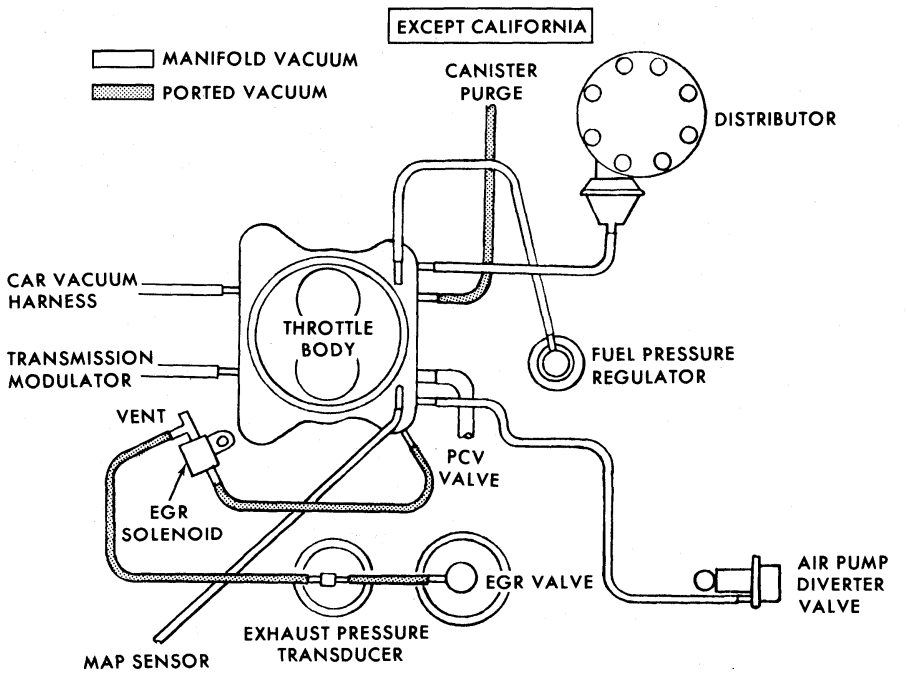


Fig. 6C-76 Vacuum Hose Routing - DeVille, Brougham



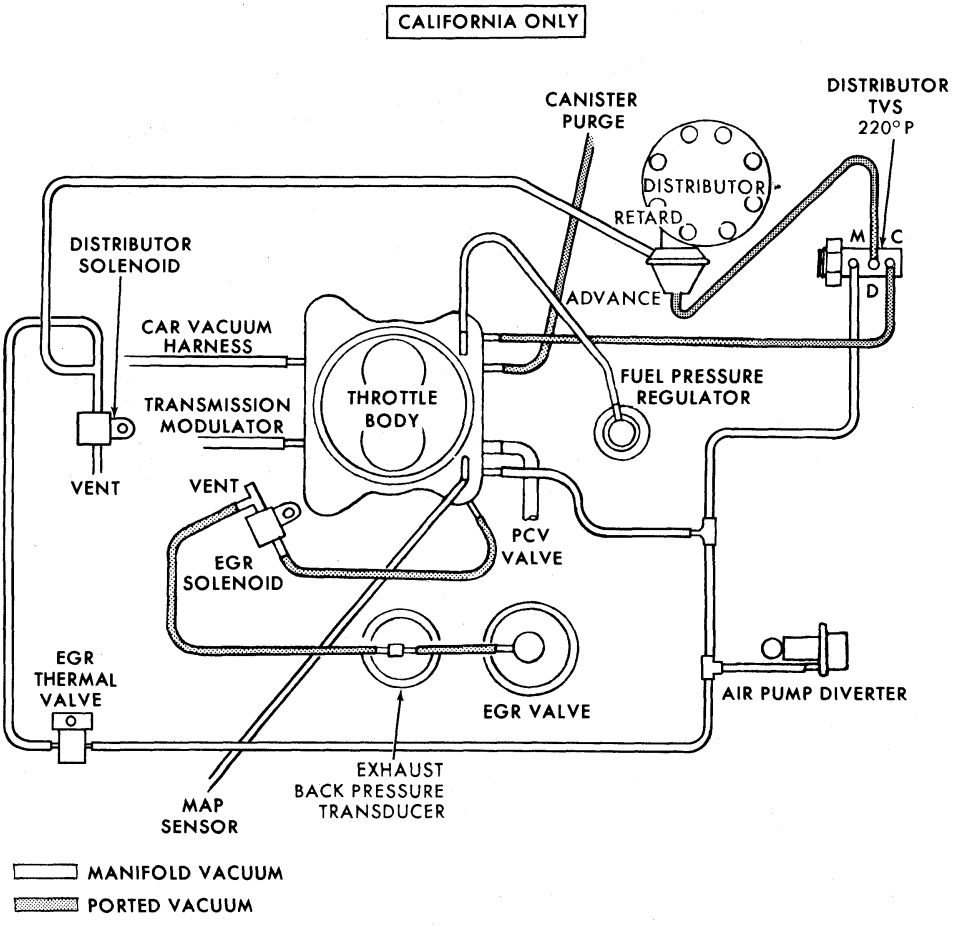


Fig. 6C-77 Vacuum Hose Routing - Eldorado

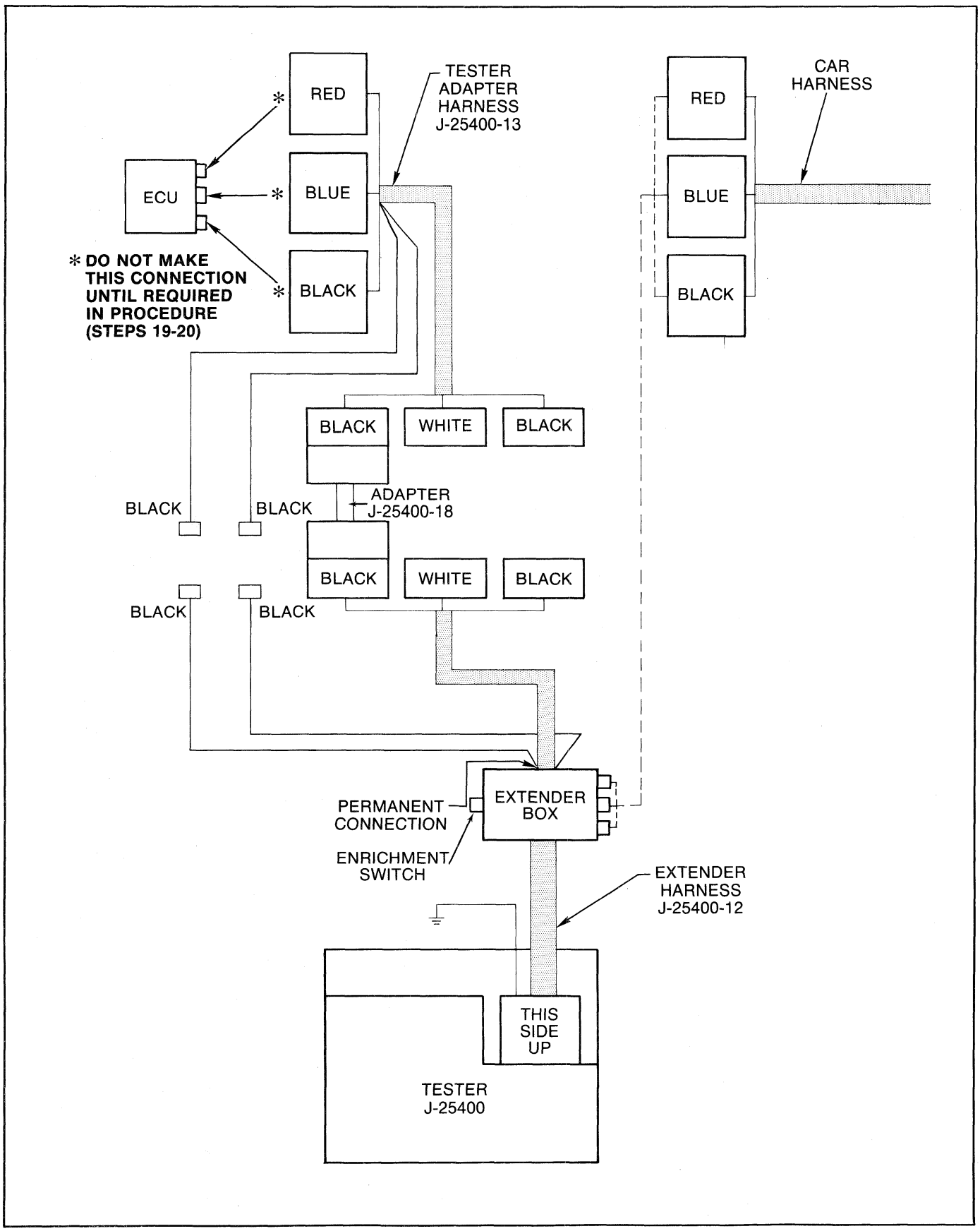


Fig. 6C-78 Tester Connections - Seville

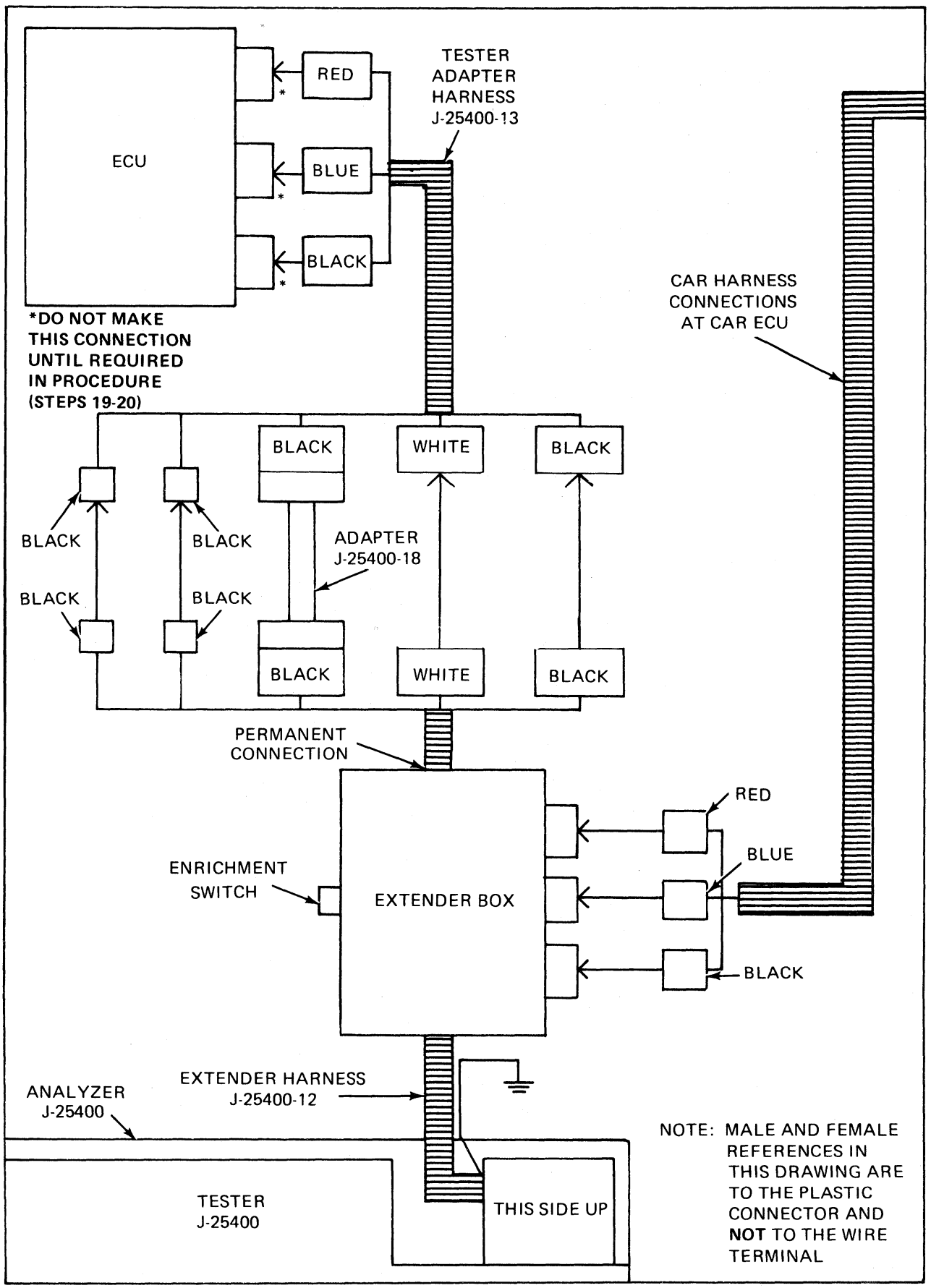


Fig. 6C-79 Tester Connections - DeVille, Brougham

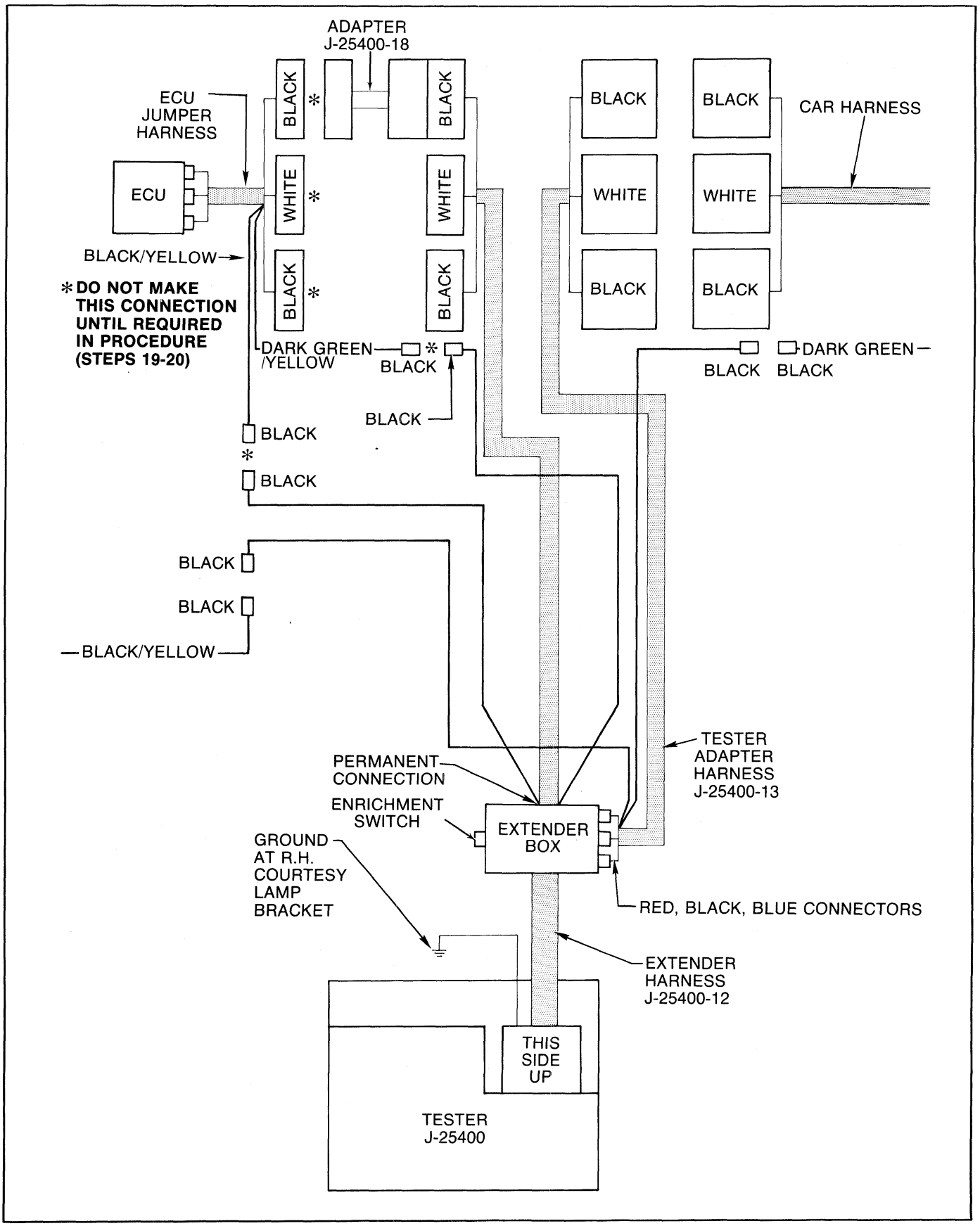


Fig. 6C-80 Tester Connections - Eldorado

c. Component Testing

STEP 1. CONNECT ANALYZER AS DESCRIBED ABOVE.

STEP 2. BATTERY VOLTAGE AND CALIBRATION.

A. Depress Analyzer Switch #2.

B. Analyzer POWER TO TESTER light should be on. If light fails to come on, check in line 10 amp fuse, (all except "C" car) or 20 amp EFI fuse ("C" car only) 5 amp fuse in analyzer extender box and fusible link at generator BAT terminal (all except "C" cars) for open, Fig. 6C-81 through 6C-83. If fuse continually blows:

1. Check dark green wire to fuel pumps for short circuit.
2. Check in-tank fuel pump assembly for short circuit. Refer to Step 17.
3. Check fast idle valve circuit for short circuit. Refer to Step 5.
4. Check ECU. Refer to Steps 18 and 20c.

C. Calibrate the analyzer by pushing the PUSH TO CALIBRATE button. With button depressed: Adjust the knob until DIGITAL METER reads 88.8.

NOTE: Tester is not functioning correctly if this value cannot be obtained.

D. Release Calibrate button.

E. The DIGITAL METER should read **above 11.5 volts.**

(Battery voltage to ECU). If reading is **less than 11.5 volts,** check battery condition, harness 14 yellow (brown) wire and 14 orange (dark green) wires, Fig. 6C-81 through 6C-83), and connections.

F. Turn Car Ignition **on.**

G. Analyzer IGNITION ON Light should be **on.** If light is **not on,** check 12 black/yellow wire between ignition switch and ECU for poor connection or open circuit (should be at least 9.5 volts), Fig. 6C-81 through 6C-83.

H. Turn the Car Ignition Switch to the START position and note the following while engine is cranking:

1. ENGINE CRANK Light should come **on.** If lamp is **not on,** inspect 12 purple wire between starter solenoid and ECU for continuity, Figs. 6C-81 through 6C-83.
2. The DIGITAL METER readout should not drop **below 9.0 volts** (cranking voltage). If voltage drops **below 9.0** check battery before proceeding with test (12 purple wire from starter solenoid should have at least 9.0 volts during cranking).

I. Return Car Ignition Switch to **off.**

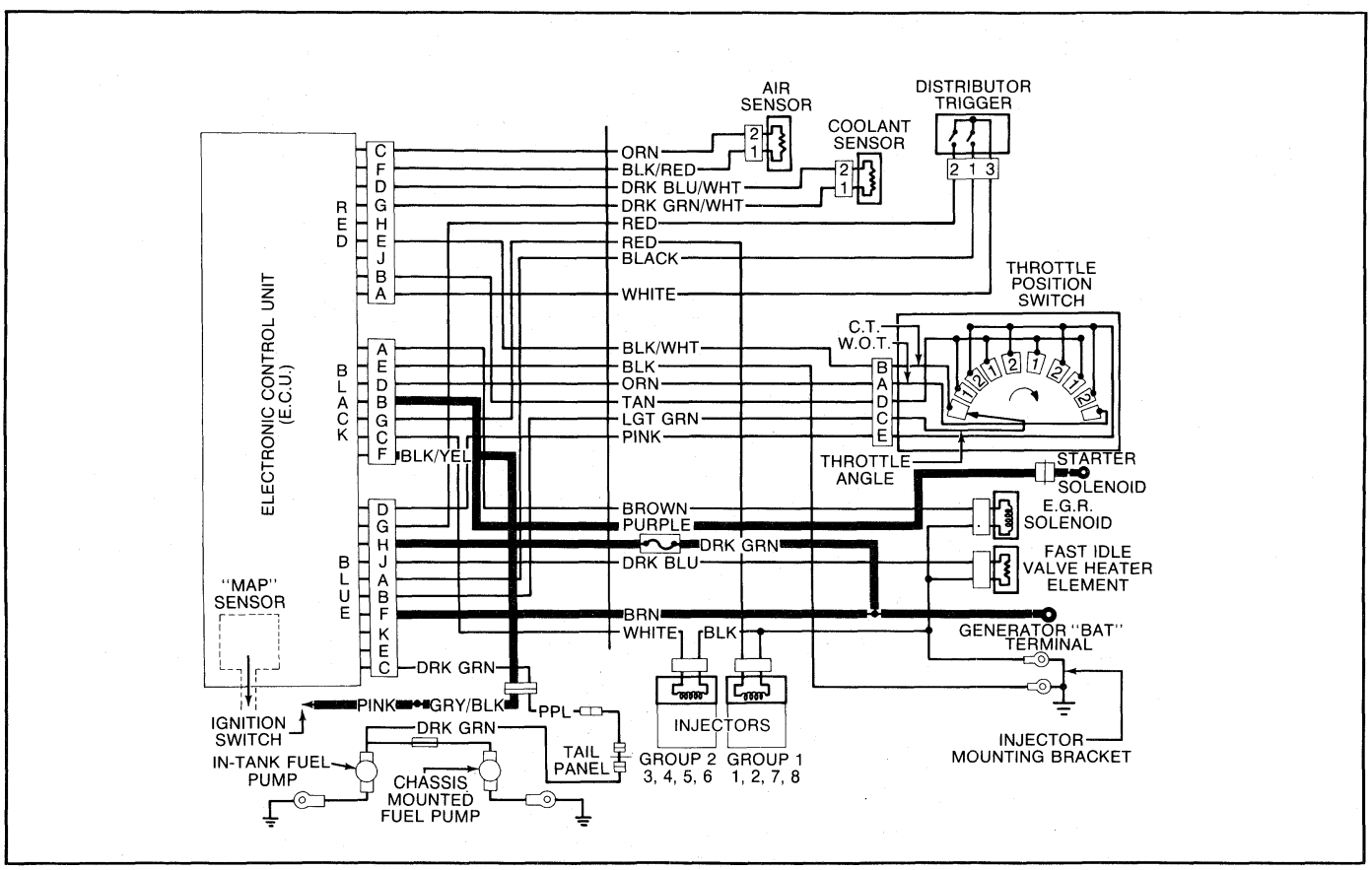


Fig. 6C-81 Step 2 Circuit - Seville

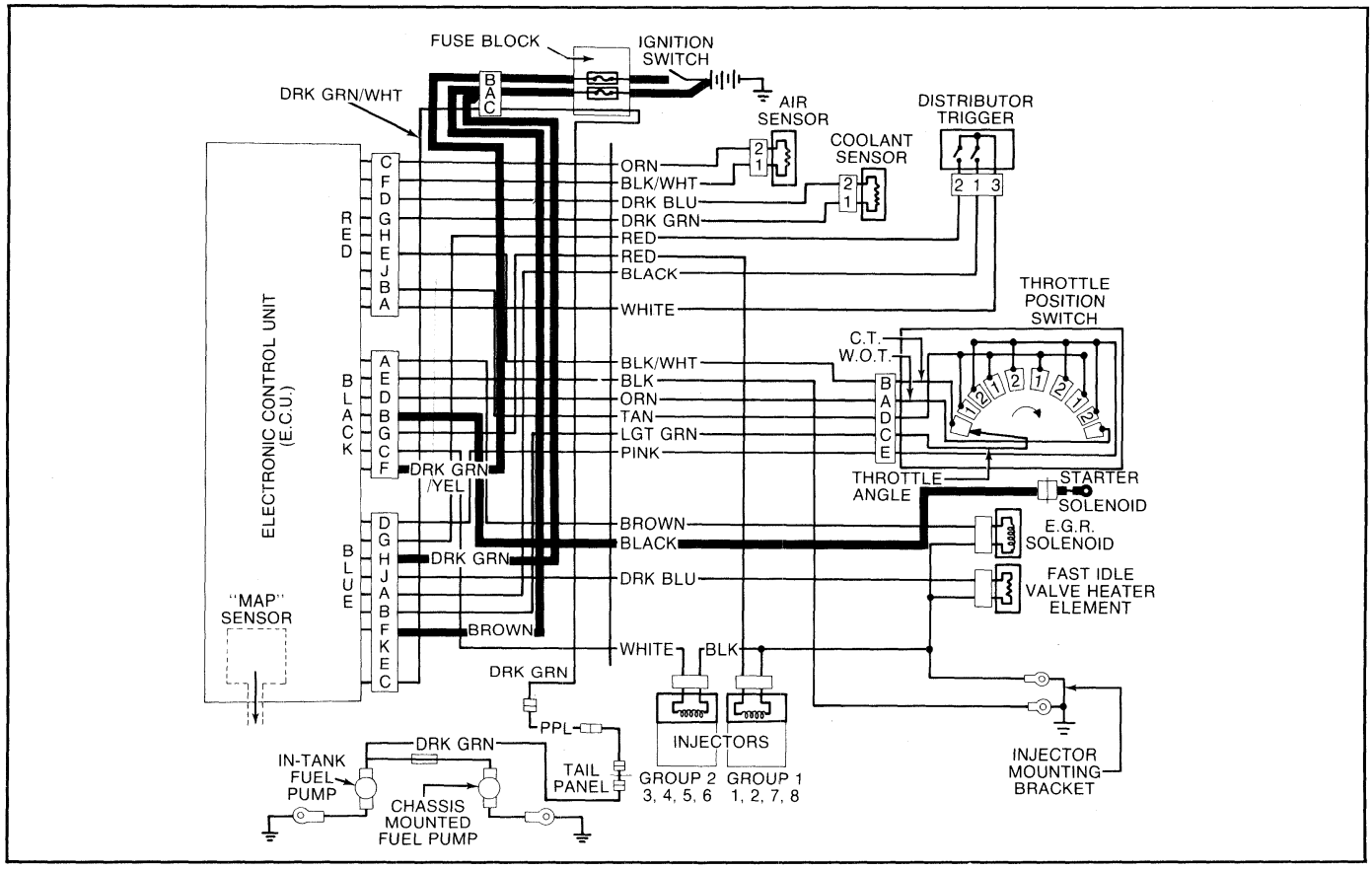


Fig. 6C-82 Step 2 Circuit - DeVille, Brougham

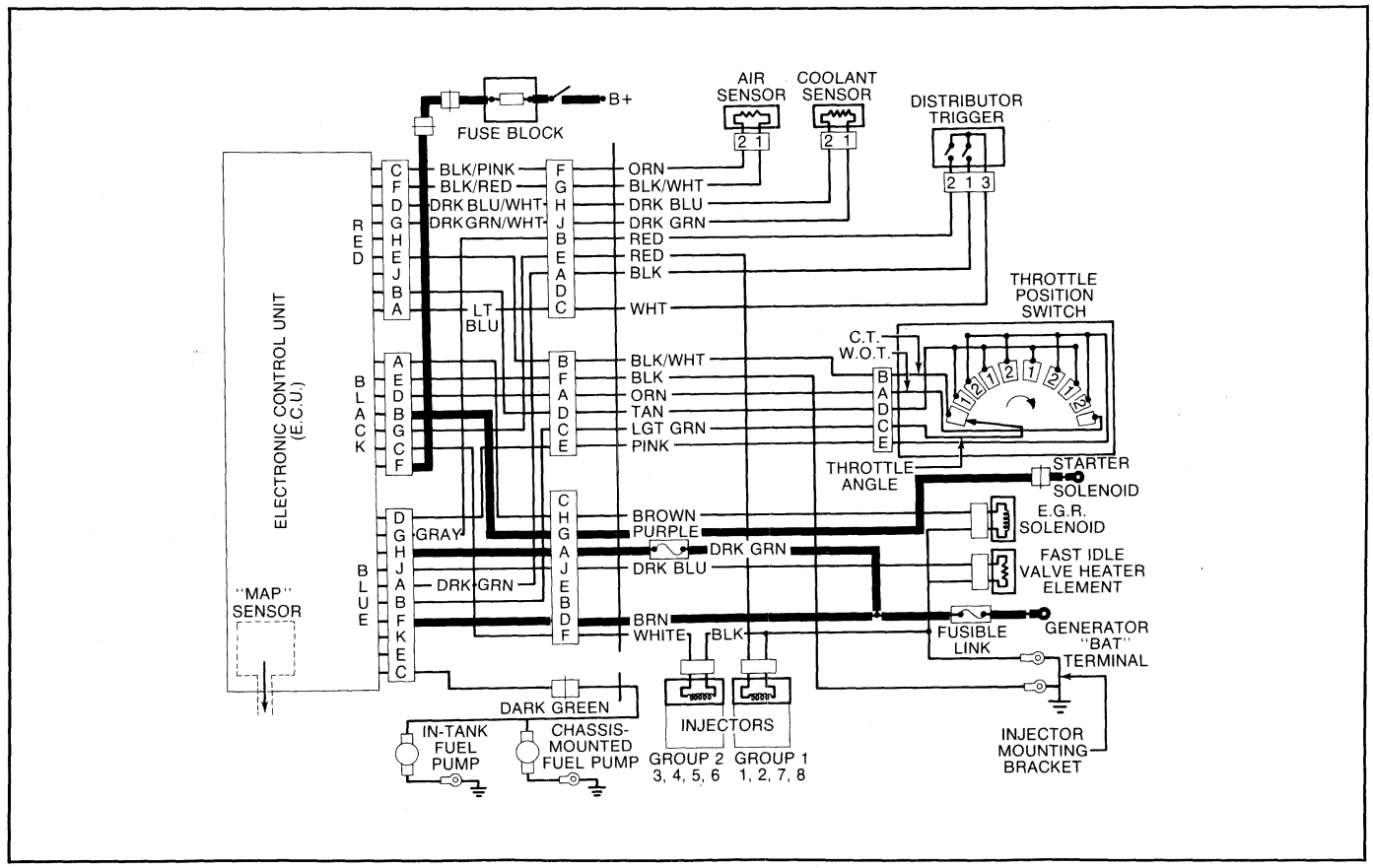


Fig. 6C-83 Step 2 Circuit - Eldorado

STEP 3. INJECTOR GROUP 1 TEST (INJECTORS 1, 2, 7, 8)

A. Depress Analyzer Switch #3. Test each individual injector by disconnecting the other 3 injectors in the group.

1. DIGITAL METER should read **between 2.4 and 3.5** for each of the four injectors. If reading is OK, proceed to step 4.

2. If DIGITAL METER reads **more than 3.5,** and/or OPEN CIRCUIT light indicates an open circuit, short the harness terminals together.

a. If DIGITAL METER reads **less than .5,** replace the injector.

b. If DIGITAL METER reads **more than .5,** inspect 18 red wire for continuity and terminal at ECU (jumper harness on Eldorado) for poor connection, Figs. 6C-84 through 6C-86. If red wire is OK, inspect ground wire and ground connection (18 black wire) at injector mounting bracket for poor connection, Figs. 6C-84 through 6C-86. Also inspect injector connector. Repair and retest.

3. If DIGITAL METER reads **less than 2.4,** inspect 18 red wire between injector connector and ECU (jumper harness on Eldorado) for short circuit, Figs. 6C-84 through 6C-86. Repair and retest.

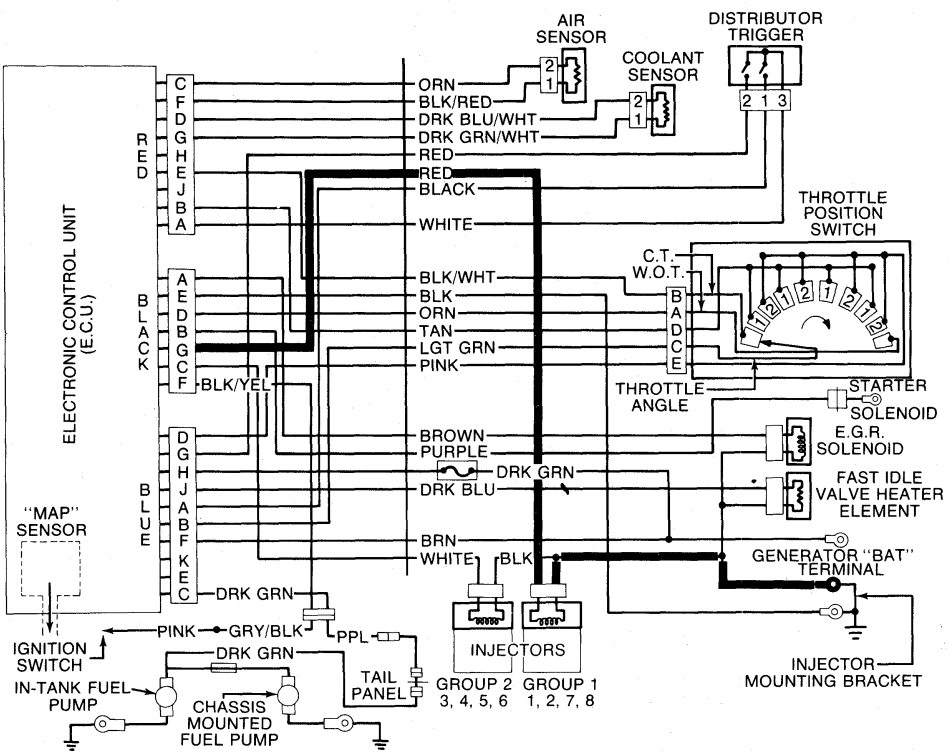


Fig. 6C-84 Step 3 Circuit - Seville

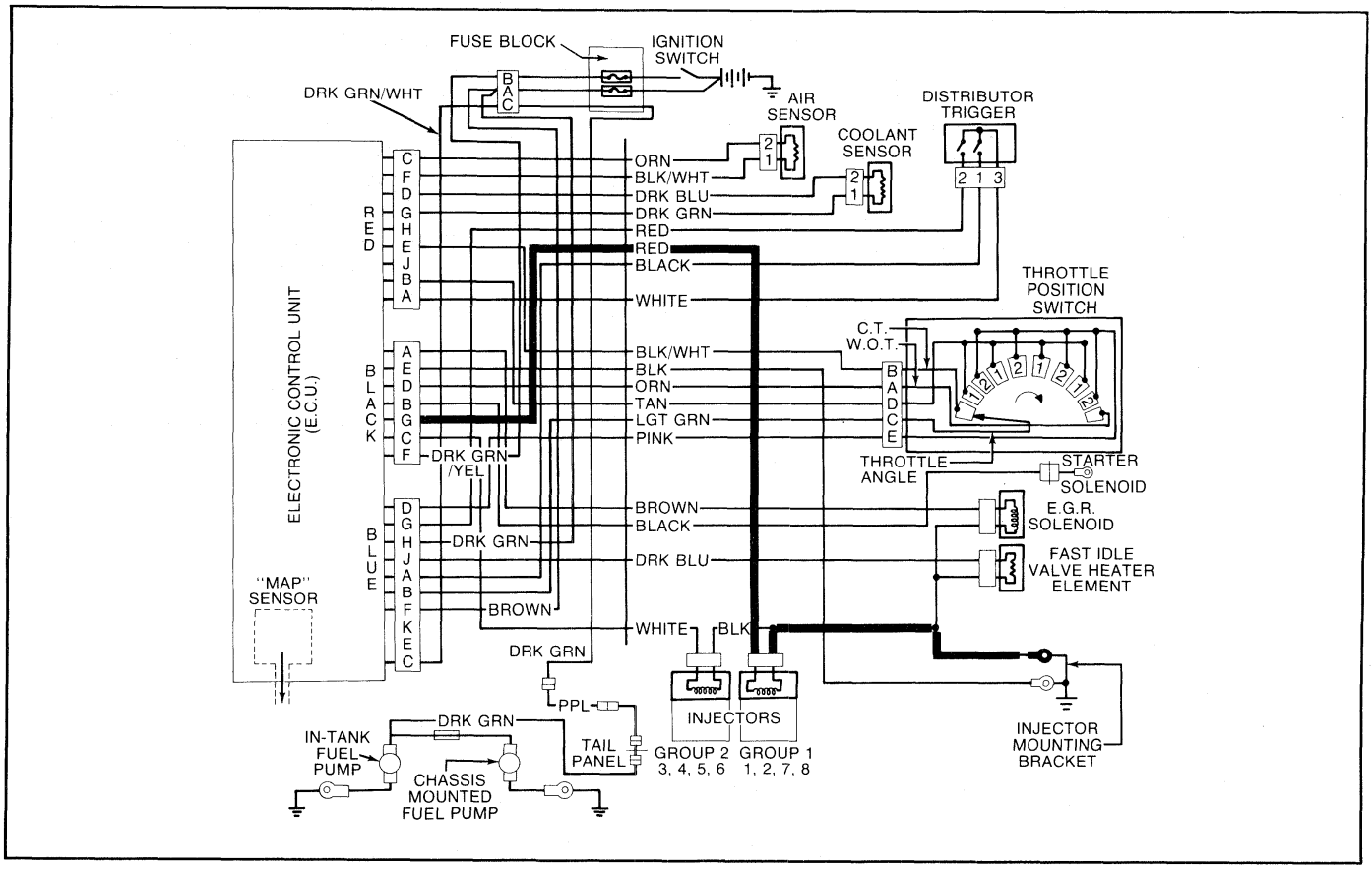


Fig. 6C-85 Step 3 Circuit - DeVille, Brougham

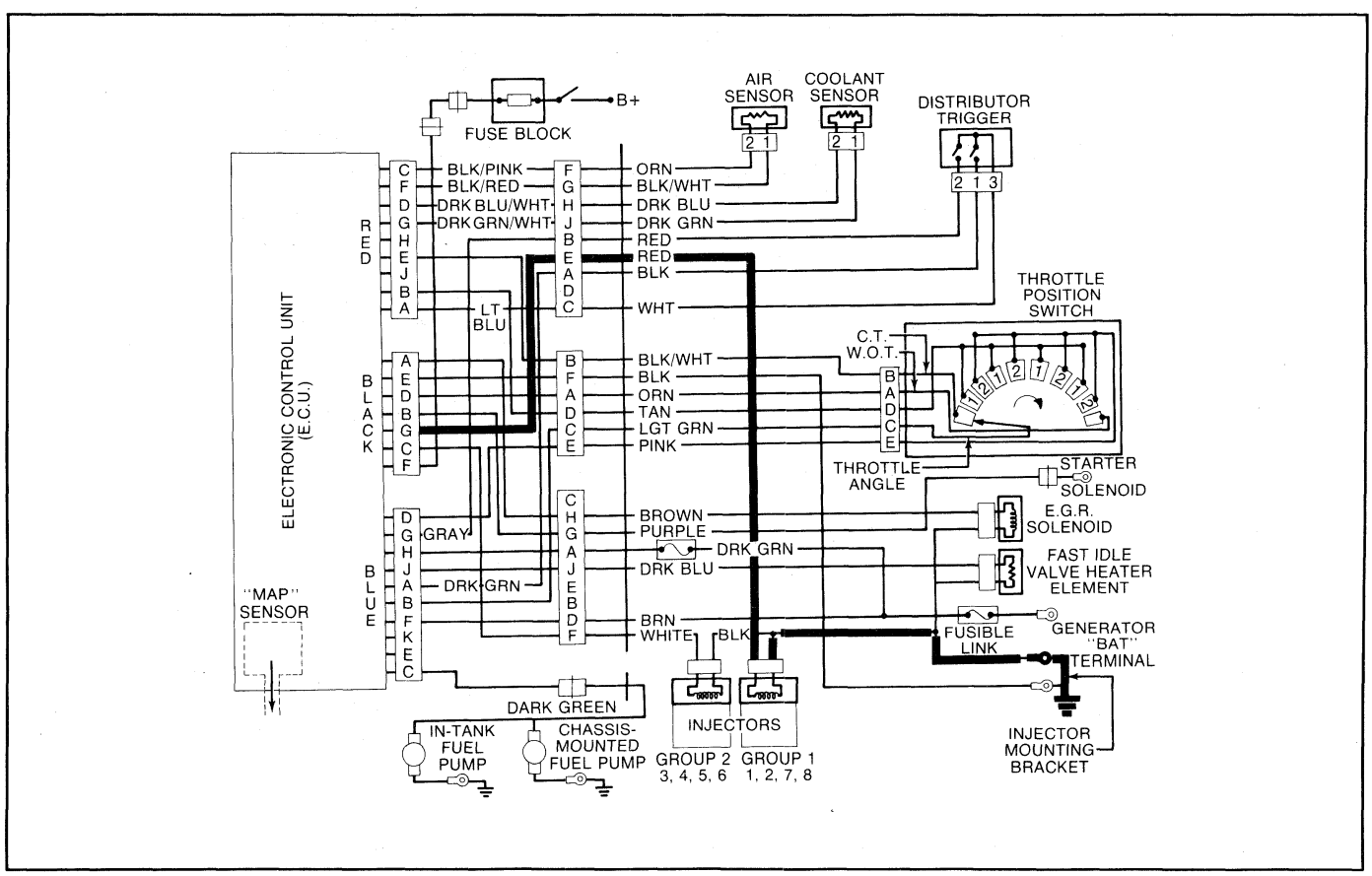


Fig. 6C-86 Step 3 Circuit - Eldorado

STEP 4. INJECTOR GROUP 2 TEST (INJECTORS 3, 4, 5, 6)

A. Depress Analyzer Switch #4. Test each individual injector by disconnecting the other 3 injectors in the group.

1. DIGITAL METER should read **between 2.4 and 3.5** for each of the four injectors. If reading is OK, proceed to Step 5.

2. If DIGITAL METER reads **more than 3.5,** and/or OPEN CIRCUIT light indicates an open circuit, short the harness terminals together.

a. If DIGITAL METER reads **less than .5,** replace the injector.

b. If DIGITAL METER reads **more than .5,** inspect 18 white wire for continuity and terminal at ECU (jumper harness on Eldorado) for poor connection, Figs. 6C-87 through 6C-89. If white wire is OK, inspect ground wire and ground connection (18 black wire) injector mounting bracket for poor connection, Figs. 6C-87 through 6C-89. Also inspect injector connector. Repair and retest.

3. If DIGITAL METER reads **less than 2.4,** inspect 18 white wire between injector connector and ECU (jumper harness on Eldorado) for short circuit, Figs. 6C-87 through 6C-89. Repair and retest.

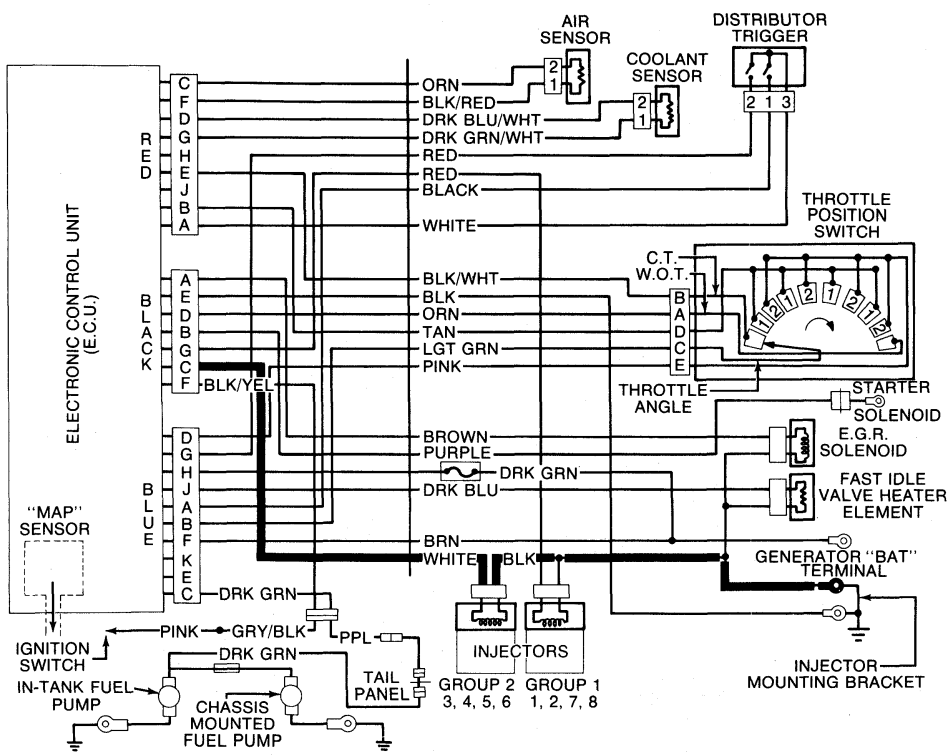


Fig. 6C-87 Step 4 Circuit - Seville

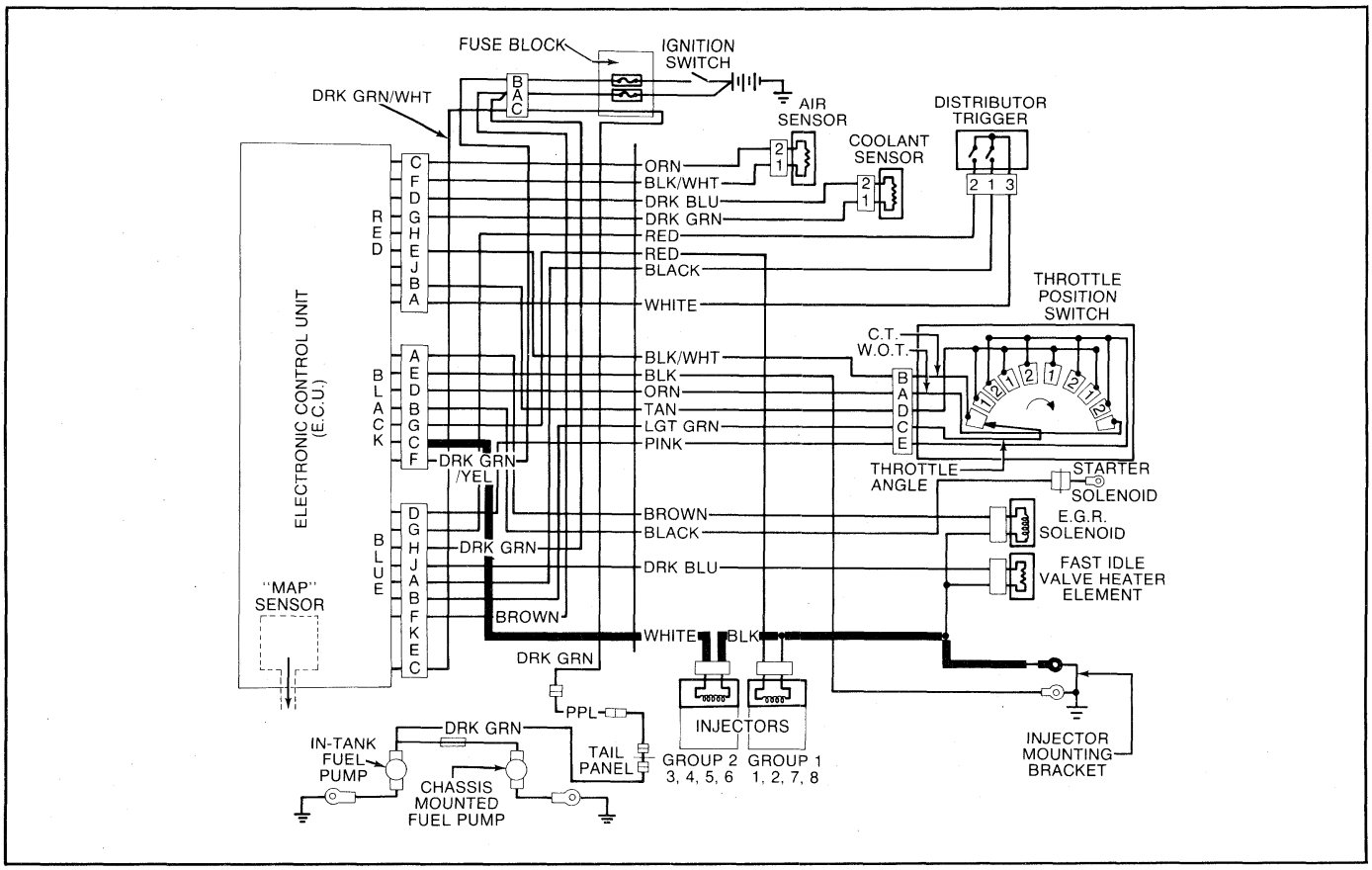


Fig. 6C-88 Step 4 Circuit - DeVille, Brougham

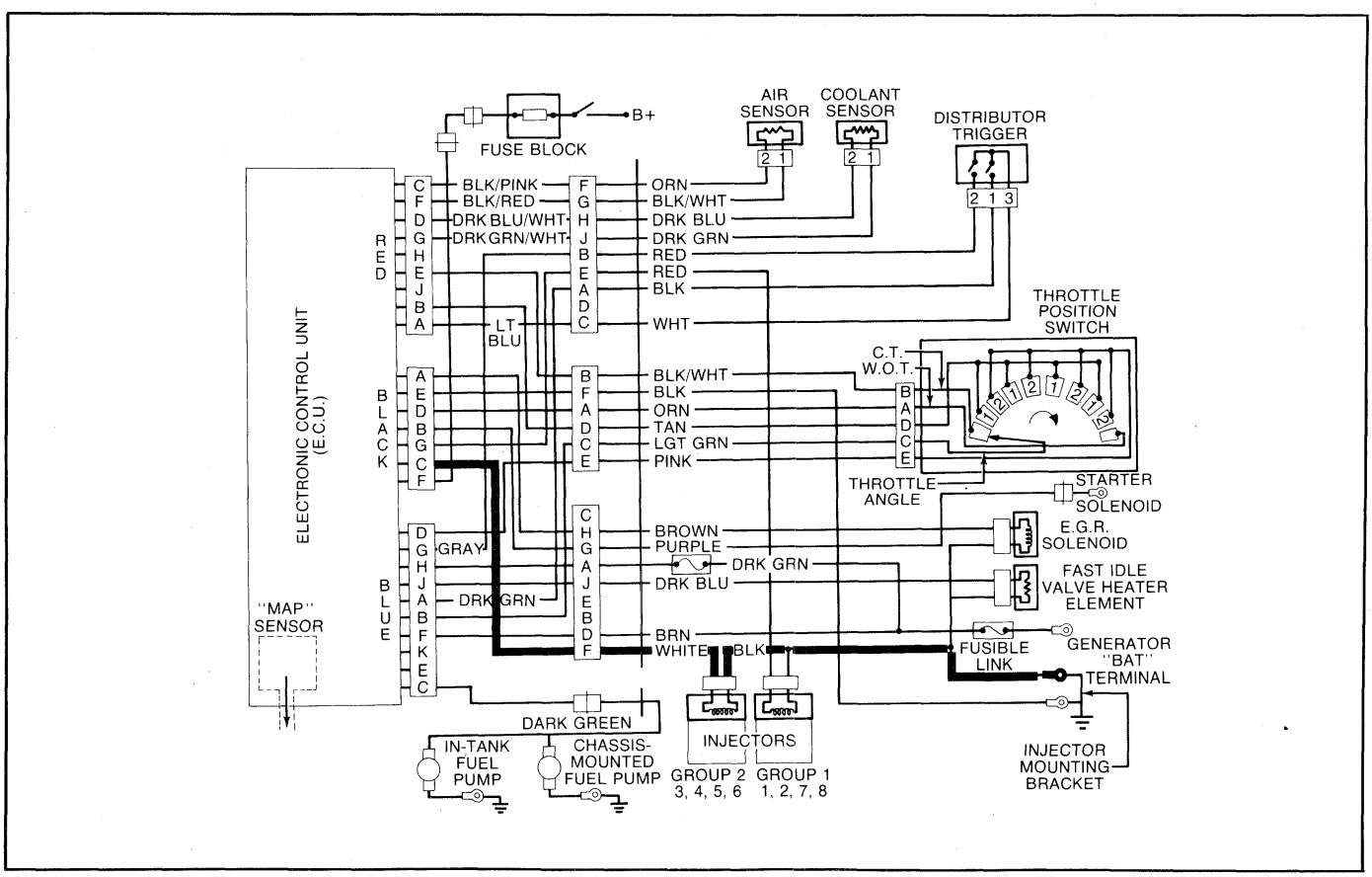


Fig. 6C-89 Step 4 Circuit - Eldorado

STEP 5. FAST IDLE VALVE

A. Depress Analyzer Switch #5.

1. If DIGITAL METER reads between **10 and 35,** proceed to Step 6.

2. If DIGITAL METER reads **more than 35** and/or OPEN CIRCUIT light indicates an open, proceed to Part "B".

3. If DIGITAL METER reads **less than 10,** proceed to Part "C".

B. Disconnect Engine Harness from Fast Idle Valve and short 20 Dark Blue wire to ground.

1. If OPEN CIRCUIT light goes **out** or if DIGITAL METER reads **less than 20,** replace Fast Idle Valve. Retest after repair.

2. If OPEN CIRCUIT light remains on, inspect 20 Dark Blue wire between fast idle valve and ECU (jumper harness on Eldorado) for open circuit or poor connection., Figs. 6C-90 through 6C-92. If 20 Dark Blue has continuity, inspect 18 black wire between fast idle valve connector and ground at injector mounting bracket for open circuit or poor connection, Figs. 6C-90 through 6C-92.

3. Repair and retest.

C. Disconnect Wiring Harness from Fast Idle Valve.

1. If OPEN CIRCUIT light comes **on** replace fast idle valve. Retest after repair:

2. If DIGITAL METER reads **less than 10,** inspect 20 dark blue wire between fast idle valve connector and ECU (jumper harness on Eldorado) for short circuit, Figs. 6C-90 through 6C-92.

3. Repair and retest.

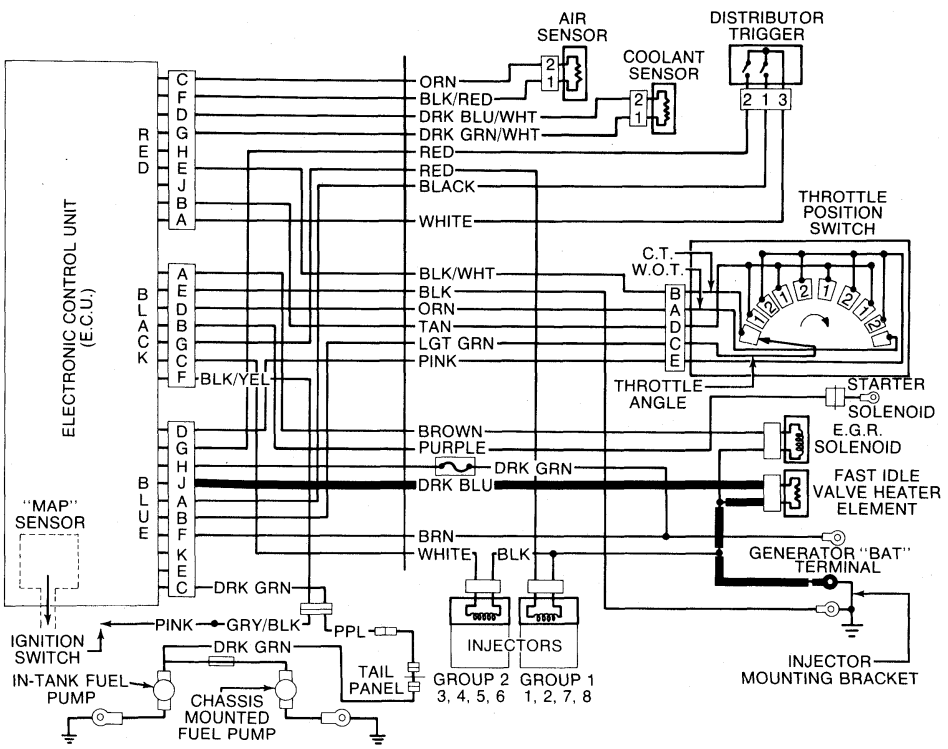


Fig. 6C-90 Step 5 Circuit - Seville

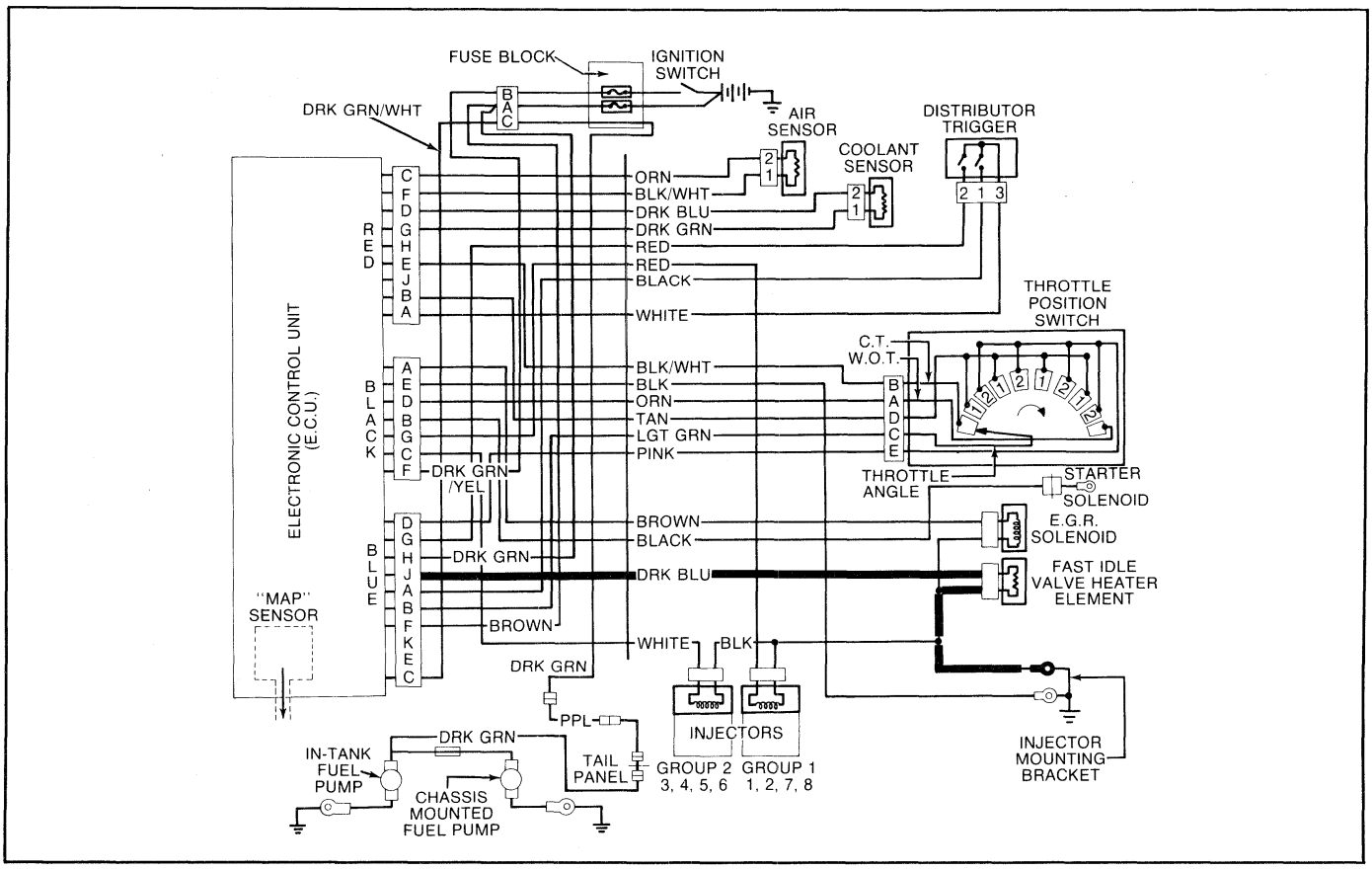


Fig. 6C-91 Step 5 Circuit - DeVille, Brougham

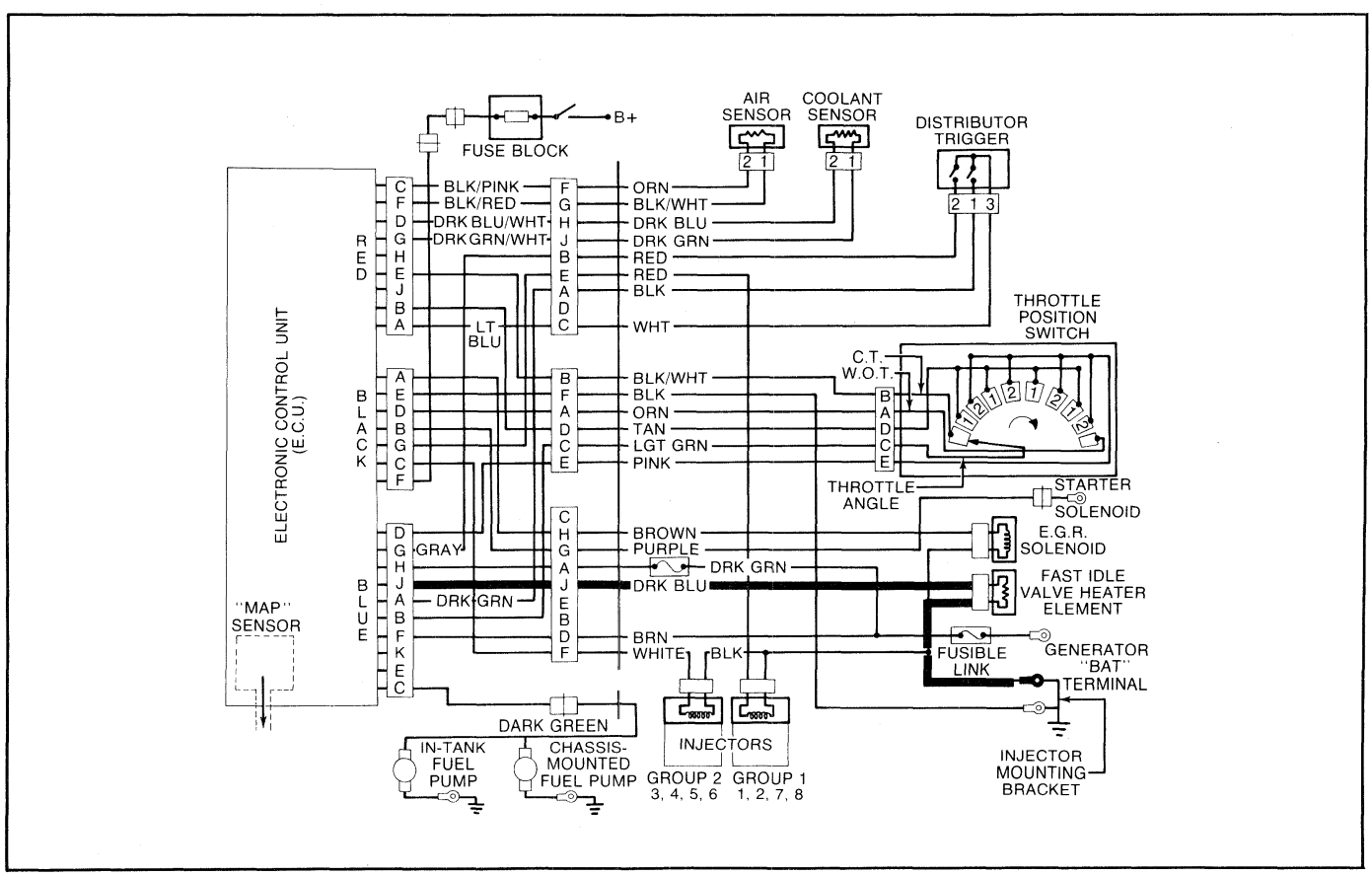


Fig. 6C-92 Step 5 Circuit - Eldorado

STEP 6. EGR VALVE SOLENOID

A. Depress Analyzer Switch #6.

1. If DIGITAL METER reads **between 40 and 60 (20 and 30** on California vehicles) proceed to Step 7.

2. If DIGITAL METER reads **more than spec.,** and/or OPEN CIRCUIT light indicates an open, proceed to Part "B".

3. If DIGITAL METER reads **less than spec.,** proceed to Part "C".

B. Disconnect Engine Harness from EGR Solenoid and connect a jumper between the harness terminals.

1. If OPEN CIRCUIT light goes **out** or DIGITAL METER reads **less than .5,** replace EGR solenoid. Retest after repair.

2. If OPEN CIRCUIT light remains **on,** inspect 14 brown wire between EGR solenoid and ECU (jumper harness on Eldorado) for open circuit or poor connection, Figs. 6C-93 through 6C-95. If brown wire has continuity, inspect 18 black wire between solenoid connector and ground at injector mounting bracket for open circuit or poor connection, Figs. 6C-93 through 6C-95.

3. Repair and retest.

C. Disconnect Wiring Harness from EGR solenoid.

1. If open CIRCUIT LIGHT comes **on,** replace EGR solenoid. Retest after repair.

2. If DIGITAL METER still reads **less than spec.,** inspect 14 brown wire between EGR solenoid connector and ECU (jumper harness on Eldorado) for short circuit, Figs. 6C-93 through 6C-95.

3. Repair and retest.

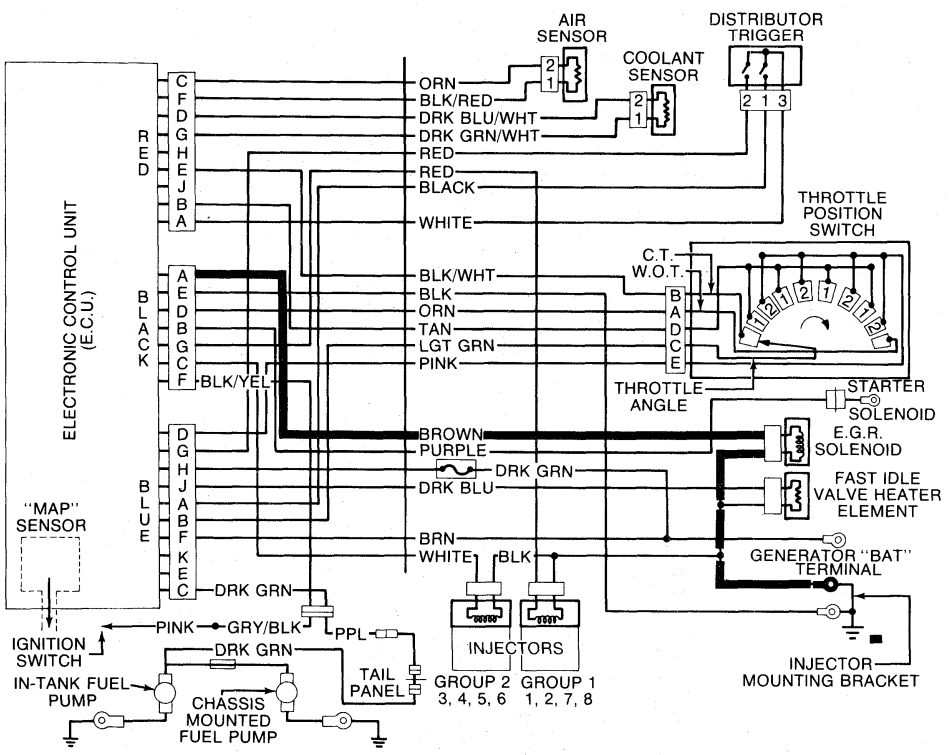


Fig. 6C-93 Step 6 Circuit - Seville

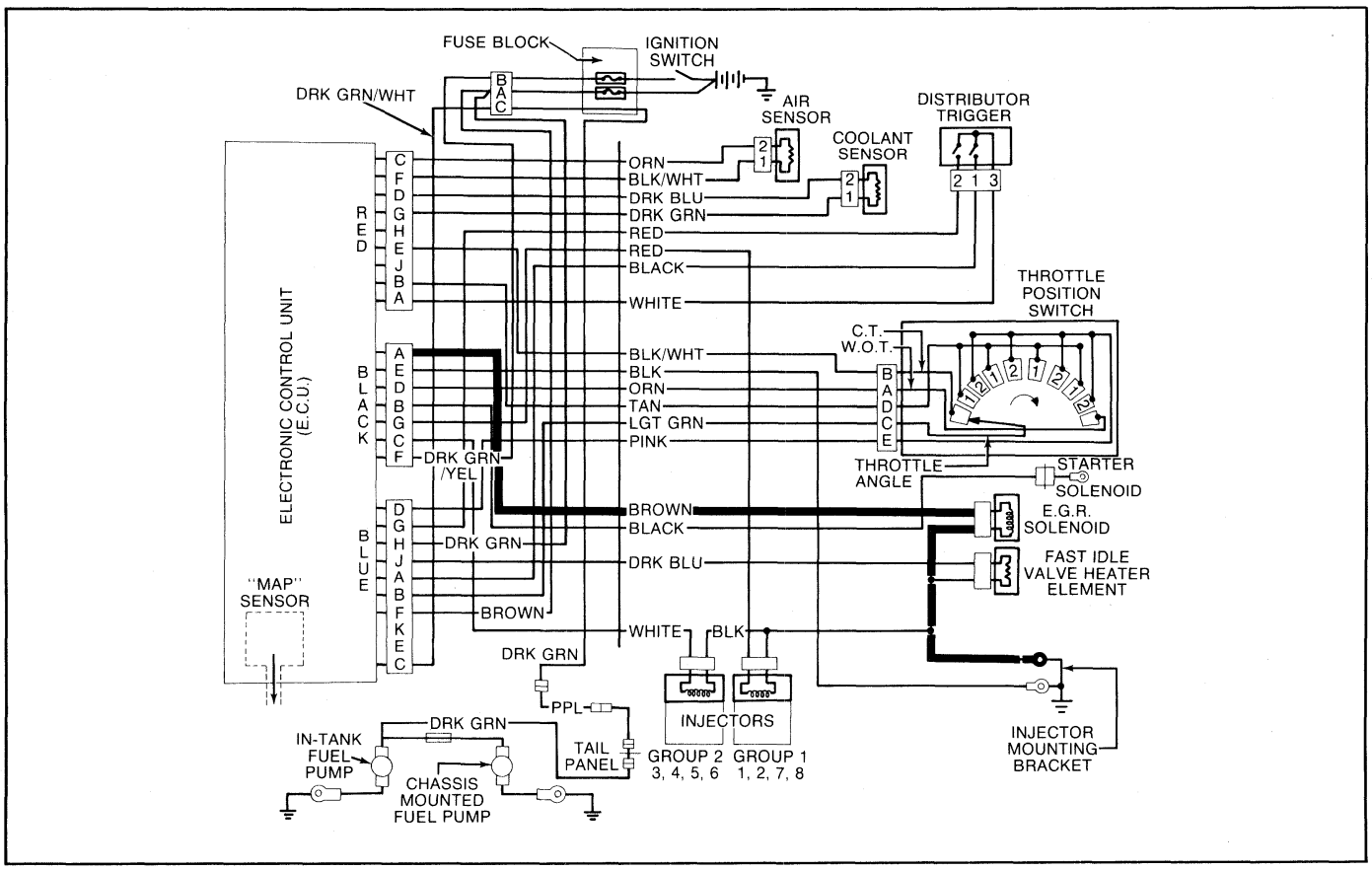


Fig. 6C-94 Step 6 Circuit - DeVille, Brougham

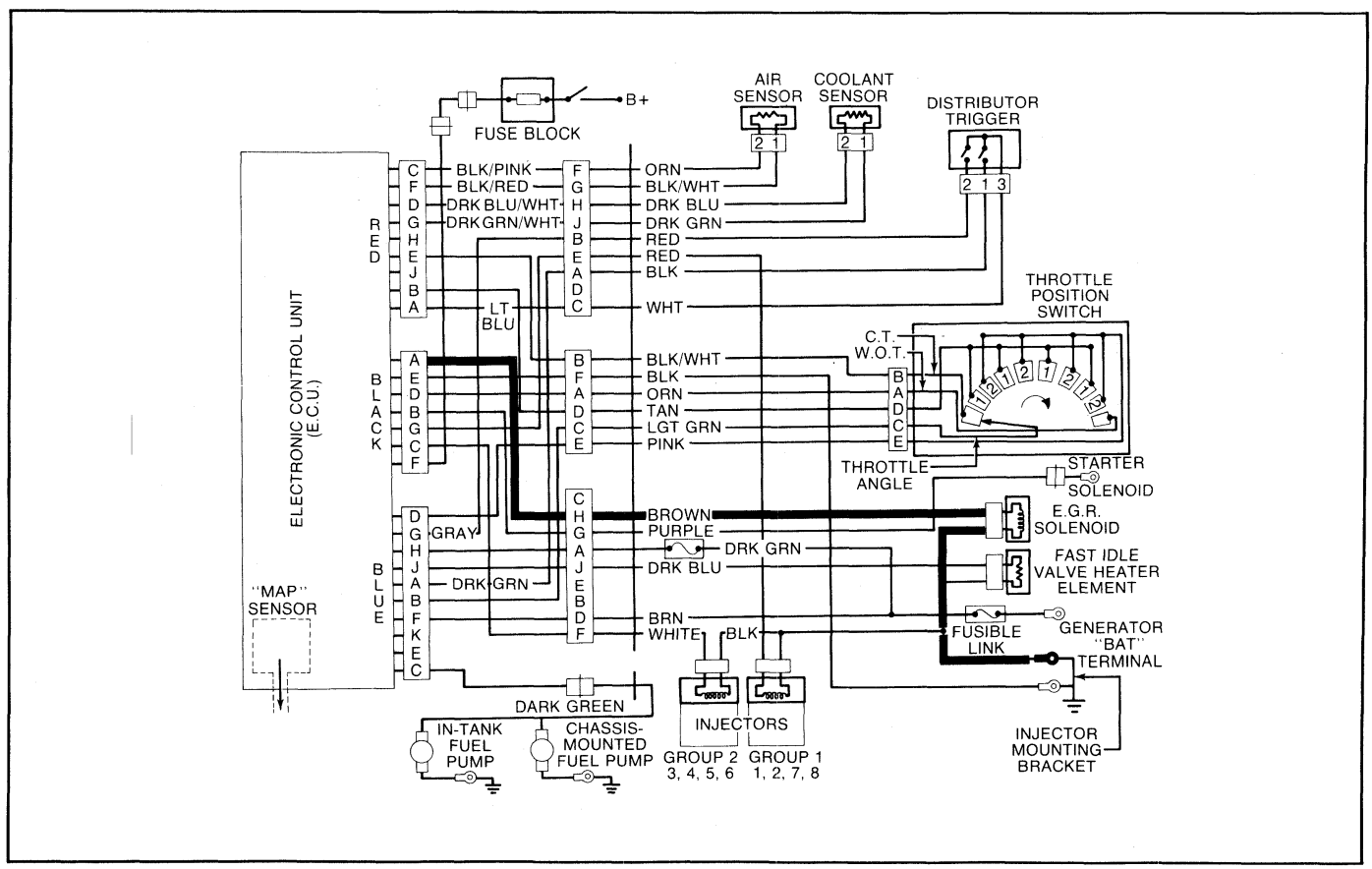


Fig. 6C-95 Step 6 Circuit - Eldorado

STEP 7. DISTRIBUTOR TRIGGER POINTS

A. Depress Analyzer Switch #7 and crank engine.

B. DISTRIBUTOR TRIGGER POINTS LIGHT 1 AND 11 should **blink alternately.**

1. If either lamp **fails to light** or **remains on,** replace speed sensor (distributor trigger). In case of car complaint, be sure to check for intermittent operation (malfunction) and lights not blinking on for equal lengths of time. Intermittent operation can be checked in Step 20.

2. If lights appear OK but engine quits or runs rough with A/C compressor off, replace speed sensor (425 engine only).

STEP 8.

Switch #8 is not used on Cadillac systems.

STEP 9. AIR TEMPERATURE SENSOR

A. Depress Analyzer Switch #9.

1. If DIGITAL METER reads **between 600 and 1600,** and is at a reasonable resistance for prevailing temperature as shown in Fig. 6C-96, proceed to Step #10.

2. If DIGITAL METER reads **more than 1600,** proceed to Part "B".

3. If DIGITAL METER reads **less than 600,** proceed to Part "C".

B. Disconnect Wiring Harness from Air Temperature Sensor and short the two Harness Terminals together.

1. If DIGITAL METER reads **less than .5,** replace Air Temperature Sensor. Retest after repair.

NOTE: A poor connection at the sensor connector can also cause a high resistance reading. Inspect connector before replacing sensor.

2. If DIGITAL METER reads **more than .5,** inspect orange and black/white (black/red on Seville) wires between sensor connector and ECU (jumper harness on Eldorado) for open circuit or poor connection, Fig. 6C-97 or 6C-98. Repair and retest.

C. Disconnect Wiring Harness from Air Temperature Sensor.

1. If OPEN CIRCUIT light comes **on,** replace Air Temperature Sensor. Repair and retest.

2. If OPEN CIRCUIT light remains **off,** inspect orange and black/white (black/red on Seville) wires between sensor connector and ECU (jumper harness on Eldorado) connector for short circuit, Fig. 6C-97 or 6C-98. Repair and retest.

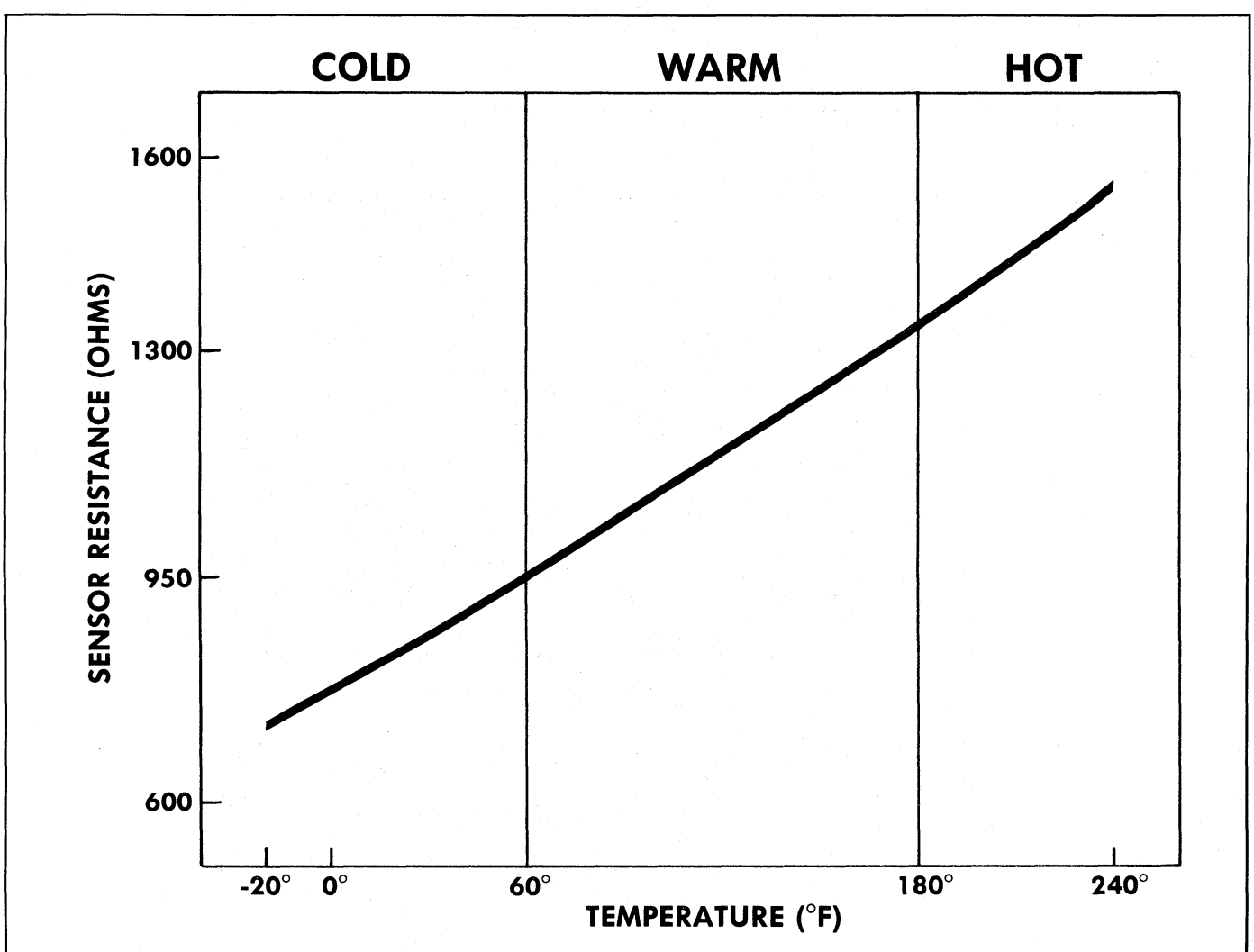


Fig. 6C-96 Sensor Resistance

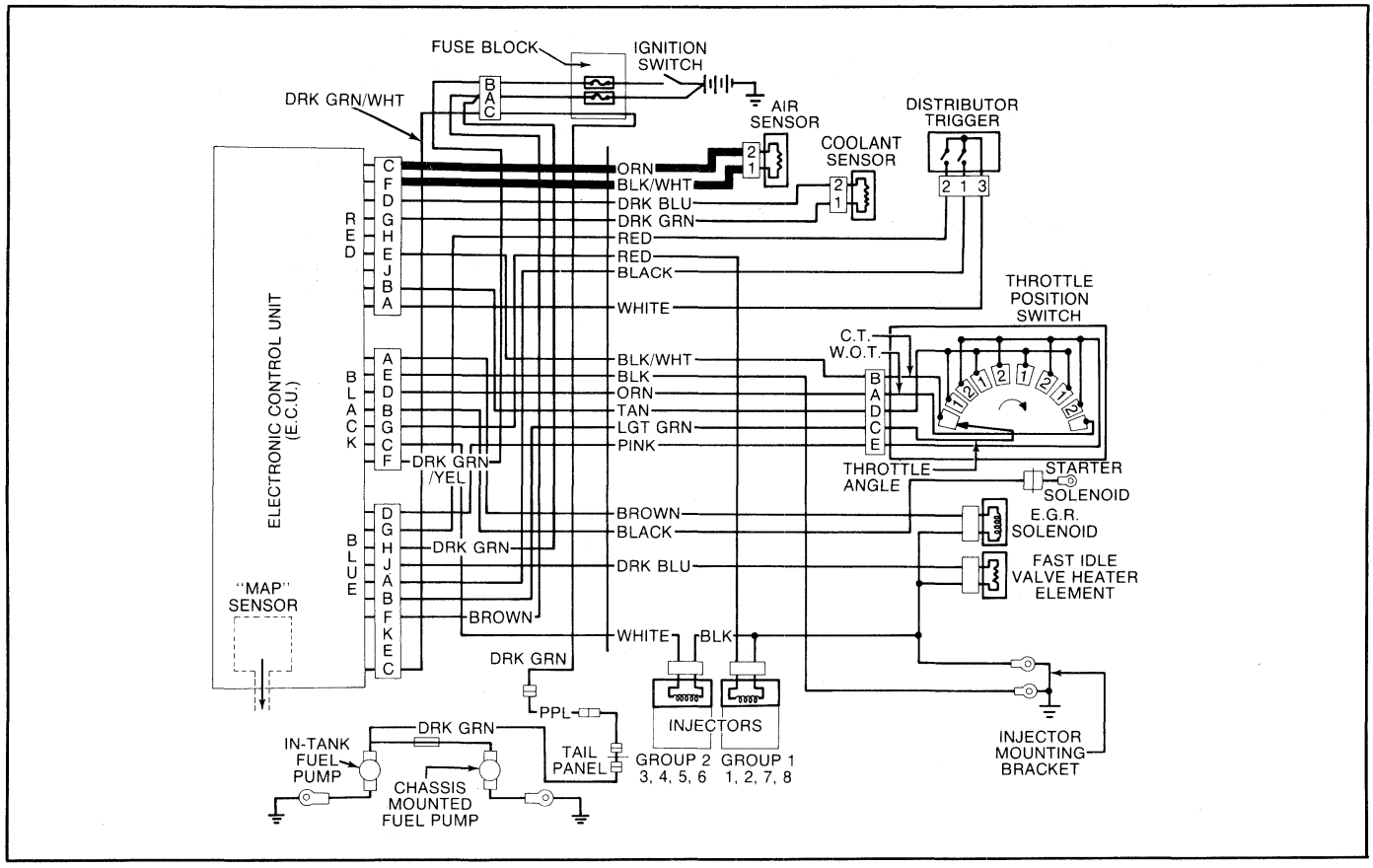


Fig. 6C-97 Step 9 Circuit - DeVille, Brougham

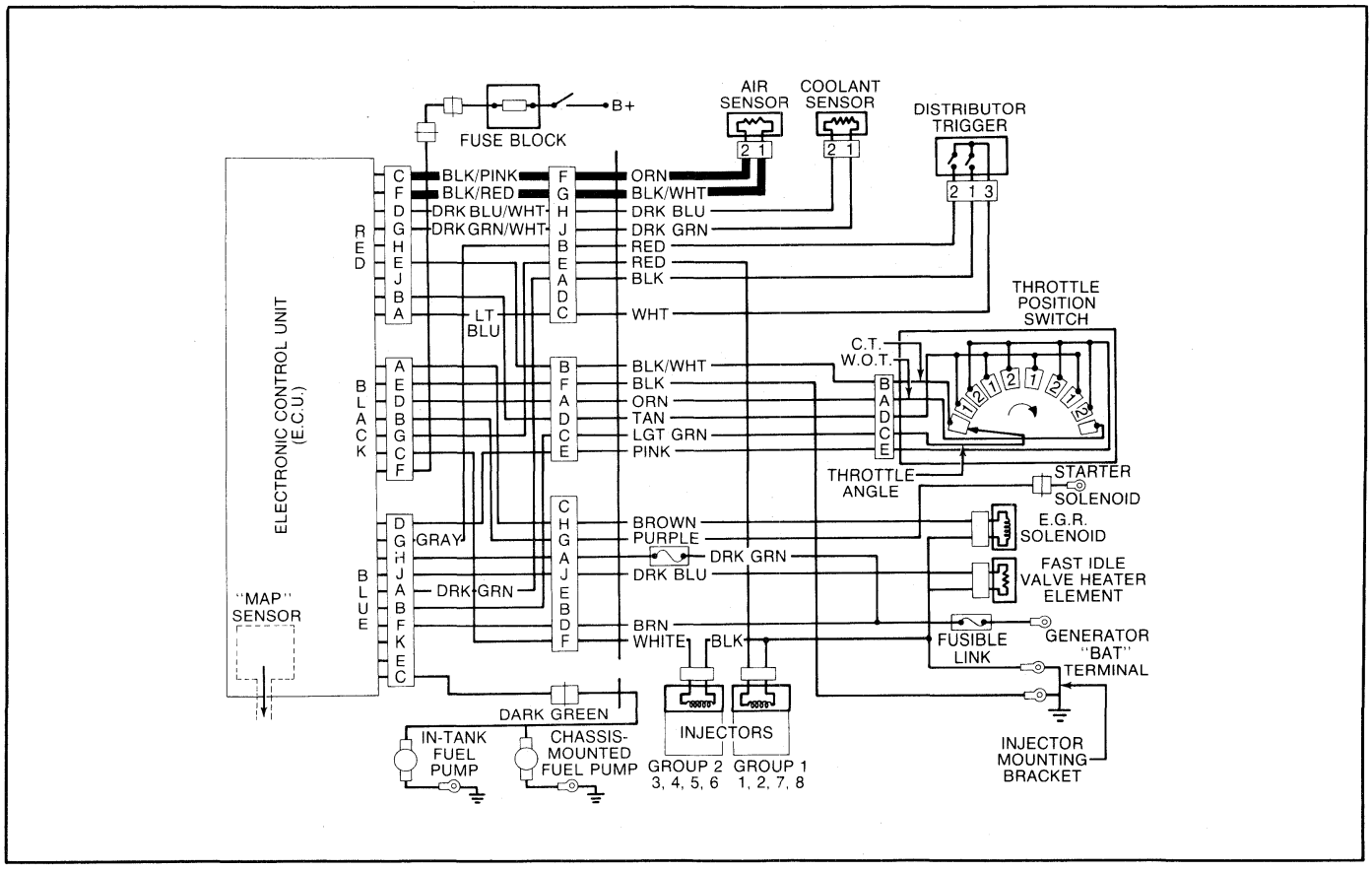


Fig. 6C-98 Step 9 Circuit - Eldorado (Typical of Seville)

STEP 10. COOLANT TEMPERATURE SENSOR

A. Depress Analyzer Switch #10.

1. If DIGITAL METER reads **between 600 and 1600,** and is at a reasonable resistance for prevailing temperature as shown in Fig. 6C-96, proceed to Step #11.

2. If DIGITAL METER reads **more than 1600,** proceed to Part "B".

3. If DIGITAL METER reads **less than 600,** proceed to Part "C".

B. Disconnect Wiring Harness from Coolant Temperature Sensor and short the two Harness Terminals together.

1. If DIGITAL METER reads **less than .5,** replace Coolant Temperature Sensor. Retest after repair.

NOTE: A poor connection at the sensor connector can also cause a high resistance reading. Inspect connector before replacing sensor.

2. If DIGITAL METER reads **more than .5,** inspect dark blue and dark green wires between sensor connector and ECU (jumper harness on Eldorado) for open circuit or poor connection, Figs. 6C-99 through 6C-101. Repair and retest.

C. Disconnect Wiring Harness from Coolant Temperature Sensor.

1. If OPEN CIRCUIT light comes **on,** replace Coolant Temperature Sensor. Repair and retest.

2. If OPEN CIRCUIT light remains **off,** inspect dark blue and dark green wires between sensor connector and ECU (jumper harness on Eldorado) connector for short circuit, Figs. 6C-99 through 6C-101. Repair and retest.

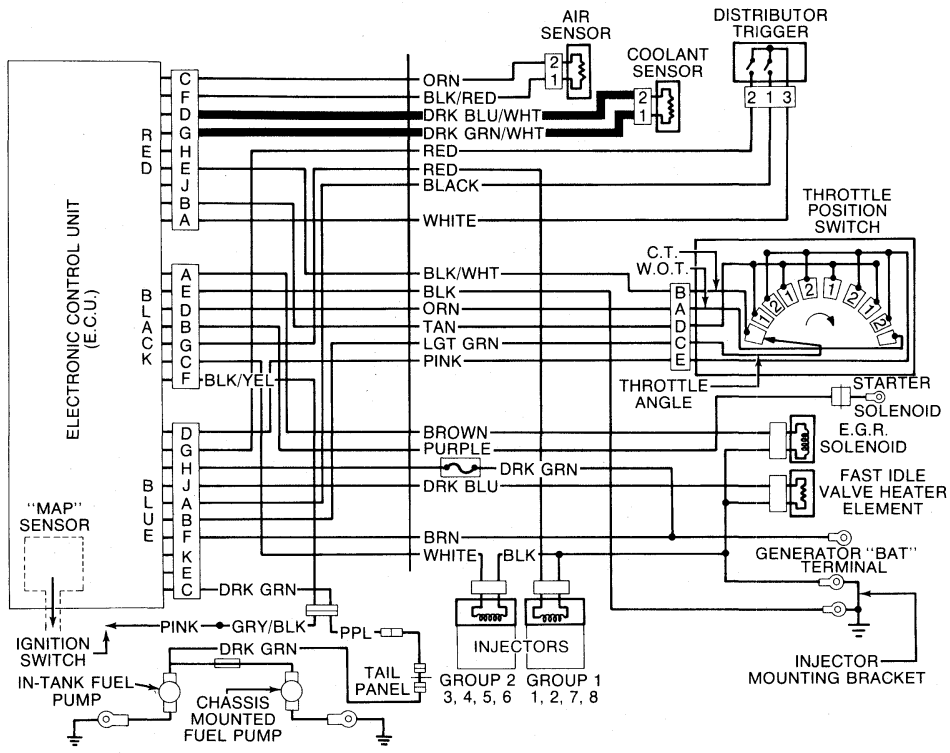


Fig. 6C-99 Step 10 Circuit - Seville

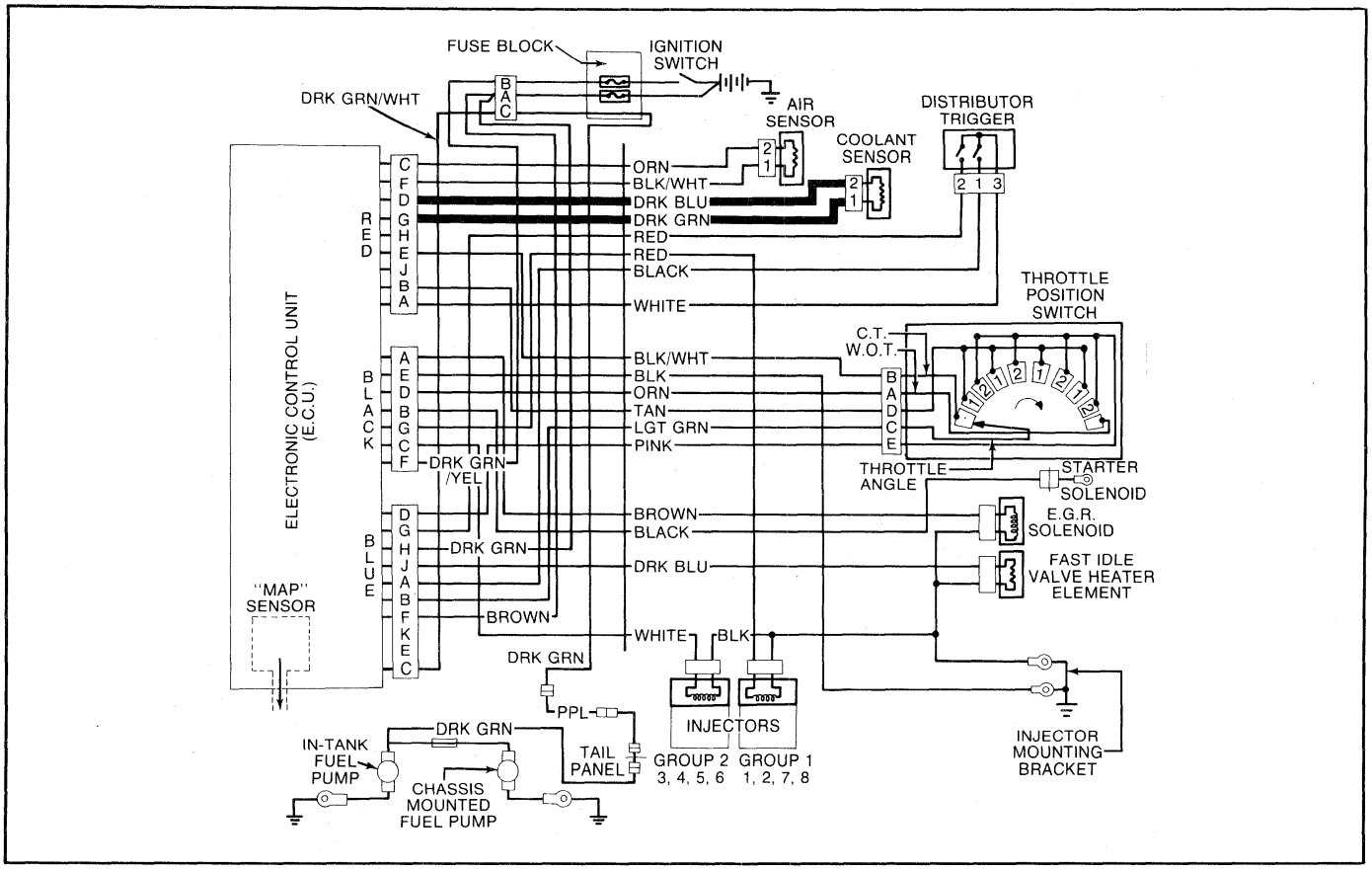


Fig. 6C-100 Step 10 Circuit - DeVille, Brougham

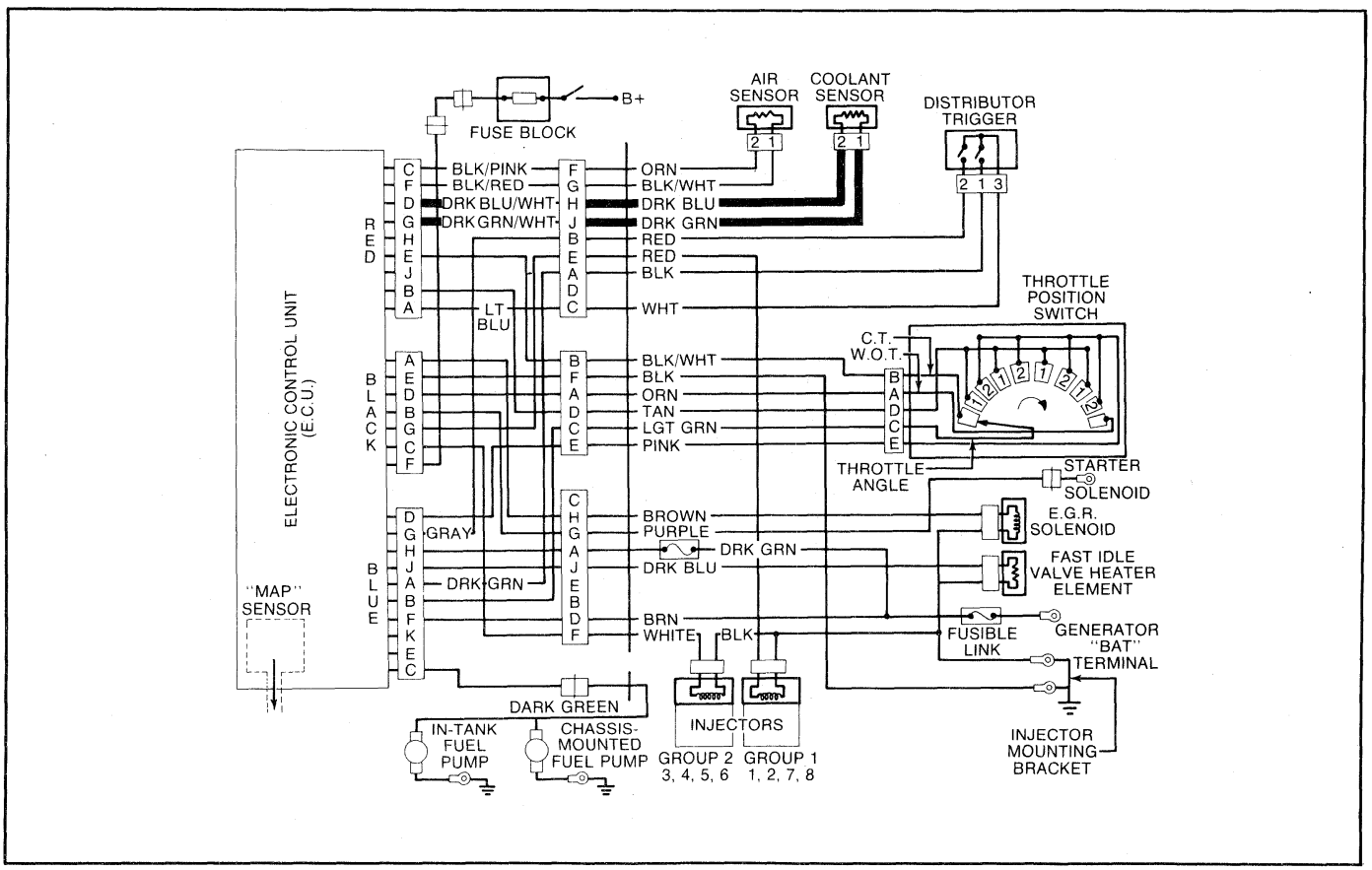


Fig. 6C-101 Step 10 Circuit - Eldorado

STEP 11. CLOSED THROTTLE SWITCH

A. Depress Analyzer Switch #11 and observe THROTTLE SWITCH lights.

B. With throttle closed, CLOSED light should be **on** and OPEN light should be **off.**

C. If lights operate properly, proceed to Part "D".

1. If CLOSED light is **off,** check to see that throttle is closing fully (linkage, cable, floor mat, etc.).

2. Connect a jumper between black/white and light green wires at Throttle Position Switch connector, Figs. 6C-102 through 6C-104.

a. If CLOSED LIGHT is now **on:**

1. Check Throttle Position Switch adjustment.
2. If adjustment is OK, replace switch.
3. Repair and retest.

b. If CLOSED light did not come on:

1. Inspect black/white and light green wires between Throttle Position Switch connector and ECU (jumper harness on Eldorado) for open circuit or poor connection, Figs. 6C-102 through 6C-104.
2. Repair and retest.

D. Open throttle slightly and observe THROTTLE SWITCH lights.

E. CLOSED light should be **off** and OPEN light should be **on.**

1. If lights operate properly, proceed to Part "F".
2. If OPEN light remains **off:**

a. Disconnect connector at Throttle Position Switch.

b. If OPEN light comes **on:**

1. Check adjustment of Throttle Position Switch.
2. If adjustment is OK, replace switch.
3. Repair and retest.

c. If OPEN light remains **off,** inspect black/white and light green wires between Throttle Position Switch connector and ECU (jumper harness on Eldorado) for short circuit, Figs. 6C-102 through 6C-104. Repair and retest.

F. Slowly close throttle and observe THROTTLE SWITCH lights.

G. CLOSED light should be **on** and OPEN light should be **off.**

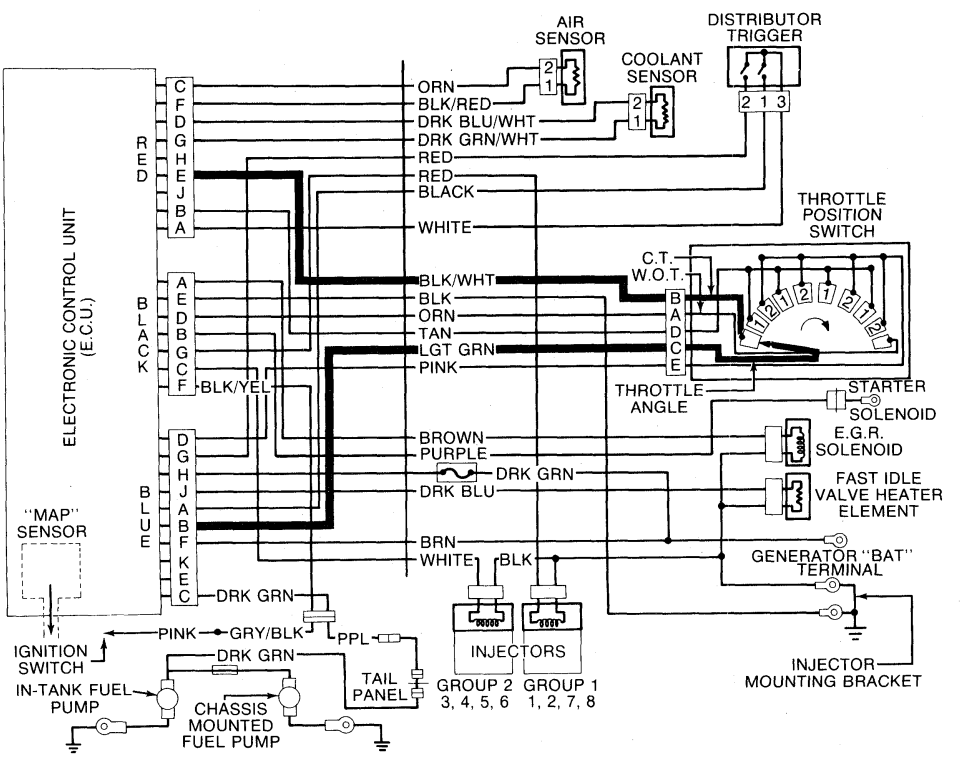


Fig. 6C-102 Step 11 Circuit - Seville

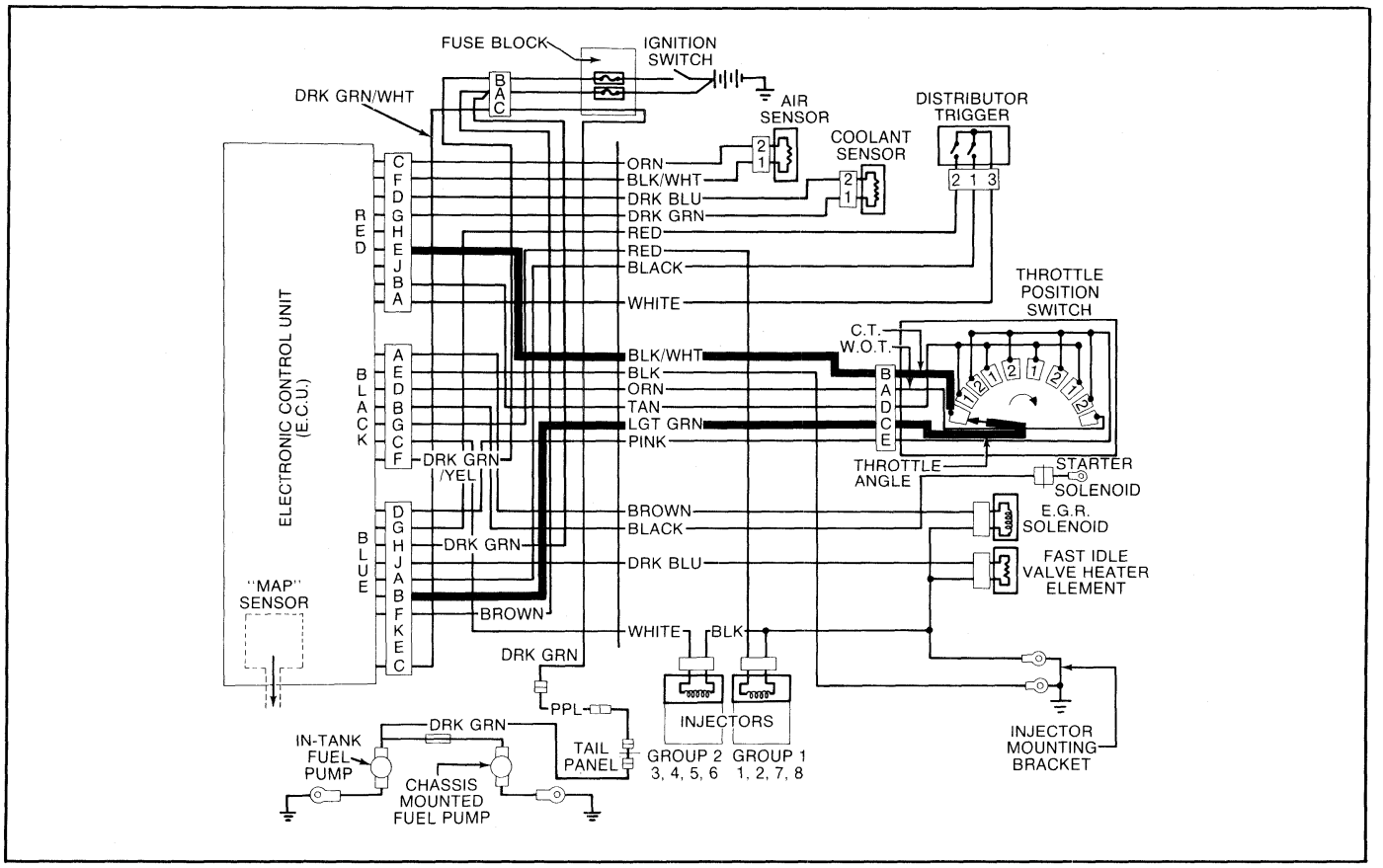


Fig. 6C-103 Step 11 Circuit - DeVille, Brougham

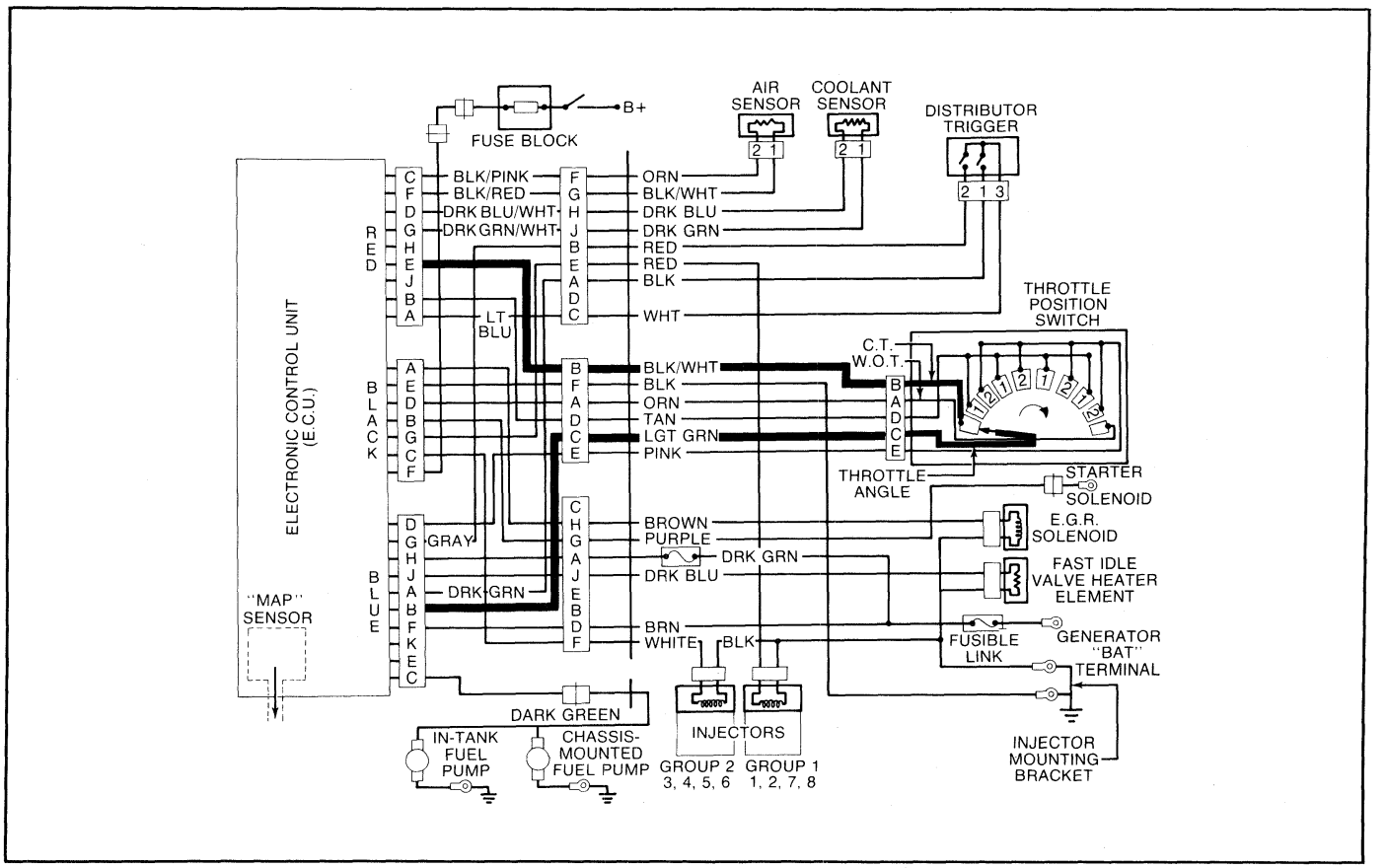


Fig. 6C-104 Step 11 Circuit - Eldorado

STEP 12. WIDE OPEN THROTTLE SWITCH

A. Depress Analyzer Switch #12 and observe THROTTLE SWITCH lights.

B. With throttle closed, CLOSED light should be **off** and OPEN light should be **on.**

1. If lights operate properly, go to Part "C".

2. If CLOSED light is **on,** disconnect Throttle Position Switch connector.

a. If light **goes out,** replace Throttle Position switch. Repair and retest.

b. If light is **still on,** inspect orange and light green wires between Throttle Position Switch connector and ECU (jumper harness on Eldorado) for short circuit, Figs. 6C-105 through 6C-107. Repair and retest.

C. With throttle held wide open, CLOSED light should be **on** and OPEN light should be **off.**

1. If lights operate properly, proceed to Step 13.

2. If CLOSED light is **off,** connect a jumper between the orange and light green wires at the Throttle Position Switch connector, Figs. 6C-105 through 6C-107.

a. If CLOSED light is **on,** check for misadjusted switch and binding or misadjusted linkage. If above checks are OK, replace Throttle Position switch and retest.

b. If CLOSED light is still **off,** inspect orange and light green wires between Throttle Position Switch connector and ECU (jumper harness on Eldorado) for poor connection or open circuit, Figs. 6C-105 through 6C-107. Repair and retest.

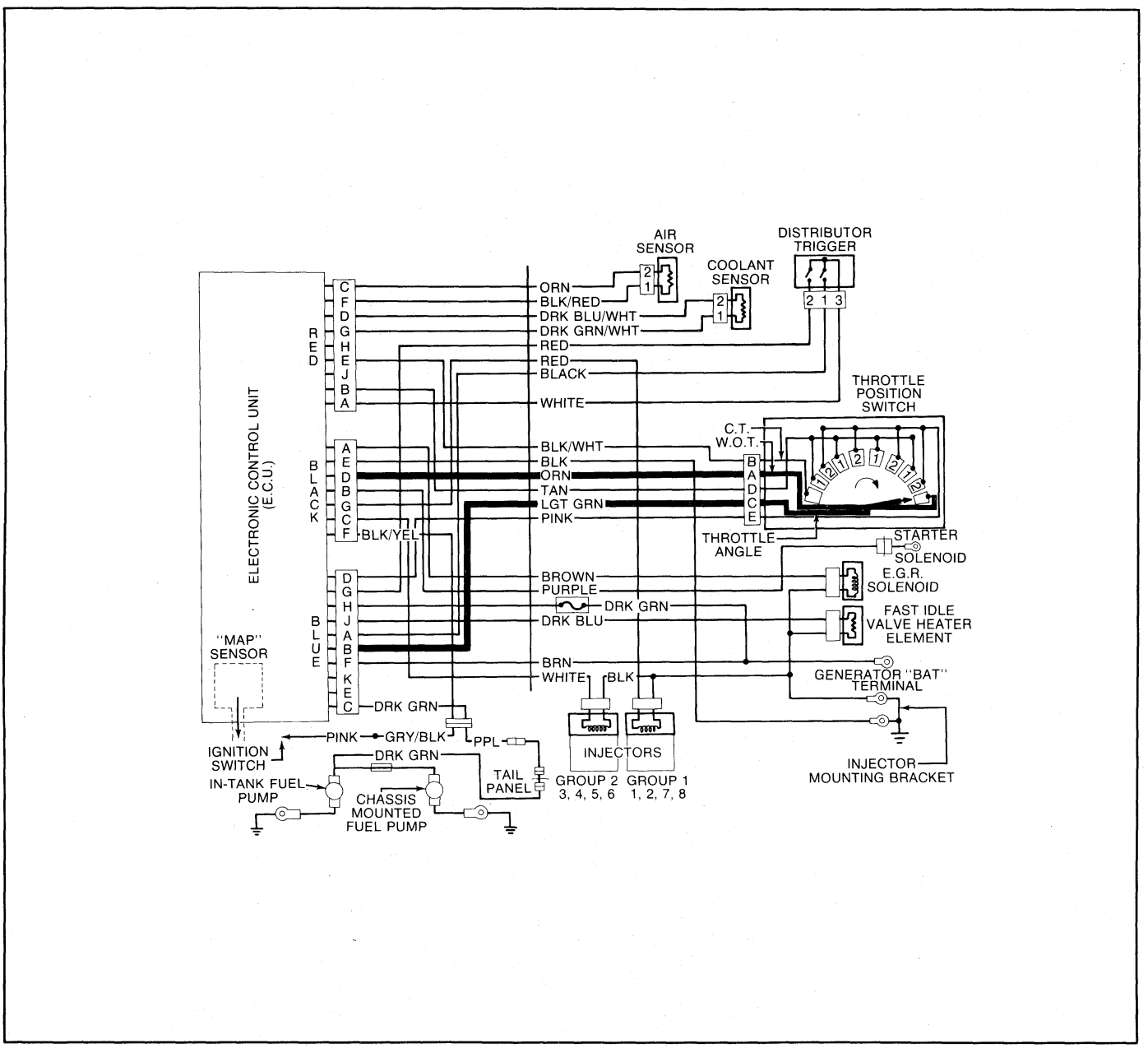


Fig. 6C-105 Step 12 Circuit - Seville

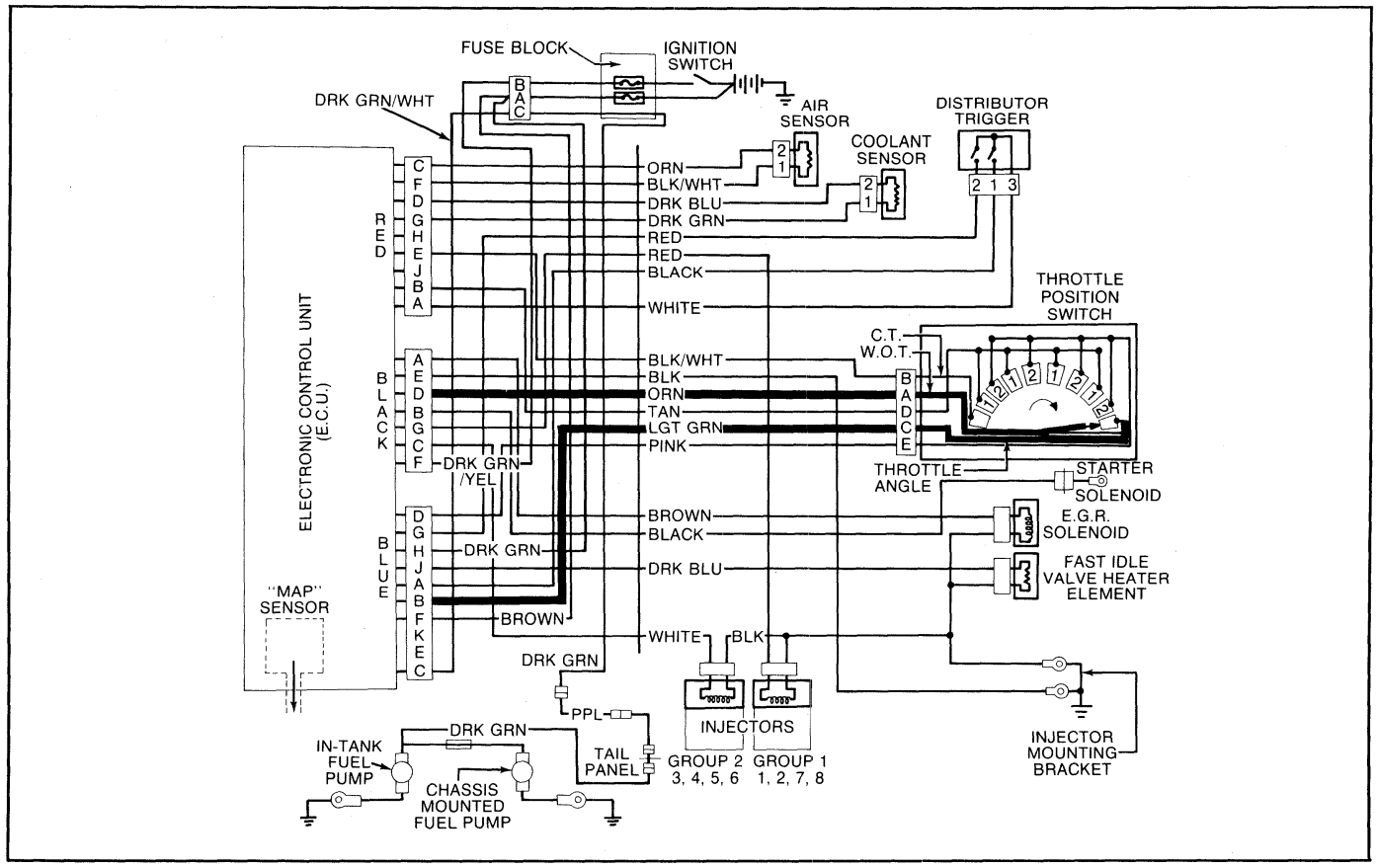


Fig. 6C-106 Step 12 Circuit - DeVille, Brougham

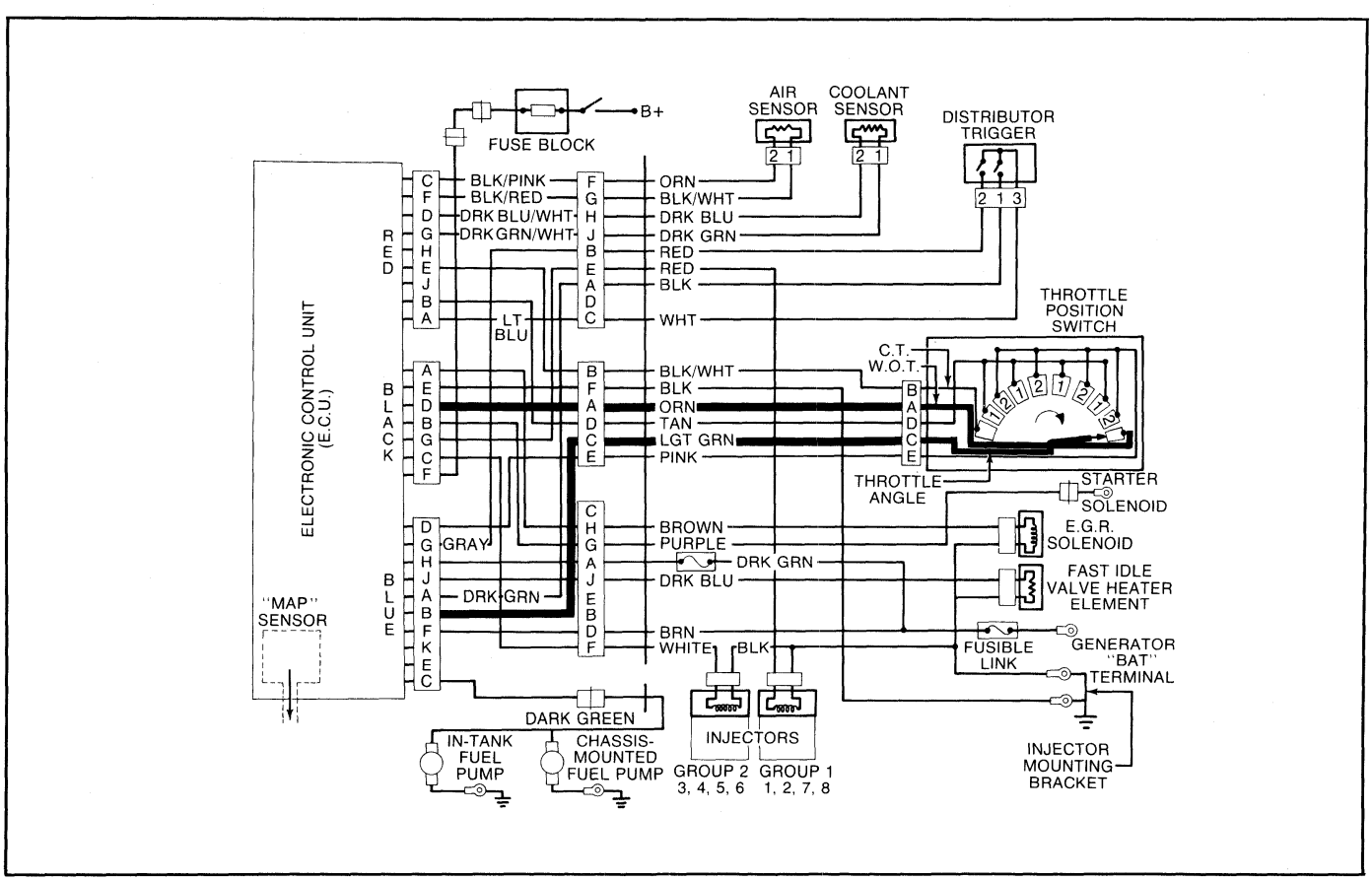


Fig. 6C-107 Step 12 Circuit - Eldorado

STEP 13. ACCELERATOR CONTACTS 1

A. Depress Analyzer Switch #13. THROTTLE SWITCH lights will alternately light as throttle is fully depressed. Number of accelerator contact switchings are displayed on the DIGITAL METER. As the throttle is returned to idle, no additional count should be observed. Throttle should be returned slowly to closed throttle position as accelerator pedal bounce might cause an erroneous reading. ("Press to calibrate" button can be used to zero the digital meter).

1. If DIGITAL METER reads **10,** proceed to Step 14.

2. If DIGITAL METER reading is **zero,**

a. Inspect tan and light green wires between Throttle Position Switch connector and ECU (jumper harness on Eldorado) for open circuit, Figs. 6C-108 through 6C-110.

b. If wiring is OK, replace Throttle Position Switch.

c. Repair and retest.

3. If DIGITAL METER reading is **not 10** (but greater than zero),

a. Check Throttle Position Switch adjustment.

b. If adjustment is OK, replace Throttle Position Switch.

c. Repair and retest.

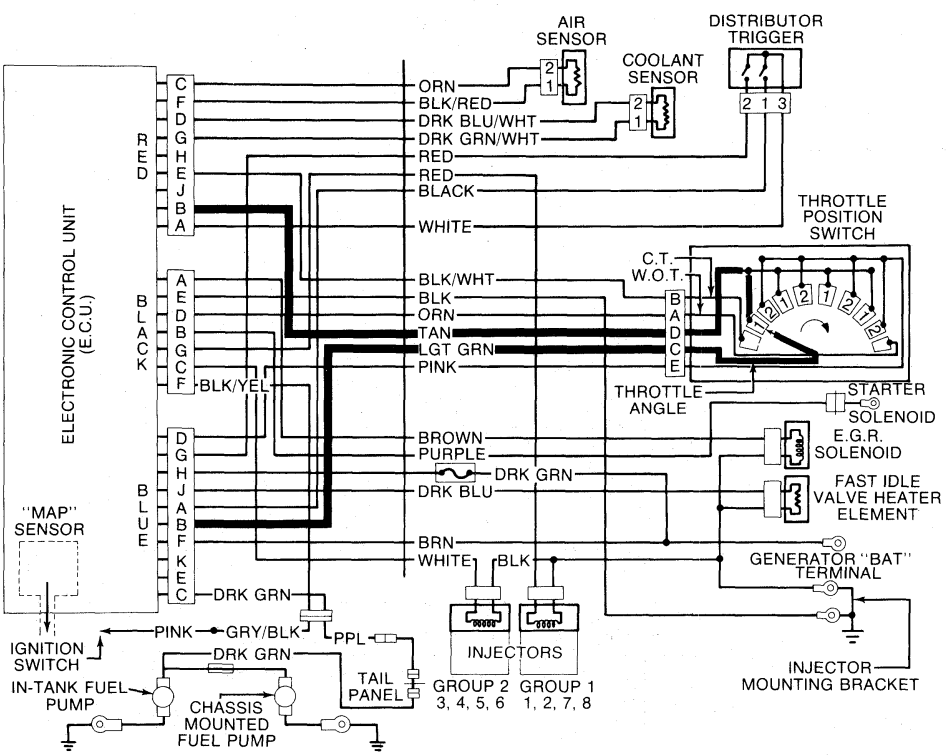


Fig. 6C-108 Step 13 Circuit - Seville

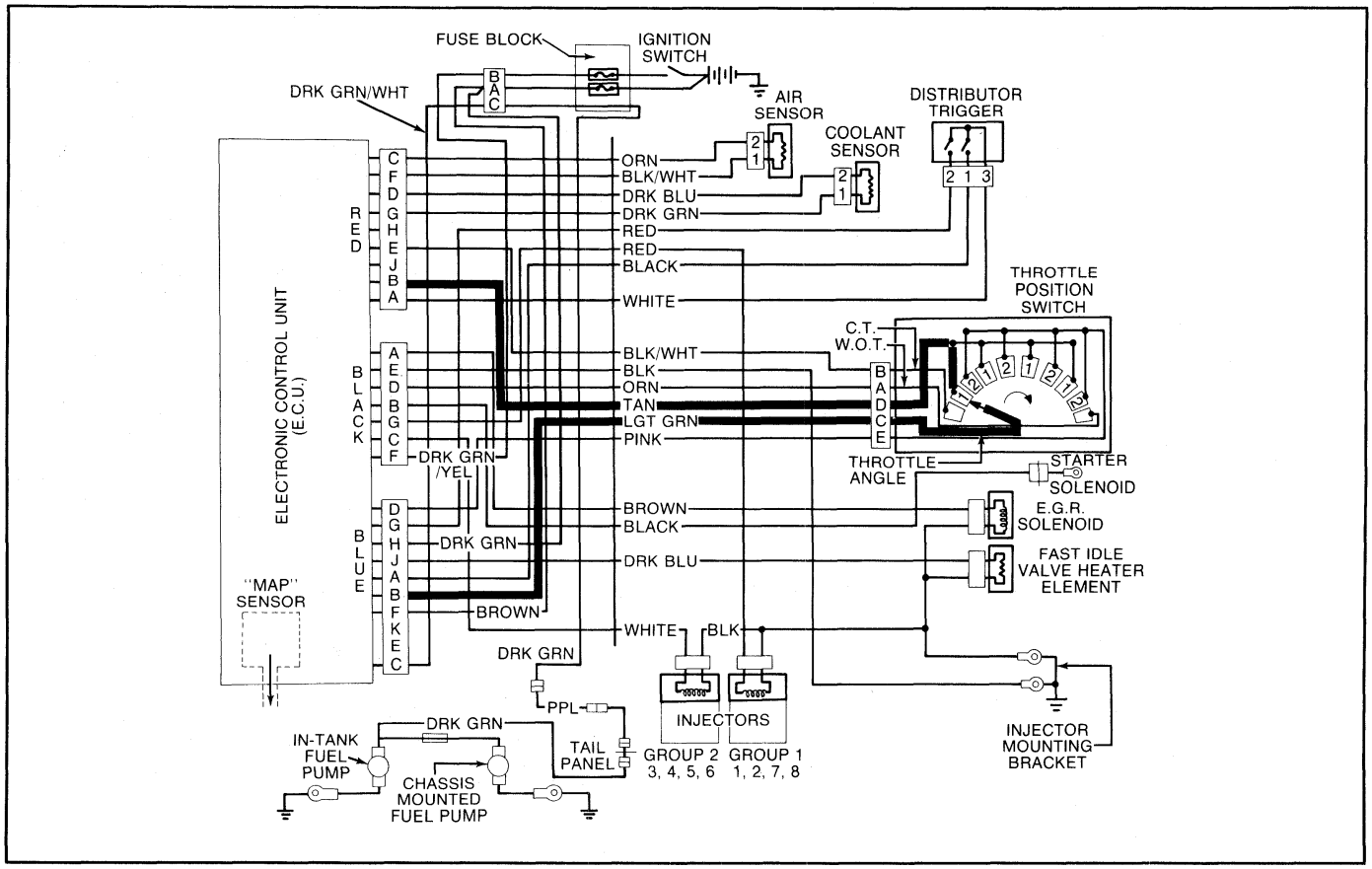


Fig. 6C-109 Step 13 Circuit - DeVille, Brougham

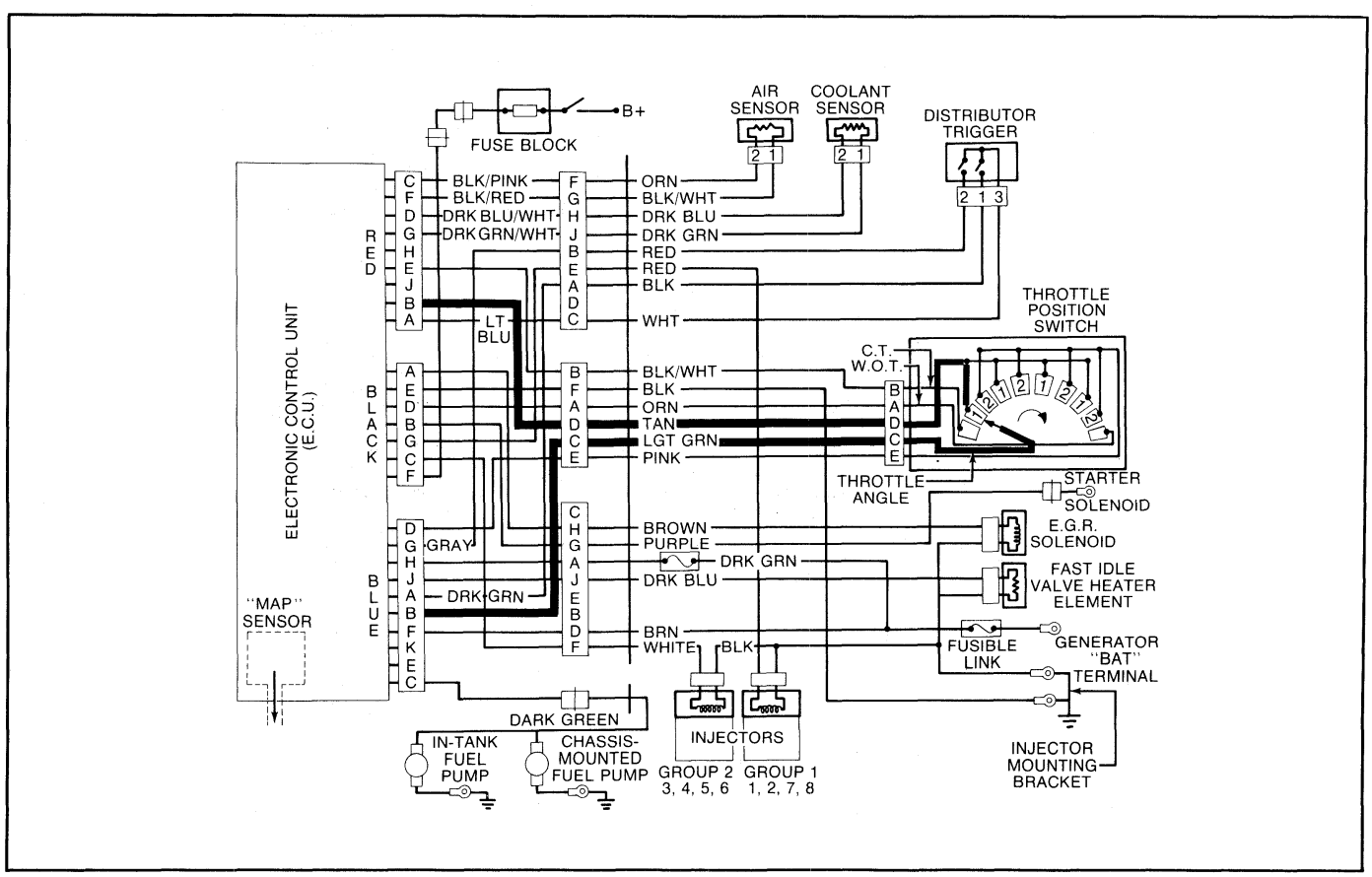


Fig. 6C-110 Step 13 Circuit - Eldorado

STEP 14. ACCELERATOR CONTACTS 2

A. Depress analyzer switch #14. THROTTLE SWITCH lights will alternately light as throttle is fully depressed. Number of accelerator contact switchings are displayed on the DIGITAL METER. As the throttle is returned to idle, no additional count should be observed. Throttle should be returned slowly to closed throttle position as accelerator pedal bounce might cause an erroneous reading. ("Press to calibrate" button can be used to zero the digital meter).

1. If DIGITAL METER reads **10,** proceed to Step 17.
2. If DIGITAL METER reading is **zero.**

a. Inspect pink and light green wires between Throttle Position Switch connector and ECU (jumper harness on Eldorado) for open circuit, Figs. 6C-111 through 6C-113.

b. If wiring is OK, replace Throttle Position Switch.

c. Repair and retest.

3. If DIGITAL METER reading is **not 10** (but greater than zero),

a. Check Throttle Position Switch adjustment.

b. If adjustment is OK, replace Throttle Position Switch.

c. Repair and retest.

STEPS 15 and 16

Switches #15 and #16 are not used on Cadillac systems.

STEP 17. FUEL SYSTEM

A. Turn Car Ignition **off.**

B. Insert Pressure Gage J-25400-300 into fuel line by connecting to the relief fitting on the fuel rail.

FUEL SYSTEM INTEGRITY

C. Depress Analyzer Switch #17.

D. Turn Fuel Pump Switch to **momentary on** position. Check for leaks at pressure gage attachment. Turn Fuel Pump Switch **off.**

1. If fuel pumps operate, go to Part "E".
2. If fuel pumps do not operate, check POWER TO TESTER light.

a. If light is **on** but pumps do not operate, inspect 18 dark green wire between ECU (jumper harness on Eldorado) and chassis-mounted fuel pump for open circuit (wire should supply 12 volts to pump).

b. If wire is OK, replace chassis-mounted fuel pump.

c. If light is **off,** check 10 amp in-line fuse in car harness (all except "C" car) and 5 amp fuse in analyzer extender box. Replace blown fuse. If pumps now operate, proceed to Part "F". If fuses are OK but light is off, check fusible link and orange wire from generator (all except "C" car) or 20 amp gages-trans fuse ("C" car only). If fuse blows consistently, proceed to Step 3.

3. If fuse consistently blows, disconnect 14 dark green wire connector near ECU jumper harness, Figs. 6C-114 through 6C-116. Connect a test light or ohmmeter to car side of connector. If short circuit is indicated, proceed as follows:

a. Inspect dark green wire between connector and fuel pumps for cuts or pinched condition. Repair, retest and proceed to Part "E".

b. If dark green wire is OK, disconnect dark green wire at chassis-mounted fuel pump and retest at connector for short circuit.

c. If not shorted, replace chassis-mounted fuel pump and proceed to Part "E".

d. If still shorted, remove fuel tank and inspect dark green wire between chassis-mounted fuel pump and in-tank fuel pump for cuts or pinched condition. Repair and retest at connector for short circuit. If OK proceed to Part "E".

E. If 37-42 psi fuel pressure is indicated, proceed to Part "F". If fuel pumps operate but insufficient pressure is indicated, proceed as follows:

1. Check fuel level.

NOTE: Fuel gage float arm may hang-up on in-tank fuel pump resulting in erroneous fuel gage reading.

2. Pinch off rubber fuel return line at pressure regulator while pumps are actuated.

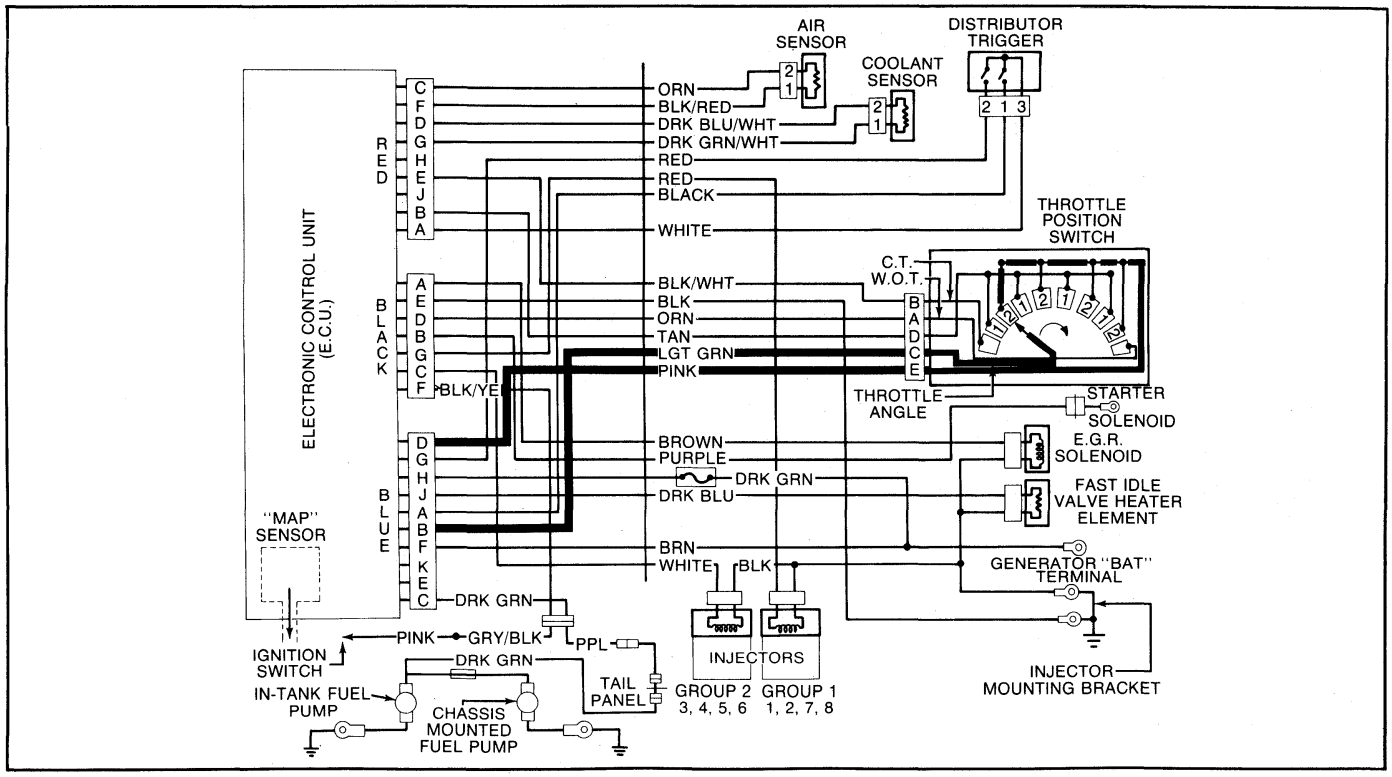


Fig. 6C-111 Step 14 Circuit - Seville

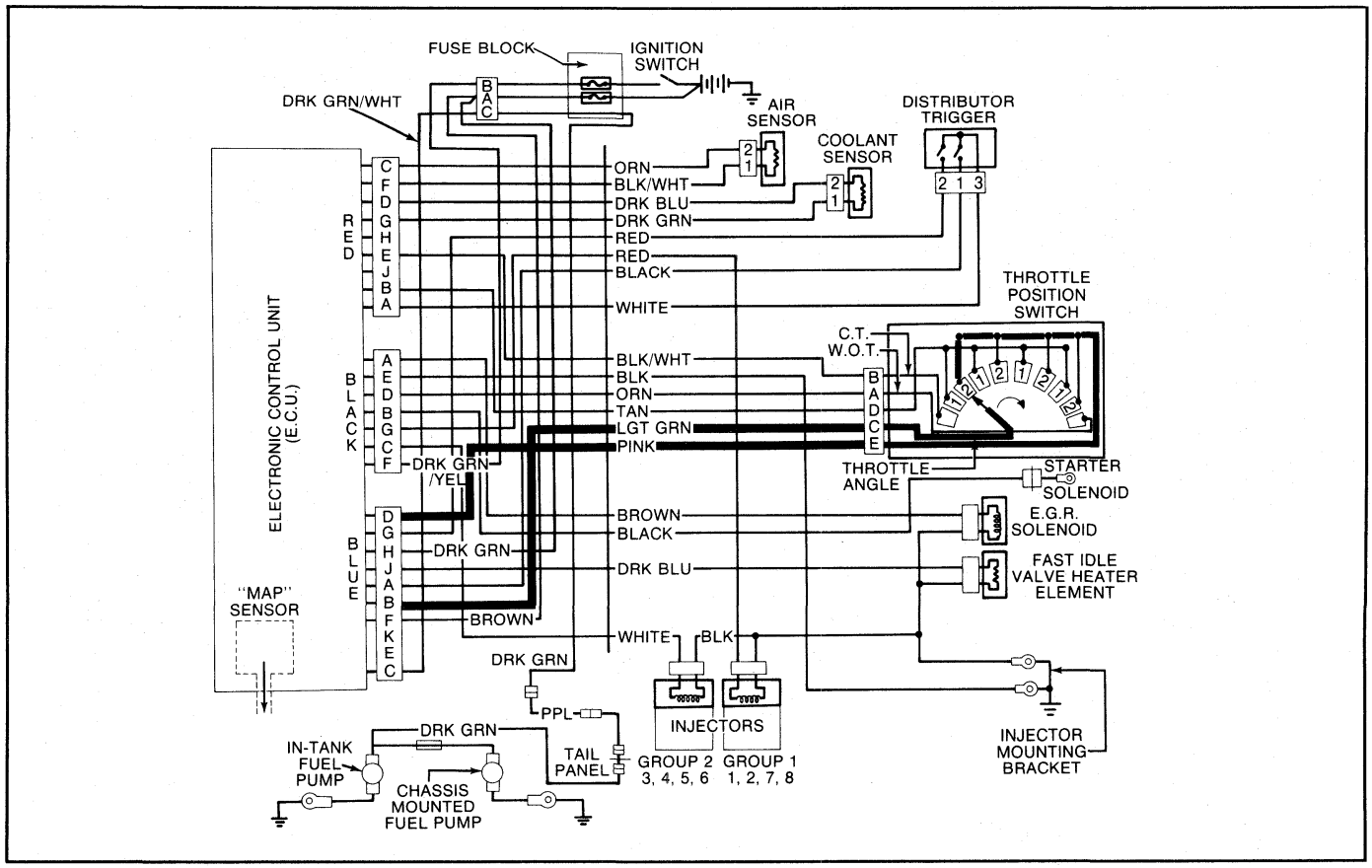


Fig. 6C-112 Step 14 Circuit - DeVille, Brougham

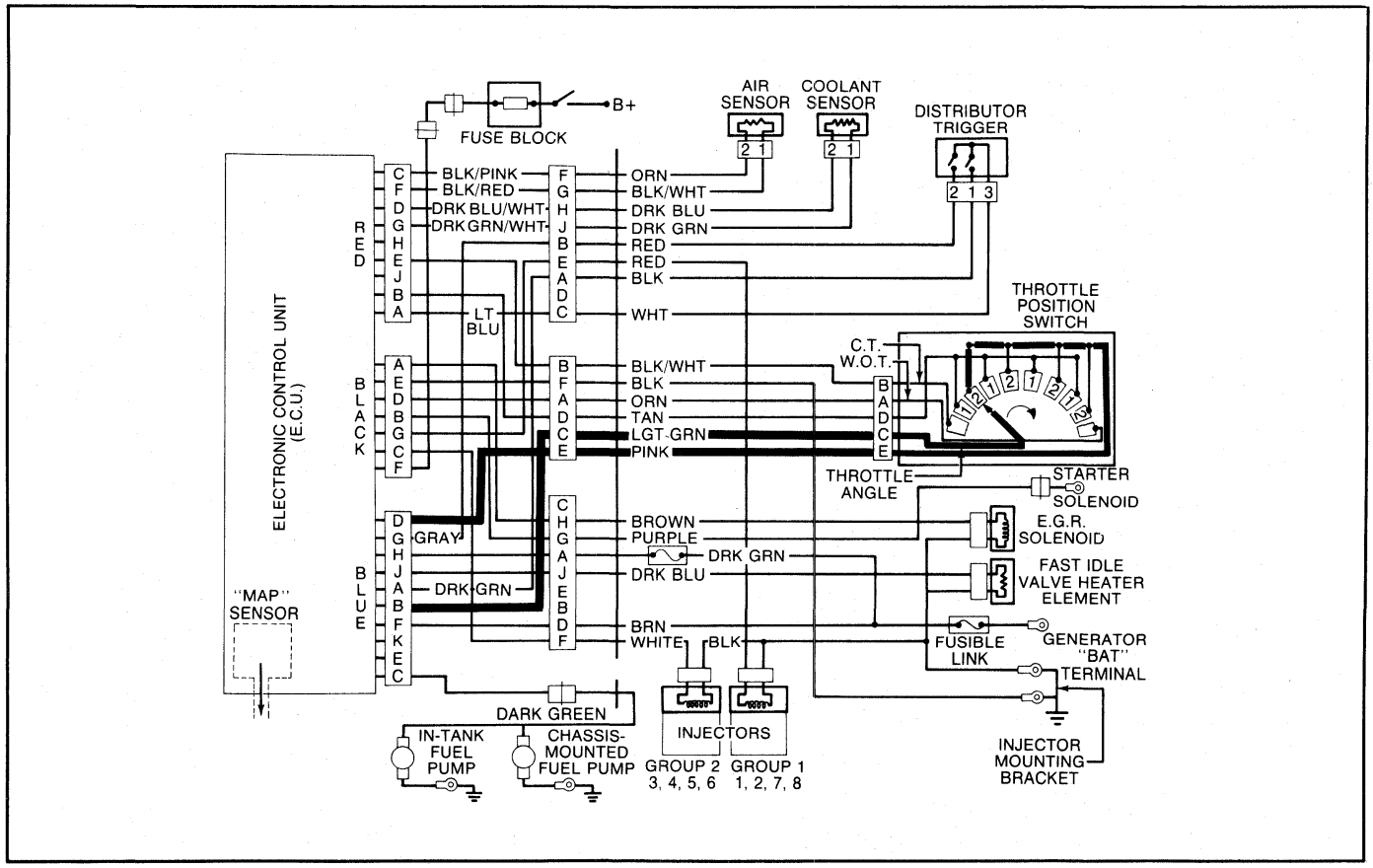


Fig. 6C-113 Step 14 Circuit - Eldorado

3. If PRESSURE GAGE reads **over 46 PSI,** replace fuel pressure regulator. Repair, retest and proceed to Part "F".

4. If PRESSURE GAGE reads less **than 46 PSI,** disconnect the fuel line at the chassis-mounted fuel pump inlet.

NOTE: Connect a length of rubber line to the fuel line and position at level higher than the fuel tank to prevent siphoning.

5. Position a container under the end of the fuel line and turn the analyzer Fuel Pump Switch to the LOCKED ON position.

6. If fuel is not pumped into the container and the fuel lines are not damaged or obstructed, proceed as follows:

a. Check for open circuit in dark green wire and between ECU and fuel pumps, Figs. 6C-111 through 6C-113.

b. If wire is okay, replace in-tank fuel pump.

c. Repair, retest and proceed to Part "F".

7. If fuel is pumped into container, reconnect the pump inlet and disconnect the pump outlet. Connect a hose between outlet and container.

8. Turn analyzer Fuel Pump Switch to LOCKED ON position.

9. If no fuel flow is evident, replace chassis-mounted fuel pump. Repair, retest and proceed to Part "F".

10. If fuel flow is evident, inspect the fuel line between the chassis-mounted fuel pump and the fuel filter for damage.

11. Replace fuel filter.

12. Repair, retest and proceed to Part "F".

F. Turn Analyzer Fuel Pump Switch to MOMENTARY ON position. Allow fuel pressure to stabilize and turn Fuel Pump Switch **off.** Observe FUEL PRESSURE gage.

1. **No drop** in fuel pressure indicates a "tight" fuel delivery system. Proceed to Part "G".

2. **Drop** in fuel pressure indicates a leak in the fuel system.

a. If fuel pressure decrease **more than 5 PSIG** in 2 minutes, pinch-off rubber fuel return line at fuel Pressure Regulator.

b. If fuel **pressure holds** with the line restricted, replace Pressure Regulator. Repair, retest and proceed to Part "G".

c. If fuel **pressure decreases,** restrict fuel delivery line by pinching-off rubber fuel line at fuel filter inlet.

d. If fuel **pressure holds** with line restricted, replace chassis-mounted fuel pump. Repair, retest and proceed to Part "G".

e. If **pressure decreases,** leave clamp on fuel pump line and install a second clamp at the rubber fuel return line at the fuel Pressure Regulator.

f. If fuel **pressure decreases,** inspect each spark plug and cylinder for wetness. If inconclusive remove fuel rails and inspect each intake port for fuel accumulation or excessively wet walls. Replace injector if this condition is observed. Remove accumulated fuel from cylinder(s). Repair, retest and proceed to Part "G".

PRESSURE REGULATOR TEST

g. If fuel pumps operate properly, proceed as follows:

1. Disconnect vacuum hose from Pressure Regulator and connect Vacuum Pump J-23738 or equivalent to Fuel Pressure Regulator.

2. Turn analyzer Fuel Pump Switch to **locked on** position.

3. Fuel pressure should be **36.75 to 41.75 PSIG with 0"HG;** if within specification, proceed to Part "H".

4. If pressure is **less than 36.75 PSIG,** pinch off rubber fuel return line at Pressure Regulator.

a. If fuel pressure is **41.75 PSIG or greater,** replace Pressure Regulator.

b. Repair and proceed to Part "H".

c. If fuel pressure is **less than 41.75 PSIG,** replace chassis-mounted fuel pump.

d. Repair, retest and proceed to Part "H".

5. If pressure is **greater than 41.75 PSIG,** disconnect rubber fuel return line from Pressure Regulator and position a container under the outlet fitting on the regulator. Turn the analyzer Fuel Pump Switch to the MOMENTARY ON position.

a. If pressure is **greater than 41.75 PSIG,** turn fuel pumps off and replace the Fuel Pressure Regulator. Repair, retest and proceed to Part "H".

b. If fuel pressure is **36.75 to 41.75 PSIG,** inspect fuel return line for damage. Repair, retest and proceed to Part "H".

h. Observe the FUEL PRESSURE GAGE while applying vacuum to the pressure regulator. The following readings should be observed:

Vacuum	Fuel Pressure
0" Hg.	36.75-41.75 P.S.I. GAUGE
5" Hg.	34.25-39.25 P.S.I. GAUGE
10" Hg.	32.0 -36.75 P.S.I. GAUGE
15" Hg.	29.5 -34.0 P.S.I. GAUGE
20" Hg.	27.0 -31.75 P.S.I. GAUGE

1. If values cannot be obtained, replace Pressure Regulator.

2. Repair, retest and proceed to Part "I".

3. Turn analyzer Fuel Pump Switch **off.**

4. Remove vacuum pump J-23738 and connect car vacuum hose to pressure regulator.

INJECTOR TEST

i. Turn Injector Selector Knob on analyzer to "**1**". Group 1 injectors (1, 2, 7 and 8) are tested in this position.

1. Disconnect electrical connector at injectors 2, 7 and 8. This isolates injector number 1.

2. Turn analyzer Fuel Pump Switch to MOMENTARY ON position allowing fuel pressure to stabilize.

3. Depress analyzer Push-To-Inject switch TWICE, and record pressure drop. (Number of injector pulses (20) will be displayed on DIGITAL METER).

4. Disconnect injector number 1 and connect injector number 2. This isolates injector number 2.

5. Repeat Parts "2", "3" and "4" for each injector in group.

6. Each injector should **drop 2-5 PSIG** and the pressure drop from each injector should be **within 1 PSI of the other 7 injectors.** Clean injector if out of specification. Repair, retest and proceed to Part "J".

j. Turn Injector Selector Knob on analyzer to "**2**". Group 2 injectors (3, 4, 5 and 6) are tested in this position.

1. Disconnect electrical connector at injectors 4, 5 and 6. This isolates injector number 3.

2. Turn analyzer Fuel Pump Switch to MOMENTARY ON position allowing fuel pressure to stabilize.

3. Depress analyzer Push To Inject switch TWICE and record pressure drop. (Number of injector pulses (20) will be displayed on DIGITAL METER).

4. Disconnect injector number 3 and connect injector number 4. This isolates injector number 4.

5. Repeat parts "2", "3" and "4" for each injector in group.

6. Each injector should **drop 2-5 PSIG** and the pressure drop from each injector should be **within 1 PSI** of the other 7 injectors. Clean injector if out of specification. Repair and retest.

7. Crank engine to exhaust excess fuel accumulated in test.

8. Remove Fuel Pressure Gage and install relief fitting cover.

STEP 18. SUBSTITUTE ECU

This step connects the car to a portion of the analyzer which contains a "skeleton" ECU. This provides manual control of pulse width to allow the car to be driven short distances in the event of problems in the ECU or connectors (or ECU jumper harness on Eldorado) which prevent the car from starting. Pulse width (fuel flow) is controlled manually by the INJECTION DURATION knob on the analyzer and must be changed as throttle opening changes. There are no automatic functions or compensations in this control unit.

A. Depress analyzer Switch #18.

B. Adjust INJECTION DURATION knob to 5-8.

C. Push ENRICHMENT SWITCH on extender box to Test 18 only position.

D. Turn analyzer Fuel Pump Switch to **locked on** position.

E. Depress accelerator **twice** to inject fuel for initial start-up.

F. Start engine adjusting INJECTION DURATION knob to the smoothest running position.

CAUTION: *Should not have to exceed injection duration setting of 8 during this test.*

G. Turn SYSTEM MONITOR KNOB TO **pulse width** to observe injector pulse duration readings on DIGITAL METER.

H. When finished, turn Car Ignition Switch **off.**

I. Turn analyzer Fuel Pump Switch **off.**

J. Turn ENRICHMENT SWITCH on extender box to all other tests position.

STEP 19. ECU FUNCTIONAL TEST

This test is a check of the ECU and ECU jumper harness only. Engine sensor signals, produced within the analyzer, are sent to the ECU. The ECU response to these signals are read on the analyzer DIGITAL METER.

A. Depress analyzer Switch #19.

NOTE: OPEN CIRCUIT light will be on during this step.

B. Turn car Ignition Switch **off.**

C. Connect the ECU Jumper Harness Connectors to the Analyzer Extender Harness as shown in Figs. 6C-78 through 6C-80. (Marked by *).

CAUTION: *On Eldorado do not connect the ECU harness to the fuel pump lead (dark green/yellow wire) at this time. Analyzer fuel pump light should be on during this test, but pumps should be off.*

D. Turn car Ignition Switch **on.**

1. Observe analyzer injector GROUP 1 AND GROUP 2 lights **blinking.**

b. If LIGHTS do **not blink** and complaint was that car would not start, replace ECU.

NOTE: If car runs properly hot or cold in STEP 20, **do not** replace ECU.

c. Repair and retest.

2. Allow some time for injector pulse width shown on DIGITAL METER to stabilize.

a. DIGITAL METER should read within the specifications on the appropriate chart on pages 6C-90 through 6C-95 for your altitude 0" Hg.

b. If OK, proceed to Step 3.

c. If DIGITAL METER reads out of specification, at 0" Hg. replace ECU.

d. Repair and retest.

3. Depress AIR TEMPERATURE SENSOR-COLD switch (simulates 0°F.).

a. DIGITAL METER should read within specifications on the appropriate chart on pages 6C-90 through 6C-95 for your altitude.

b. If OK, proceed to Step 4.

c. If out of specification replace ECU. Repair and retest.

4. Depress AIR TEMPERATURE SENSOR-WARM switch (simulates 70°F.).

a. DIGITAL METER should read within specifications on the appropriate chart on pages 6C-90 through 6C-95 for your altitude.

b. If OK, proceed to Step 5.

c. If out of specification, replace ECU. Repair and retest.

5. Depress ENGINE COOLANT TEMPERATURE SENSOR-COLD switch (simulates 0°F.).

a. DIGITAL METER SHOULD READ WITHIN SPECIFICATIONS ON THE APPROPRIATE CHART ON PAGES 6C-90 through 6C-95 for your altitude.

b. If OK, proceed to Step 6.

c. If out of specification, replace ECU. Repair and retest.

6. Depress ENGINE COOLANT TEMPERATURE SENSOR-WARM switch (simulates 70°F.).

a. DIGITAL METER should read within specifications on the appropriate chart on pages 6C-90 through 6C-95 for your altitude.

b. If OK, proceed to Step 7.

c. If out of specification, replace ECU. Repair and retest.

7. Depress ENGINE SPEED LOW switch and allow DIGITAL METER to stabilize (simulates 600 RPM).

a. DIGITAL METER should respond as shown in appropriate chart on pages 6C-90 through 6C-95.

b. If OK, proceed to Step 8.

c. If out of specification, replace ECU. Repair and retest.

8. Depress ENGINE SPEED HIGH switch (simulates 1700 RPM).

a. DIGITAL METER should respond as shown in appropriate chart on pages 6C-90 through 6C-95.

b. If OK, proceed to Step 9.

c. If out of specification, replace ECU. Repair and retest.

9. Attach Vacuum Pump J-23738 or equivalent into vacuum hose attached to ECU.

a. Pump vacuum to values on appropriate chart on pages 6C-90 through 6C-95 and observe readings on DIGITAL METER for altitude in your area.

b. If vacuum leakage is observed, check for vacuum leaks at vacuum pump, hoses or connections. If no leakage is found external to the ECU, replace ECU. Repair and retest.

c. If out of specification, replace ECU.

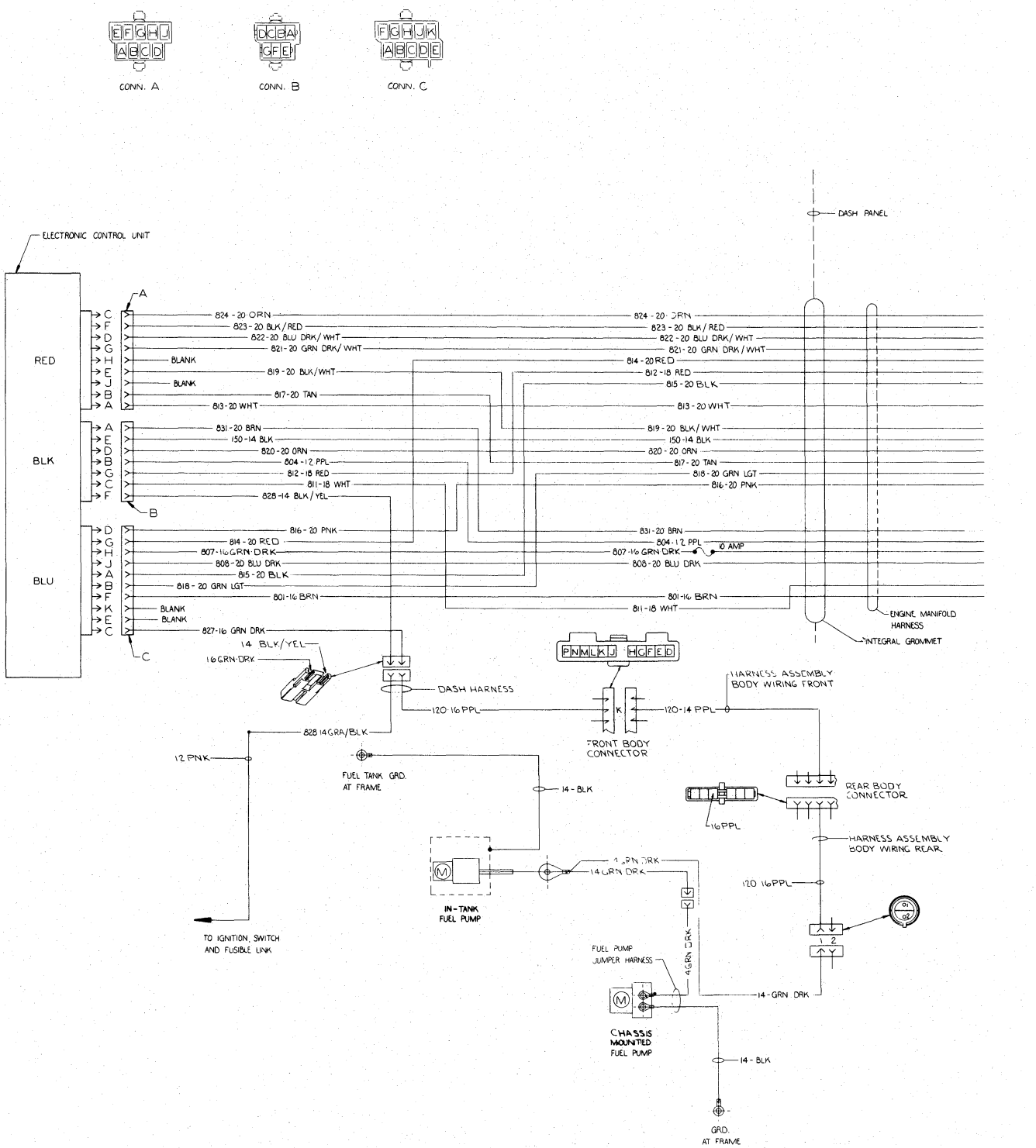


Fig. 6C-114 Circuit Diagram - Seville

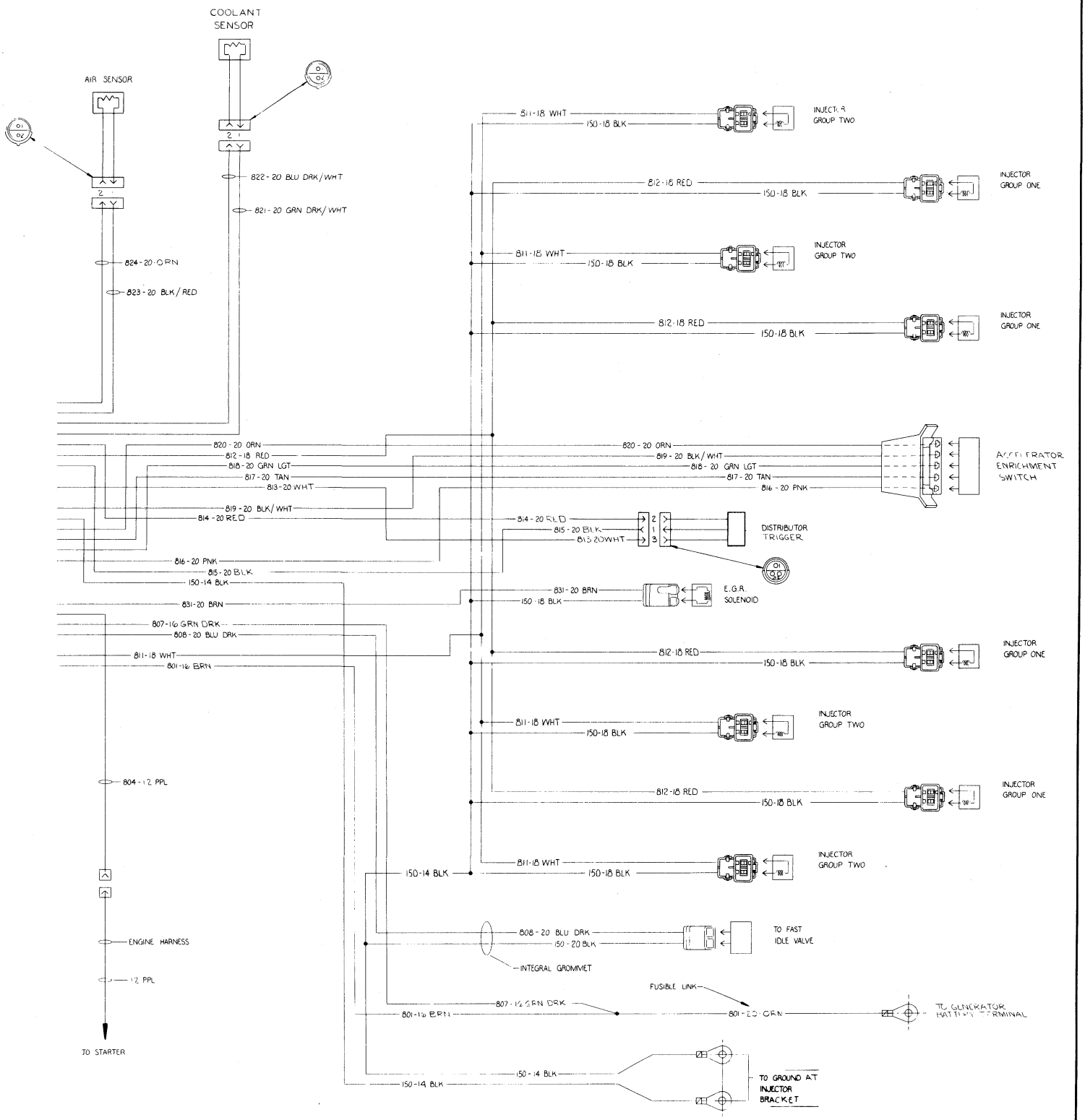


Fig. 6C-114 Circuit Diagram - Seville

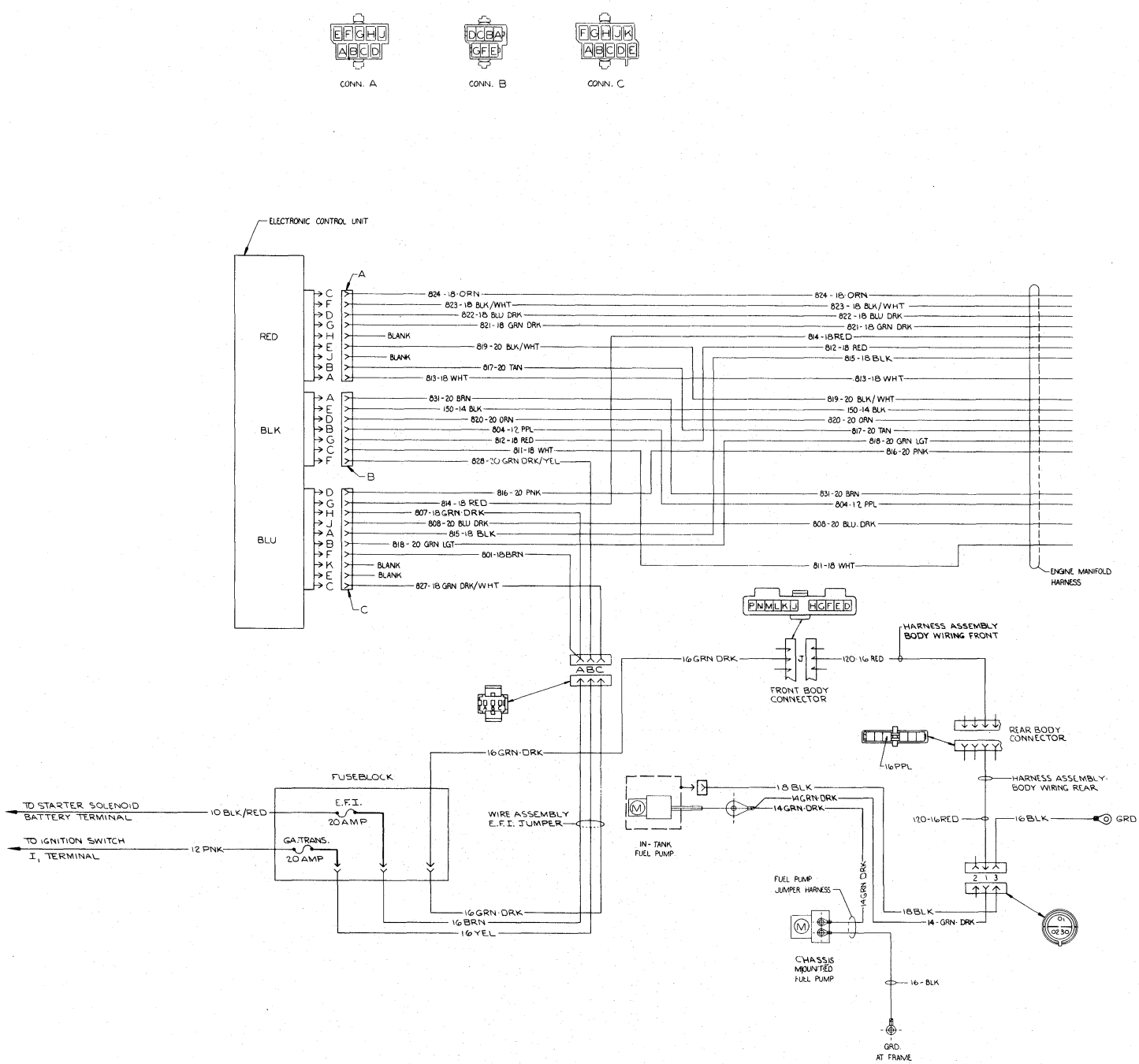


Fig. 6C-115 Circuit Diagram - DeVille, Brougham

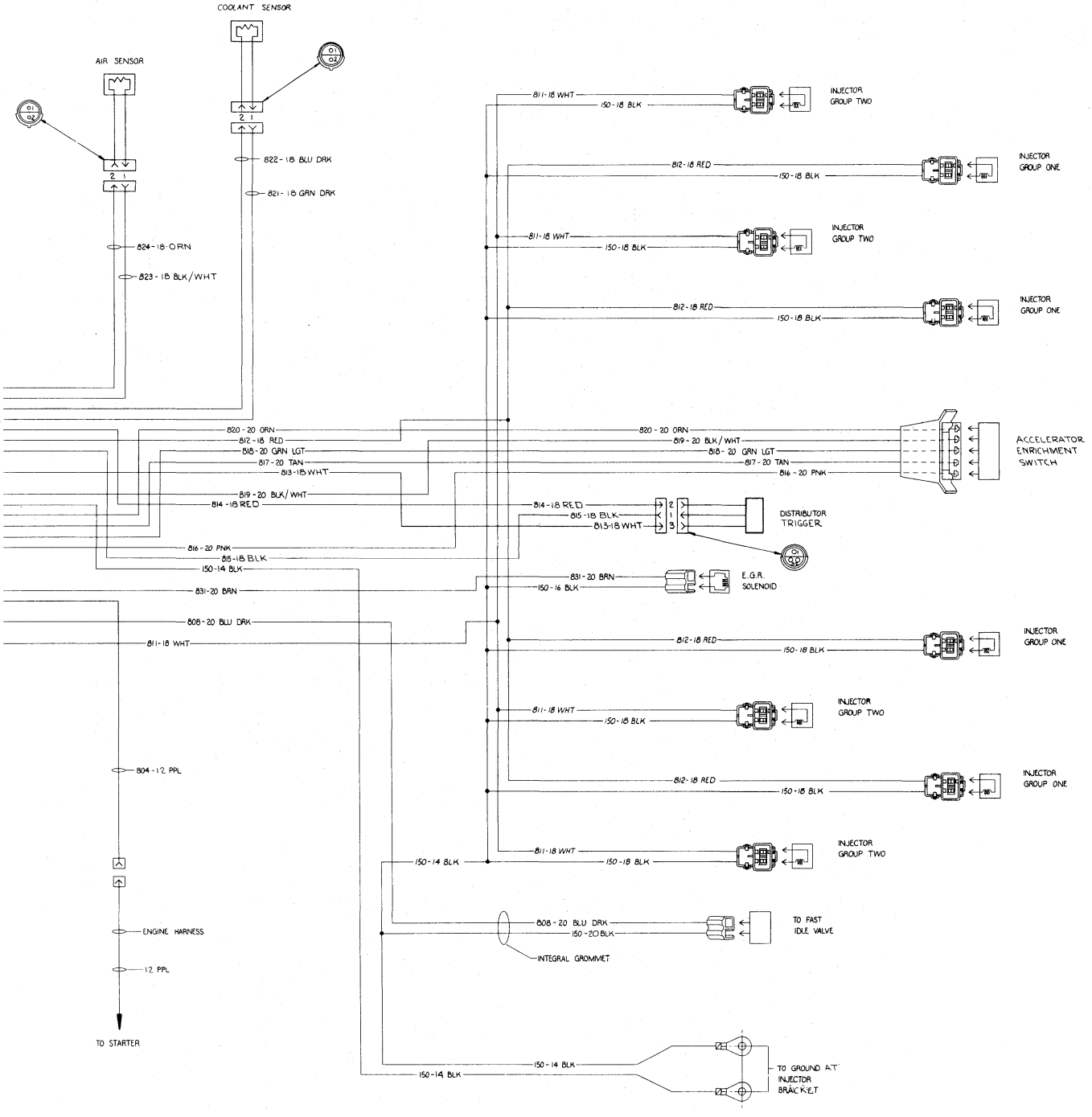


Fig. 6C-115 Circuit Diagram - DeVille, Brougham

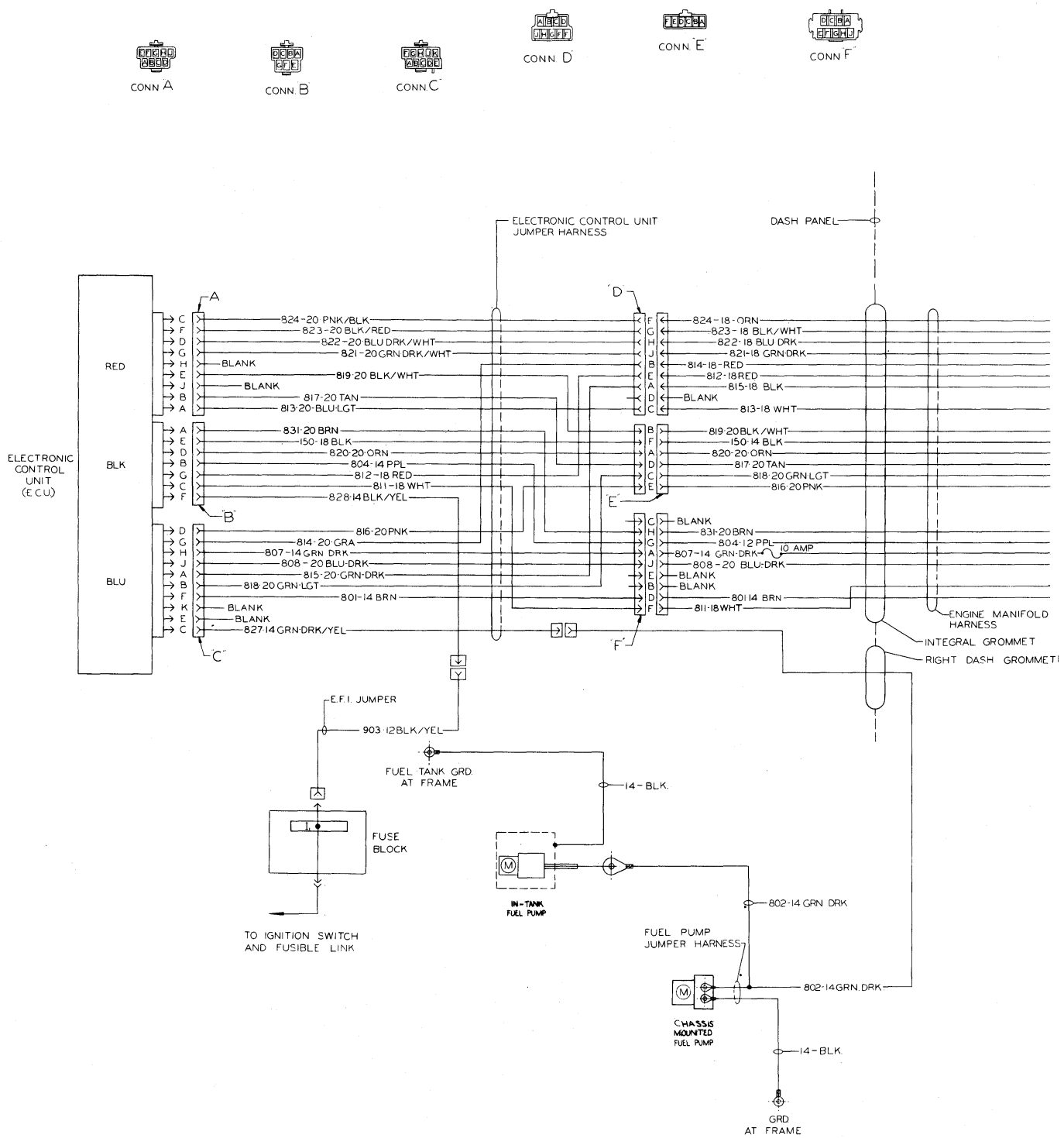


Fig. 6C-116 Circuit Diagram - Eldorado

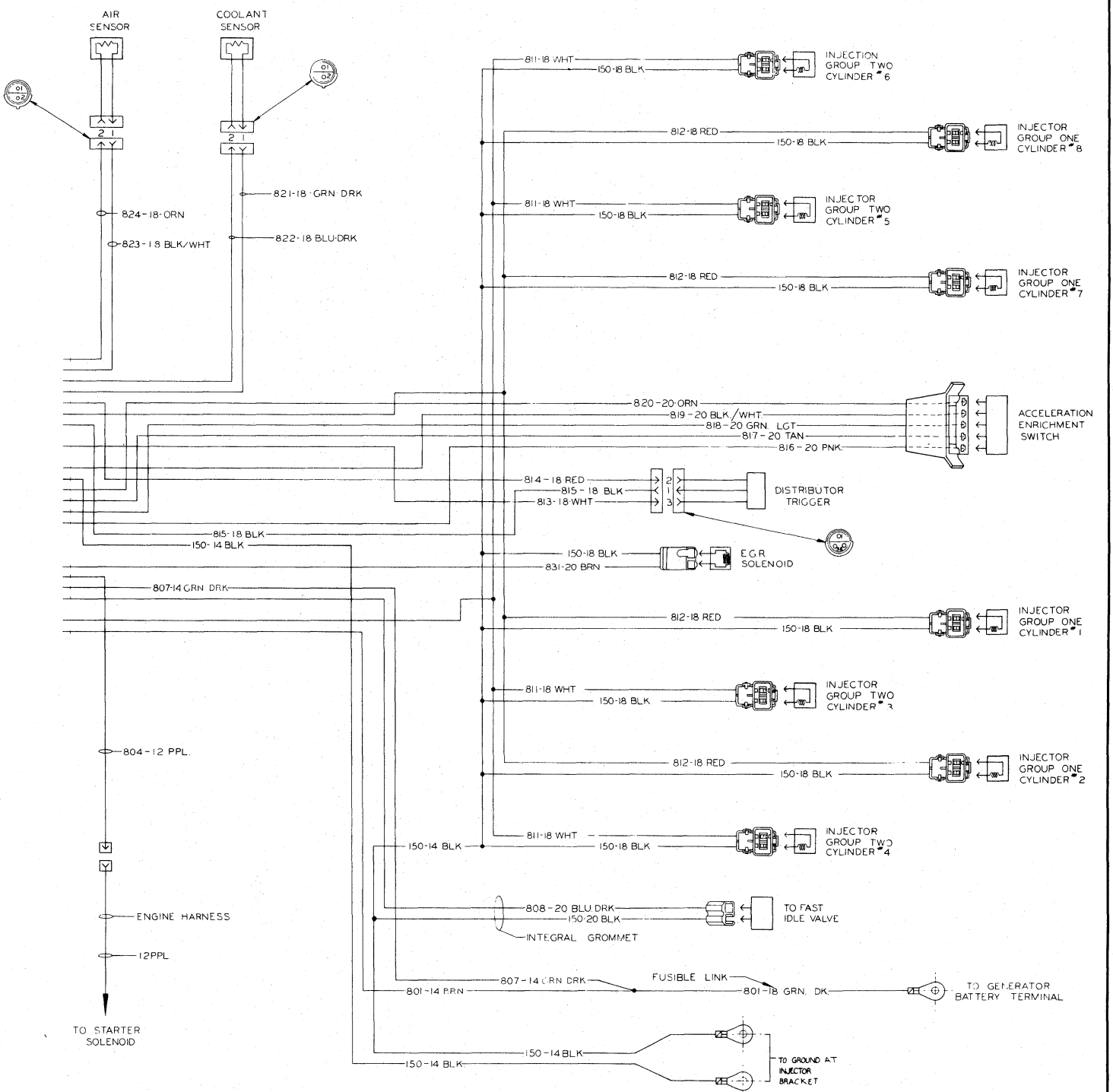


Fig. 6C-116 Circuit Diagram - Eldorado

DE VILLE, BROUGHAM — ALL (INCLUDING HIGH ALTITUDE) EXCEPT CALIFORNIA

VACUUM	SEA LEVEL	500 FT.	1,000 FT.	1,500 FT.	2,000 FT.	2,500 FT.	3,000 FT.	3,500 FT.	4,000 FT.	4,500 FT.	5,000 FT.
0"HG	11.1 TO 17.2	10.6 TO 19.5	10.1 TO 19.0	9.6 TO 18.5	9.1 TO 17.9	8.7 TO 17.4	8.2 TO 16.9	7.8 TO 16.4	7.3 TO 15.9	7.1 TO 15.4	6.9 TO 14.9
5" HG*	6.9 TO 12.1	6.7 TO 14.5	6.5 TO 14.0	6.3 TO 13.4	6.1 TO 12.9	5.9 TO 12.4	5.7 TO 11.9	5.6 TO 11.4	5.4 TO 10.9	5.3 TO 10.4	5.2 TO 9.9
10" HG*	5.2 TO 7.7	5.0 TO 9.5	4.9 TO 8.9	4.7 TO 8.4	4.6 TO 7.9	4.4 TO 7.3	4.3 TO 6.8	4.2 TO 6.4	4.0 TO 6.1	3.9 TO 5.9	3.8 TO 5.8
15" HG*	3.7 TO 5.8	3.6 TO 5.7	3.4 TO 5.5	3.3 TO 5.3	3.2 TO 5.2	3.0 TO 5.0	2.9 TO 4.9	4.7 OR LESS	4.6 OR LESS	4.4 OR LESS	4.3 OR LESS
20" HG*	4.3 OR LESS	4.2 OR LESS	4.0 OR LESS	3.8 OR LESS	3.7 OR LESS	3.5 OR LESS	3.4 OR LESS	3.2 OR LESS	3.1 OR LESS	2.9 OR LESS	2.8 OR LESS
AIR TEMP. SENSOR — COLD	12.7 TO 19.7	12.1 TO 22.4	11.5 TO 21.8	11.0 TO 21.2	10.4 TO 20.5	9.9 TO 20.0	9.4 TO 19.4	8.9 TO 18.8	8.3 TO 18.3	8.1 TO 17.7	7.9 TO 17.1
— WARM	11.8 TO 18.3	11.2 TO 20.8	10.7 TO 20.2	10.2 TO 19.7	9.6 TO 19.1	9.2 TO 18.5	8.7 TO 18.0	8.3 TO 17.5	7.7 TO 16.9	7.5 TO 16.4	7.3 TO 15.9
COOLANT TEMP. SENSOR — COLD	23.8 TO 37.0	22.7 TO 41.9	21.7 TO 40.9	20.6 TO 39.8	19.5 TO 38.5	18.7 TO 37.4	17.6 TO 36.3	16.7 TO 35.3	15.6 TO 34.2	15.2 TO 33.1	14.8 TO 32.0
— WARM	16.8 TO 26.1	16.1 TO 29.6	15.3 TO 28.9	14.5 TO 28.1	13.8 TO 27.2	13.2 TO 26.4	12.4 TO 25.7	11.8 TO 24.9	11.0 TO 24.2	10.7 TO 23.4	10.4 TO 22.6
ENG. SPEED — LOW	NO CHANGE TO 0.2 DECREASE										
— HIGH	±0.1 OR NO CHANGE										

VACUUM	5,500 FT.	6,000 FT.	6,500 FT.	7,000 FT.	7,500 FT.	8,000 FT.	8,500 FT.	9,000 FT.	9,500 FT.	10,000 FT.
0" HG	6.7 TO 14.5	8.2 TO 14.0	7.8 TO 13.5	7.4 TO 13.1	7.0 TO 12.6	6.6 TO 12.2	6.2 TO 11.8	5.9 TO 11.3	5.5 TO 10.9	5.4 TO 10.5
5" HG*	5.0 TO 9.4	4.9 TO 8.9	4.8 TO 8.5	4.7 TO 8.0	4.6 TO 7.6	4.4 TO 7.1	4.3 TO 6.7	4.2 TO 6.4	4.1 TO 6.1	4.0 TO 6.0
10" HG*	3.6 TO 5.6	3.5 TO 5.5	3.4 TO 5.4	3.3 TO 5.2	3.1 TO 5.1	3.0 TO 5.0	2.9 TO 4.8	2.8 TO 4.7	4.6 OR LESS	4.5 OR LESS
15" HG*	4.1 OR LESS	4.0 OR LESS	3.9 OR LESS	3.7 OR LESS	3.6 OR LESS	3.5 OR LESS	3.3 OR LESS	3.2 OR LESS	3.1 OR LESS	3.0 OR LESS
20" HG*	—	—	—	—	—	—	—	—	—	—
AIR TEMP. SENSOR — COLD	7.6 TO 16.6	9.4 TO 16.1	8.9 TO 15.5	8.4 TO 15.0	8.0 TO 14.5	7.5 TO 14.0	7.1 TO 13.5	6.7 TO 13.0	6.3 TO 12.5	6.1 TO 12.1
— WARM	7.1 TO 15.4	8.7 TO 14.9	8.3 TO 14.4	7.8 TO 14.0	7.4 TO 13.4	7.0 TO 13.0	6.6 TO 12.6	6.2 TO 12.0	5.8 TO 11.6	5.7 TO 11.2
COOLANT TEMP. SENSOR — COLD	14.4 TO 31.2	17.6 TO 30.1	16.7 TO 29.0	15.9 TO 28.2	15.0 TO 27.1	14.1 TO 26.2	13.3 TO 25.4	12.6 TO 24.3	11.8 TO 23.4	11.6 TO 22.6
— WARM	10.1 TO 22.0	12.4 TO 21.3	11.8 TO 20.5	11.2 TO 19.9	10.6 TO 19.2	10.0 TO 18.5	9.4 TO 17.9	8.9 TO 17.2	8.3 TO 16.6	8.2 TO 16.0
ENG. SPEED — LOW	NO CHANGE TO 0.2 DECREASE									
— HIGH	±0.1 OR NO CHANGE									

*PULSE WIDTH MUST DECREASE FOR EACH INCREASE IN VACUUM.

DE VILLE, BROUGHAM — CALIFORNIA

VACUUM	SEA LEVEL	500 FT.	1,000 FT.	1,500 FT.	2,000 FT.	2,500 FT.	3,000 FT.	3,500 FT.	4,000 FT.	4,500 FT.	5,000 FT.
0" HG	10.4 TO 16.5	9.9 TO 19.8	9.4 TO 19.3	8.9 TO 18.7	8.4 TO 18.2	7.9 TO 17.6	7.6 TO 17.1	7.4 TO 16.6	7.2 TO 16.1	6.9 TO 15.6	6.7 TO 15.1
5" HG*	6.7 TO 11.3	6.4 TO 14.6	6.2 TO 14.1	6.0 TO 13.5	5.7 TO 12.9	5.6 TO 12.4	5.4 TO 11.9	5.3 TO 11.4	5.2 TO 10.8	5.1 TO 10.3	5.0 TO 9.8
10" HG*	5.0 TO 7.5	4.8 TO 9.4	4.7 TO 8.8	4.6 TO 8.3	4.5 TO 7.7	4.3 TO 7.3	4.2 TO 6.9	4.1 TO 6.5	4.0 TO 6.1	3.9 TO 5.7	3.8 TO 5.6
15" HG*	3.8 TO 5.6	3.6 TO 5.5	3.5 TO 5.3	3.4 TO 5.2	3.2 TO 5.1	3.1 TO 4.9	3.0 TO 4.8	2.9 TO 4.7	2.8 TO 4.5	4.4 OR LESS	4.3 OR LESS
20" HG*	4.3 OR LESS	4.2 OR LESS	4.0 OR LESS	3.9 OR LESS	3.8 OR LESS	3.6 OR LESS	3.5 OR LESS	3.4 OR LESS	3.2 OR LESS	3.1 OR LESS	3.0 OR LESS
AIR TEMP. SENSOR — COLD	11.5 TO 18.3	10.9 TO 21.9	10.4 TO 21.4	9.8 TO 20.7	9.2 TO 20.1	8.7 TO 19.5	8.4 TO 18.9	8.1 TO 18.4	7.9 TO 17.8	7.6 TO 17.3	7.4 TO 16.7
— WARM	11.2 TO 17.8	10.6 TO 21.3	10.1 TO 20.8	9.5 TO 20.1	9.0 TO 19.6	8.5 TO 19.0	8.1 TO 18.4	7.9 TO 17.9	7.7 TO 17.3	7.4 TO 16.8	7.2 TO 16.3
COOLANT TEMP. SENSOR — COLD	20.5 TO 32.7	19.6 TO 39.2	18.6 TO 38.2	17.6 TO 37.0	16.6 TO 36.0	15.6 TO 34.8	15.0 TO 33.9	14.6 TO 32.9	14.2 TO 31.9	13.6 TO 30.9	13.2 TO 29.9
— WARM	14.4 TO 22.9	13.7 TO 27.5	13.0 TO 26.8	12.3 TO 26.0	11.6 TO 25.3	10.9 TO 24.5	10.5 TO 23.8	10.2 TO 23.1	10.0 TO 22.4	9.5 TO 21.7	9.3 TO 21.0
ENG. SPEED — LOW	NO CHANGE TO 0.2 DECREASE										
— HIGH	±0.1 OR NO CHANGE										

VACUUM	5,500 FT.	6,000 FT.	6,500 FT.	7,000 FT.	7,500 FT.	8,000 FT.	8,500 FT.	9,000 FT.	9,500 FT.	10,000 FT.
0" HG	6.5 TO 14.6	8.1 TO 14.1	7.7 TO 13.6	7.3 TO 13.1	6.9 TO 12.7	6.5 TO 12.2	6.2 TO 11.8	5.9 TO 11.3	5.6 TO 10.9	5.3 TO 10.5
5" HG*	4.9 TO 9.3	4.8 TO 8.9	4.7 TO 8.4	4.6 TO 7.9	4.5 TO 7.5	4.3 TO 7.1	4.2 TO 6.8	4.1 TO 6.4	4.1 TO 6.1	4.0 TO 5.8
10"*	3.7 TO 5.5	3.5 TO 5.3	3.4 TO 5.2	3.3 TO 5.1	3.2 TO 5.0	3.1 TO 4.9	3.0 TO 4.8	2.9 TO 4.6	2.8 TO 4.5	4.4 OR LESS
15" HG*	4.2 OR LESS	4.0 OR LESS	3.9 OR LESS	3.8 OR LESS	3.7 OR LESS	3.6 OR LESS	3.5 OR LESS	3.4 OR LESS	3.2 OR LESS	3.1 OR LESS
20" HG*	2.9 OR LESS	—	—	—	—	—	—	—	—	—
AIR TEMP. SENSOR — COLD	7.1 TO 16.2	8.9 TO 15.6	8.5 TO 15.1	8.0 TO 14.5	7.6 TO 14.1	7.1 TO 13.5	6.8 TO 13.1	6.5 TO 12.5	6.1 TO 12.1	5.8 TO 11.6
— WARM	7.0 TO 15.7	8.7 TO 15.2	8.2 TO 14.6	7.8 TO 14.1	7.4 TO 13.7	7.0 TO 13.1	6.6 TO 12.7	6.3 TO 12.2	6.0 TO 11.7	5.7 TO 11.3
COOLANT TEMP. SENSOR — COLD	12.8 TO 28.9	16.0 TO 27.9	15.2 TO 26.9	14.4 TO 25.9	13.6 TO 25.1	12.8 TO 24.2	12.2 TO 23.4	11.6 TO 22.4	11.0 TO 21.6	10.4 TO 20.8
— WARM	9.0 TO 20.3	11.2 TO 19.6	10.7 TO 18.9	10.1 TO 18.2	9.5 TO 17.7	9.0 TO 17.0	8.6 TO 16.4	8.2 TO 15.7	7.7 TO 15.2	7.3 TO 14.6
ENG. SPEED — LOW	NO CHANGE TO 0.2 DECREASE									
— HIGH	±0.1 OR NO CHANGE									

*PULSE WIDTH MUST DECREASE FOR EACH INCREASE IN VACUUM.

ELDORADO — EXCEPT CALIFORNIA AND HIGH ALTITUDE

VACUUM	SEA LEVEL	500 FT.	1,000 FT.	1,500 FT.	2,000 FT.	2,500 FT.	3,000 FT.	3,500 FT.	4,000 FT.	4,500 FT.	5,000 FT.
0" HG	10.8 TO 17.4	10.3 TO 20.7	9.7 TO 20.1	9.2 TO 19.5	8.7 TO 18.9	8.1 TO 18.3	7.8 TO 17.8	7.6 TO 17.2	7.4 TO 16.7	7.2 TO 16.1	7.0 TO 15.6
5" HG*	7.0 TO 11.8	6.7 TO 15.1	6.5 TO 14.5	6.3 TO 13.9	6.1 TO 13.4	5.9 TO 12.8	5.7 TO 12.2	5.6 TO 11.7	5.4 TO 11.1	5.3 TO 10.6	5.2 TO 10.00
10" HG	5.2 TO 7.8	5.0 TO 9.6	4.9 TO 9.0	4.7 TO 8.4	4.6 TO 7.8	4.4 TO 7.2	4.3 TO 6.7	4.2 TO 6.2	4.0 TO 6.1	3.9 TO 5.9	3.8 TO 5.8
15" HG*	3.8 TO 5.8	3.6 TO 5.7	3.5 TO 5.5	3.3 TO 5.3	3.2 TO 5.2	3.1 TO 5.0	2.9 TO 4.9	2.8 TO 4.7	4.6 OR LESS	4.5 OR LESS	4.3 OR LESS
20" HG*	4.3 OR LESS	4.2 OR LESS	4.0 OR LESS	3.9 OR LESS	3.7 OR LESS	3.6 OR LESS	3.4 OR LESS	3.3 OR LESS	3.1 OR LESS	3.0 OR LESS	2.8 OR LESS
AIR TEMP. SENSOR — COLD	12.4 TO 20.0	11.8 TO 23.8	11.1 TO 23.1	10.5 TO 22.4	10.0 TO 21.8	9.3 TO 21.1	8.9 TO 20.5	8.7 TO 19.8	8.5 TO 19.2	8.2 TO 18.5	8.0 TO 18.0
— WARM	11.4 TO 18.5	10.9 TO 22.0	10.3 TO 21.3	9.7 TO 20.7	9.2 TO 20.1	8.6 TO 19.4	8.2 TO 18.9	8.0 TO 18.3	7.8 TO 17.7	7.6 TO 17.1	7.4 TO 16.6
COOLANT TEMP. SENSOR — COLD	22.8 TO 36.9	21.8 TO 43.9	20.5 TO 42.6	19.5 TO 41.3	18.4 TO 40.1	17.1 TO 38.8	16.5 TO 37.7	16.1 TO 36.5	15.6 TO 35.4	15.2 TO 34.1	14.8 TO 33.1
— WARM	15.8 TO 25.6	15.1 TO 30.4	14.2 TO 29.5	13.5 TO 28.7	12.7 TO 27.8	11.9 TO 26.9	11.4 TO 26.2	11.1 TO 25.3	10.8 TO 24.5	10.5 TO 23.7	10.2 TO 22.9
ENG. SPEED — LOW	DECREASE 0.1 TO 0.2										
— HIGH	±0.1 OR NO CHANGE										

VACUUM	5,500 FT.	6,000 FT.	6,500 FT.	7,000 FT.	7,500 FT.	8,000 FT.	8,500 FT.	9,000 FT.	9,500 FT.	10,000 FT.
0" HG	6.8 TO 15.1	8.3 TO 14.6	7.8 TO 14.0	7.4 TO 13.5	6.9 TO 13.1	6.5 TO 12.6	6.0 TO 12.1	5.7 TO 11.6	5.5 TO 11.2	5.4 TO 10.7
5" HG*	5.0 TO 9.5	4.9 TO 9.0	4.8 TO 8.5	4.7 TO 8.0	4.6 TO 7.5	4.4 TO 7.0	4.3 TO 6.6	4.2 TO 6.2	4.1 TO 6.1	4.0 TO 6.0
10" HG*	3.7 TO 5.6	3.5 TO 5.5	3.4 TO 5.4	3.3 TO 5.2	3.2 TO 5.1	3.1 TO 5.0	3.0 TO 4.9	2.8 TO 4.7	4.6 OR LESS	4.5 OR LESS
15" HG*	4.2 OR LESS	4.0 OR LESS	3.9 OR LESS	3.8 OR LESS	3.6 OR LESS	3.5 OR LESS	3.4 OR LESS	3.3 OR LESS	3.1 OR LESS	3.0 OR LESS
20" HG*	—	—	—	—	—	—	—	—	—	—
AIR TEMP. SENSOR — COLD	7.8 TO 17.4	9.5 TO 16.8	8.9 TO 16.1	8.5 TO 15.5	7.9 TO 15.1	7.4 TO 14.5	6.9 TO 13.9	6.5 TO 13.4	6.3 TO 12.9	6.2 TO 12.3
— WARM	7.2 TO 16.0	8.8 TO 15.5	8.2 TO 14.9	7.8 TO 14.3	7.3 TO 13.9	6.9 TO 13.4	6.3 TO 12.9	6.0 TO 12.3	5.8 TO 11.9	5.7 TO 11.4
COOLANT TEMP. SENSOR — COLD	14.4 TO 32.0	17.5 TO 31.0	16.5 TO 29.7	15.6 TO 8 28.6	14.6 TO 27.8	13.7 TO 26.7	12.7 TO 25.7	12.0 TO 24.6	11.6 TO 23.7	11.4 TO 22.7
— WARM	9.9 TO 22.2	12.2 TO 21.5	11.4 TO 20.6	10.8 TO 19.8	10.1 TO 19.3	9.5 TO 18.5	8.8 TO 17.8	8.3 TO 17.1	8.1 TO 16.5	7.9 TO 15.7
ENG. SPEED — LOW	DECREASE 0.1 TO 0.2									
— HIGH	±0.1 OR NO CHANGE									

*PULSE WIDTH MUST DECREASE FOR EACH INCREASE IN VACUUM.

ELDORADO — HIGH ALTITUDE

VACUUM	SEA LEVEL	500 FT.	1,000 FT.	1,500 FT.	2,000 FT.	2,500 FT.	3,000 FT.	3,500 FT.	4,000 FT.	4,500 FT.	5,000 FT.
0" HG	10.8 TO 17.4	10.3 TO 19.3	9.7 TO 18.7	9.2 TO 18.1	8.7 TO 17.5	8.1 TO 16.9	7.8 TO 16.4	7.6 TO 15.8	7.4 TO 15.2	7.2 TO 14.7	7.0 TO 14.2
5" HG*	7.0 TO 11.8	6.7 TO 13.7	6.5 TO 13.1	6.3 TO 12.5	6.1 TO 11.9	5.9 TO 11.4	5.7 TO 10.8	5.6 TO 10.2	5.4 TO 9.7	5.3 TO 9.1	5.2 TO 8.6
10" HG*	5.2 TO 7.8	5.0 TO 8.1	4.9 TO 7.5	4.7 TO 7.0	4.6 TO 6.8	4.4 TO 6.6	4.3 TO 6.4	4.2 TO 6.2	4.0 TO 6.1	3.9 TO 5.9	3.8 TO 5.8
15" HG*	3.8 TO 5.8	3.6 TO 5.7	3.5 TO 5.5	3.3 TO 5.3	3.2 TO 5.2	3.1 TO 5.0	2.9 TO 4.9	2.8 TO 4.7	4.6 OR LESS	4.5 OR LESS	4.3 OR LESS
20" HG*	4.3 OR LESS	4.2 OR LESS	4.0 OR LESS	3.9 OR LESS	3.7 OR LESS	3.6 OR LESS	3.4 OR LESS	3.3 OR LESS	3.1 OR LESS	3.0 OR LESS	2.8 OR LESS
AIR TEMP. SENSOR — COLD	12.4 TO 20.0	11.8 TO 22.2	11.1 TO 21.5	10.5 TO 20.8	10.0 TO 20.1	9.3 TO 19.5	8.9 TO 18.9	8.7 TO 18.2	8.5 TO 17.5	8.2 TO 16.9	8.0 TO 16.3
— WARM	11.4 TO 18.5	10.9 TO 20.5	10.3 TO 19.9	9.7 TO 19.2	9.2 TO 18.6	8.6 TO 17.9	8.2 TO 17.4	8.0 TO 16.8	7.8 TO 16.1	7.6 TO 15.6	7.4 TO 15.1
COOLANT TEMP. SENSOR — COLD	22.8 TO 36.9	21.8 TO 40.9	20.5 TO 39.6	19.5 TO 38.4	18.4 TO 37.1	17.1 TO 35.8	16.5 TO 34.8	16.1 TO 33.5	15.6 TO 32.2	15.2 TO 31.2	14.8 TO 30.1
— WARM	15.8 TO 25.6	15.1 TO 28.4	14.2 TO 27.5	13.5 TO 26.6	12.7 TO 25.7	11.9 TO 24.8	11.4 TO 24.1	11.1 TO 23.2	10.8 TO 22.3	10.5 TO 21.6	10.2 TO 20.9
ENG. SPEED — LOW	DECREASE 0.2 TO 0.3										
— HIGH	±0.1 OR NO CHANGE										

VACUUM	5,500 FT.	6,000 FT.	6,500 FT.	7,000 FT.	7,500 FT.	8,000 FT.	8,500 FT.	9,000 FT.	9,500 FT.	10,000 FT.
0" HG	6.8 TO 13.7	7.0 TO 13.1	6.5 TO 12.6	6.2 TO 12.1	6.1 TO 11.6	5.9 TO 11.1	5.7 TO 10.7	5.6 TO 10.2	5.5 TO 9.7	5.4 TO 9.3
5" HG*	5.0 TO 8.1	4.9 TO 7.6	4.8 TO 7.1	4.7 TO 6.9	4.6 TO 6.7	4.4 TO 6.5	4.3 TO 6.3	4.2 TO 6.2	4.1 TO 6.1	4.0 TO 6.0
10" HG*	3.7 TO 5.6	3.5 TO 5.5	3.4 TO 5.4	3.3 TO 5.2	3.2 TO 5.1	3.1 TO 5.0	3.0 TO 4.9	2.8 TO 4.7	4.6 OR LESS	4.5 OR LESS
15" HG*	4.2 OR LESS	4.0 OR LESS	3.9 OR LESS	3.8 OR LESS	3.6 OR LESS	3.5 OR LESS	3.4 OR LESS	3.3 OR LESS	3.1 OR LESS	3.0 OR LESS
20" HG*	—	—	—	—	—	—	—	—	—	—
AIR TEMP. SENSOR — COLD	7.8 TO 15.8	8.0 TO 15.1	7.4 TO 14.5	7.1 TO 13.9	7.0 TO 13.4	6.7 TO 12.8	6.5 TO 12.3	6.4 TO 11.7	6.3 TO 11.2	6.2 TO 10.7
— WARM	7.2 TO 14.5	7.4 TO 13.9	6.9 TO 13.4	6.5 TO 12.9	6.4 TO 12.3	6.2 TO 11.8	6.0 TO 11.4	5.9 TO 10.8	5.8 TO 10.3	5.7 TO 9.9
COOLANT TEMP. SENSOR — COLD	14.4 TO 29.0	14.8 TO 27.8	13.7 TO 26.7	13.1 TO 25.7	12.9 TO 24.6	12.5 TO 23.5	12.0 TO 22.7	11.9 TO 21.6	11.6 TO 20.6	11.4 TO 19.7
— WARM	9.9 TO 20.1	10.2 TO 19.3	9.5 TO 18.5	9.1 TO 17.8	8.9 TO 17.1	8.6 TO 16.3	8.3 TO 15.7	8.2 TO 15.0	8.0 TO 14.3	7.9 TO 13.7
ENG. SPEED — LOW	DECREASE 0.2 TO 0.3									
— HIGH	±0.1 OR NO CHANGE									

*PULSE WIDTH MUST DECREASE FOR EACH INCREASE IN VACUUM.

SEVILLE — EXCEPT CALIFORNIA AND HIGH ALTITUDE

VACUUM	SEA LEVEL	500 FT.	1,000 FT.	1,500 FT.	2,000 FT.	2,500 FT.	3,000 FT.	3,500 FT.	4,000 FT.	4,500 FT.	5,000 FT.
0" HG	9.1 TO 14.0	8.7 TO 16.0	8.3 TO 15.6	7.9 TO 15.1	7.5 TO 14.7	7.1 TO 14.3	6.8 TO 13.9	6.4 TO 13.5	6.1 TO 13.1	6.0 TO 12.7	5.8 TO 12.3
5" HG*	5.8 TO 9.9	5.7 TO 12.0	5.5 TO 11.5	5.4 TO 11.1	5.2 TO 10.7	5.1 TO 10.3	5.0 TO 9.8	4.8 TO 9.4	4.7 TO 9.0	4.5 TO 8.6	4.4 TO 8.3
10" HG*	4.4 TO 6.5	4.2 TO 7.9	4.1 TO 7.5	4.0 TO 7.0	3.8 TO 6.6	3.7 TO 6.2	3.5 TO 5.8	3.4 TO 5.4	3.3 TO 5.2	3.1 TO 5.1	3.0 TO 4.9
15" HG*	3.0 TO 5.0	2.8 TO 4.8	4.7 OR LESS	4.5 OR LESS	4.3 OR LESS	4.2 OR LESS	4.0 OR LESS	3.9 OR LESS	3.7 OR LESS	3.6 OR LESS	3.4 OR LESS
20" HG*	3.5 OR LESS	3.3 OR LESS	3.2 OR LESS	3.0 OR LESS	2.8 OR LESS	—	—	—	—	—	—
AIR TEMP. SENSOR — COLD	10.3 TO 15.9	9.9 TO 18.2	9.4 TO 17.8	8.9 TO 17.2	8.5 TO 16.7	8.0 TO 16.3	7.7 TO 15.8	7.2 TO 15.4	6.9 TO 14.9	6.8 TO 14.5	6.6 TO 14.0
— WARM	9.5 TO 14.8	9.1 TO 16.9	8.7 TO 16.4	8.3 TO 15.9	7.9 TO 15.5	7.4 TO 15.1	7.1 TO 14.7	6.7 TO 14.2	6.4 TO 13.8	6.3 TO 13.4	6.1 TO 13.0
COOLANT TEMP. SENSOR — COLD	20.4 TO 31.5	19.5 TO 36.0	18.6 TO 35.1	17.7 TO 34.0	16.8 TO 33.1	15.9 TO 32.2	15.3 TO 31.3	14.4 TO 30.4	13.7 TO 29.5	13.5 TO 28.6	13.0 TO 27.7
— WARM	14.1 TO 21.7	13.4 TO 24.8	12.8 TO 24.2	12.2 TO 23.4	11.6 TO 22.8	11.0 TO 22.2	10.5 TO 21.5	9.9 TO 20.9	9.4 TO 20.3	9.3 TO 19.7	8.9 TO 19.1
ENG. SPEED — LOW	±0.1 OR NO CHANGE										
— HIGH	±0.1 OR NO CHANGE										

VACUUM	5,500 FT.	6,000 FT.	6,500 FT.	7,000 FT.	7,500 FT.	8,000 FT.	8,500 FT.	9,000 FT.	9,500 FT.	10,000 FT.
0" HG	5.7 TO 11.9	6.9 TO 11.5	6.5 TO 11.2	6.2 TO 10.8	5.9 TO 10.5	5.6 TO 10.1	5.2 TO 9.7	4.9 TO 9.4	4.7 TO 9.1	4.6 TO 8.7
5" HG*	4.3 TO 7.9	4.2 TO 7.5	4.0 TO 7.1	3.9 TO 6.8	3.8 TO 6.4	3.7 TO 6.1	3.6 TO 5.7	3.4 TO 5.4	3.3 TO 5.2	3.2 TO 5.1
10" HG*	2.9 TO 4.8	4.7 OR LESS	4.5 OR LESS	4.4 OR LESS	4.3 OR LESS	4.1 OR LESS	4.0 OR LESS	3.9 OR LESS	3.7 OR LESS	3.6 OR LESS
15" HG*	3.3 OR LESS	3.2 OR LESS	3.0 OR LESS	2.9 OR LESS	2.8 OR LESS	—	—	—	—	—
20" HG*	—	—	—	—	—	—	—	—	—	—
AIR TEMP. SENSOR — COLD	6.4 TO 13.5	7.8 TO 13.1	7.3 TO 12.7	7.0 TO 12.3	6.7 TO 11.9	6.3 TO 11.5	5.9 TO 11.0	5.5 TO 10.7	5.3 TO 10.4	5.2 TO 9.9
— WARM	6.0 TO 12.5	7.3 TO 12.1	6.8 TO 11.8	6.5 TO 11.4	6.2 TO 11.1	5.9 TO 10.6	5.4 TO 10.2	5.1 TO 9.9	4.9 TO 9.6	4.8 TO 9.2
COOLANT TEMP. SENSOR — COLD	12.8 TO 26.8	15.5 TO 25.9	14.6 TO 25.2	13.9 TO 24.3	13.2 TO 23.6	12.6 TO 22.7	11.7 TO 21.8	11.0 TO 21.1	10.5 TO 20.5	10.3 TO 19.6
— WARM	8.8 TO 18.4	10.6 TO 17.8	10.0 TO 17.4	9.6 TO 16.7	9.1 TO 16.3	8.6 TO 15.7	8.0 TO 15.0	7.5 TO 14.6	7.2 TO 14.1	7.1 TO 13.5
ENG. SPEED — LOW	±0.1 OR NO CHANGE									
— HIGH	±0.1 OR NO CHANGE									

*PULSE WIDTH MUST DECREASE FOR EACH INCREASE IN VACUUM.

SEVILLE — CALIFORNIA AND HIGH ALTITUDE

VACUUM	SEA LEVEL	500 FT.	1,000 FT.	1,500 FT.	2,000 FT.	2,500 FT.	3,000 FT.	3,500 FT.	4,000 FT.	4,500 FT.	5,000 FT.
0" HG	7.8 TO 11.6	7.5 TO 13.0	7.2 TO 12.7	6.9 TO 12.4	6.6 TO 12.1	6.3 TO 11.8	6.1 TO 11.5	5.9 TO 11.2	5.8 TO 10.9	5.7 TO 10.6	5.6 TO 10.3
5" HG*	5.5 TO 8.5	5.4 TO 10.0	5.3 TO 9.7	5.1 TO 9.4	5.0 TO 9.1	4.9 TO 8.8	4.7 TO 8.5	4.6 TO 8.2	4.5 TO 7.9	4.4 TO 7.6	4.3 TO 7.3
10" HG*	4.2 TO 6.2	4.1 TO 7.0	3.9 TO 6.7	3.8 TO 6.4	3.7 TO 6.1	3.5 TO 5.8	3.4 TO 5.5	3.3 TO 5.2	3.2 TO 5.0	3.0 TO 4.9	2.9 TO 4.8
15" HG*	2.9 TO 4.8	2.8 TO 4.6	4.5 OR LESS	4.3 OR LESS	4.2 OR LESS	4.0 OR LESS	3.9 OR LESS	3.8 OR LESS	3.6 OR LESS	3.5 OR LESS	3.4 OR LESS
20" HG*	3.4 OR LESS	3.2 OR LESS	3.1 OR LESS	2.9 OR LESS	2.8 OR LESS	—	—	—	—	—	—
AIR TEMP. SENSOR — COLD	8.8 TO 13.2	8.5 TO 14.8	8.2 TO 14.5	7.8 TO 14.1	7.5 TO 13.8	7.1 TO 13.5	6.9 TO 13.1	6.7 TO 12.8	6.6 TO 12.4	6.4 TO 12.1	6.3 TO 11.7
— WARM	8.2 TO 12.2	7.8 TO 13.7	7.5 TO 13.4	7.2 TO 13.1	6.9 TO 12.7	6.6 TO 12.4	6.4 TO 12.1	6.2 TO 11.8	6.1 TO 11.5	6.0 TO 11.2	5.8 TO 10.8
COOLANT TEMP. SENSOR — COLD	17.7 TO 26.4	17.1 TO 29.6	16.4 TO 29.0	15.7 TO 28.3	15.0 TO 27.6	14.3 TO 26.9	13.9 TO 26.2	13.4 TO 25.5	13.2 TO 24.9	12.9 TO 24.2	12.7 TO 23.5
— WARM	11.3 TO 16.8	10.8 TO 18.9	10.4 TO 18.4	10.0 TO 18.0	9.5 TO 17.5	9.1 TO 17.1	8.8 TO 16.7	8.5 TO 16.2	8.4 TO 15.8	8.2 TO 15.4	8.1 TO 14.9
ENG. SPEED — LOW	±0.1 OR NO CHANGE										
— HIGH	±0.1 OR NO CHANGE										

VACUUM	5,500 FT.	6,000 FT.	6,500 FT.	7,000 FT.	7,500 FT.	8,000 FT.	8,500 FT.	9,000 FT.	9,500 FT.	10,000 FT.
0" HG	5.4 TO 10.0	6.1 TO 9.7	5.9 TO 9.5	5.6 TO 9.2	5.4 TO 8.9	5.2 TO 8.7	4.9 TO 8.4	4.7 TO 8.1	4.5 TO 7.9	4.4 TO 7.6
5" HG*	4.1 TO 7.0	4.0 TO 6.7	3.9 TO 6.4	3.8 TO 6.2	3.7 TO 5.9	3.6 TO 5.6	3.4 TO 5.4	3.3 TO 5.1	3.2 TO 5.0	3.1 TO 4.9
10" HG*	2.8 TO 4.6	4.8 OR LESS	4.4 OR LESS	4.2 OR LESS	4.1 OR LESS	4.0 OR LESS	3.9 OR LESS	3.7 OR LESS	3.6 OR LESS	3.5 OR LESS
15" HG*	3.2 OR LESS	3.1 OR LESS	3.0 OR LESS	2.8 OR LESS	—	—	—	—	—	—
20" HG*	—	—	—	—	—	—	—	—	—	—
AIR TEMP. SENSOR — COLD	6.1 TO 11.4	6.9 TO 11.1	6.7 TO 10.8	6.3 TO 10.5	6.1 TO 10.1	5.9 TO 9.9	5.5 TO 9.6	5.3 TO 9.2	5.1 TO 9.0	5.0 TO 8.7
— WARM	5.6 TO 10.5	6.4 TO 10.2	6.2 TO 10.0	5.8 TO 9.7	5.6 TO 9.4	5.4 TO 9.2	5.1 TO 8.8	4.9 TO 8.5	4.7 TO 8.3	4.6 TO 8.0
COOLANT TEMP. SENSOR — COLD	12.3 TO 22.8	13.9 TO 22.1	13.4 TO 21.7	12.7 TO 21.0	12.3 TO 20.3	11.8 TO 19.8	11.1 TO 19.2	10.7 TO 18.5	10.2 TO 18.0	10.0 TO 17.3
— WARM	7.8 TO 14.5	8.8 TO 14.1	8.5 TO 13.8	8.1 TO 13.3	7.8 TO 12.9	7.5 TO 12.6	7.1 TO 12.2	6.8 TO 11.7	6.5 TO 11.5	6.3 TO 11.0
ENG. SPEED — LOW	±0.1 OR NO CHANGE									
— HIGH	±0.1 OR NO CHANGE									

*PULSE WIDTH MUST DECREASE FOR EACH INCREASE IN VACUUM.

STEP 20. SYSTEM MONITOR.

This step can be used to check the signals to and from the ECU when operating with the car's own EFI components. It can be used after making other system checks and repairs to assure that EFI components are functioning satisfactorily as part of the car's total EFI system. Also; intermittent conditions can best be found by operating the vehicle while monitoring the total system.

A. Depress analyzer Switch #20.

B. On Eldorado connect ECU harness dark green/yellow connector to harness connector (fuel pump lead), Fig. 6C-80.

C. Start car and allow to run at idle. If car will not start, crank the engine while checking the functions described in the following parts 1-7. If required for diagnosis or evaluation of particular conditions, the vehicle may be driven with the analyzer in this monitor mode (switch 20).

1. POWER TO TESTER light should be **on** to indicate power from the car battery is reaching the ECU through the fusible link and brown wire (or 20 amp gages-trans fuse on "C" car). If it is **not on,** go to Step #2, page 6C-60.

2. IGNITION light should be **on** when the ignition switch is in the "On" or "Start" position to close (turn on) the internal ECU power relay and internal fuel pump power relay. If it is **not on,** go to Step #2, page 6C-60.

3. ENGINE CRANK light should be **on** when the ignition switch is in the "Start" position to indicate the crank signal from the starter solenoid is reaching the ECU jumper harness. This signal pulls in the ECU cranking calibration and holds in the fuel pump relay.

ENGINE CRANK light should be **off** when the ignition switch is in the "On" position. If **not,** go to step #2, page 6C-60.

4. FUEL PUMP light should be **on** and indicates that the dark green/yellow wire from the ECU jumper harness is providing power to the fuel pump body wiring harness. This light does not indicate the pumps are functioning properly. If it is **not on,** go to step #17, page 6C-80.

5. DISTRIBUTOR TRIGGER POINTS LIGHTS I AND II should be blinking to indicate trigger signals to the ECU from the distributor trigger (speed sensor). For the ECU to pulse the injectors, alternate signals must be received from distributor triggers I and II. If they are **not on,** go to Step #7, page 6C-70.

6. INJECTOR LIGHTS GROUP I AND II should be **blinking** to indicate ECU pulses to the injectors. If they are **not on,** check Steps #3 and 4, pages 6C-62 and 6C-64.

7. FAST IDLE VALVE light should be **on** and indicates the ECU jumper harness is supplying power to the dark blue wire going to the fast idle valve. This light does **not** indicate the fast idle valve is functioning properly. If it is **not on,** go to step #5, page 6C-66.

8. EGR SOLENOID light should be **on** when the engine is **not** warmed up (auto temp. control blower inhibited by engine temp. switch) to indicate ECU is supplying power to the brown EGR vacuum shut-off solenoid feed wire. EGR solenoid light should be **off** when engine is warmed up. This same action is used to energize the vacuum retard solenoid on California Seville and Eldorado. If light **does not** operate properly, go to step #6, page 6C-68.

D. Check the following EFI system values by rotating the system monitor switch to the appropriate position.

1. *Battery voltage.* DIGITAL METER should read greater **than 11.5** volts. If not, go to step #2, page 6C-60.

2. *Air Temperature Sensor.* DIGITAL METER should rear **4-6** on a warm engine (70-90°F intake manifold temperature) or **5-7** on a hot engine (over 100°F intake manifold temperature). If not, go to step #9, page 6C-70.

3. *Engine coolant temperature sensor.* DIGITAL METER should read **4-6** on a warm engine (70-90°F coolant temp), **5-7** on a partially warmed up engine (100-140°F coolant temp) or **6-8** on a hot engine (coolant temp over 180°F). If not, go to Step #10, page 6C-72.

ON-CAR SERVICE

Relieving Fuel Pressure

Fuel in the fuel system may be under pressure and could spray out while loosening fittings. All cars are equipped with a "Schrader" fitting to relieve fuel pressure. The fitting is located on the fuel rail near the pressure regulator on Seville and near the fuel inlet on all other cars.

1. Remove protective cap from pressure fitting.
2. Loosely install valve depressor J-5420 on fitting.
3. Arrange a shop towel or suitable container so that displaced fuel will be contained.
4. Slowly tighten valve depressor J-5420 until pressure is relieved.
5. Dispose of gasoline properly.
6. Remove valve depressor and install protective cap.
7. Proceed with fuel system service.

Fuel Line Gaskets

A conical-shaped metal gasket should be used when servicing EFI fuel rail fitting connections. The gasket, Part No. 1608786 or equivalent, is not required in production however, for service repairs this gasket should be inserted in the fuel rail inverted flare fitting each time a fitting is separated and reconnected in the field. This will minimize the possibility of gasoline leakage.

This gasket cannot be reused and must be replaced **each time** a fitting is disassembled.

Idle Speed Adjustment

NOTE: Before low idle speed adjustment is made, distributor vacuum advance hose(s) must be disconnected at the distributor and plugged to eliminate the possibility of changing the timing and engine rpm. Hose must be disconnected at this location to include any calibrated leakage in balance of system. Reset timing before making idle speed adjustment.

1. Disconnect parking brake hose at vacuum release cylinder and plug hose. Set parking brake and block wheels. Disconnect air leveling compressor hose at air cleaner and plug hose.
2. Connect tachometer, start and warm-up engine to operating temperature in park.
3. Place transmission selector lever in drive, turn air conditioning "off".
4. Loosen lock nut on idle by-pass adjusting screw on front of throttle body, Fig. 6C-117.
5. Adjust idle by-pass adjusting screw to give 650 rpm.
6. Tighten lock nut on idle by-pass adjusting screw.
7. Shut off engine. Remove tachometer.
8. Reconnect all disconnected hoses.

Throttle Position Switch Adjustment

1. Loosen two TPS screws to permit rotation of the switch.
2. Hold the throttle valves in the idle position while performing steps 3 and 4.
3. Turn the TPS carefully counterclockwise until the end stop is reached.
4. Tighten TPS mounting screws to 11 inch-pounds.
5. Check to insure that throttle valves close to throttle stop. If not, repeat procedure.

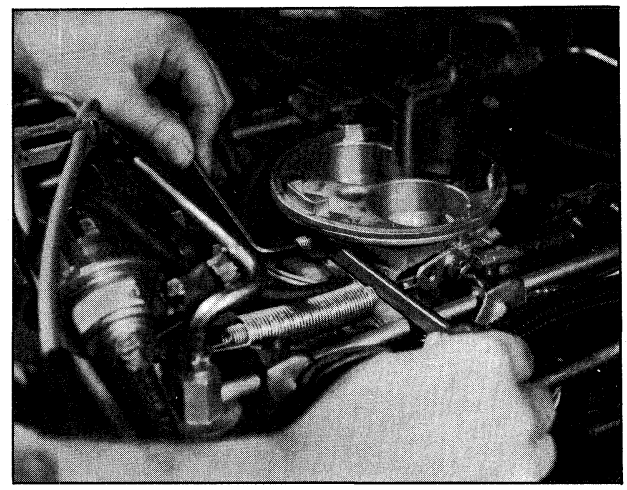


Fig. 6C-117 Adjusting Idle Speed

6. Obtain a .020" feeler gage and turn ignition switch ON.
7. Rotate throttle lever until first click is heard and insert feeler gage between throttle lever and idle stop screw. Feeler gage must fit tightly or not at all (clearance must be less than .020").
8. If clearance is over .020", adjust TPS slightly clockwise from setting and repeat steps 6 and 7.
9. If switch cannot be adjusted, replace switch.

Electronic Control Unit-Seville

a. Removal

1. Disconnect negative battery cable.
2. Loosen right hand forward screw which secures ECU cover to ECU, Fig. 6C-118.
3. Remove remaining 3 screws which secure ECU cover to ECU.
4. Remove 3 screws which secure ECU to instrument panel supports.
5. Carefully lower ECU enough to disconnect 3 electrical connectors from left hand side and MAP hose from front of ECU.
6. Lower ECU and remove.

b. Installation

1. Position ECU under center of instrument panel and connect 3 electrical connectors and MAP hose.
2. Install ECU to instrument panel supports with 3 screws. Tighten to 25 inch pounds.
3. Position ECU cover under right hand forward screw and tighten screw to 25 inch pounds.
4. Install remaining 3 ECU cover to ECU attaching screws and tighten to 25 inch pounds torque.
5. Connect negative battery cable. Tighten to 70 inch pounds.

Electronic Control Unit (Except Eldorado and Seville)

a. Removal

1. Disconnect negative battery cable.

2. Remove glove compartment liner by removing six screws around opening.

3. Remove four mounting screws, Fig. 6C-119, and remove ECU.

4. Disconnect three electrical connectors (red, black and blue) and disconnect MAP Sensor Hose.

b. Installation

1. Connect red, black and blue connectors to ECU and MAP hose to ECU fitting.

2. Position ECU to A/C module making sure that MAP sensor hose is properly routed to avoid kinks and pinches. Secure with four screws.

3. Install glove compartment liner.

4. Connect negative battery cable.

Electronic Control Unit - Eldorado

a. Removal

1. Disconnect negative battery cable.

2. Remove three climate control outlet grilles right, left and right center.

3. Working through outlet openings, remove 3 fasteners securing pad to instrument panel support.

4. Remove screws securing pad to instrument panel horizontal support.

5. Pull pad outward and disconnect electrical connector from windshield wiper switch.

6. Remove pad.

NOTE: To facilitate removal or installation, place shift lever in lo range and on cars equipped with tilt wheel, place wheel in lowest position.

7. Remove MAP sensor hose, Fig. 6C-120.

8. Remove three mounting screws holding ECU in position (one in front, two at side bracket, Fig. 6C-120) and remove ECU.

9. Remove electrical connectors (3) from side of ECU.

b. Installation

1. Connect electrical harness to ECU - 3 connectors. Connectors will only fit one way, black towards front of car, blue in center and red towards rear.

2. Position ECU with electrical connectors on right side of car and install three mounting screws, Fig. 6C-120.

3. Install MAP sensor hose, Fig. 6C-120.

4. Position pad to instrument panel and connect

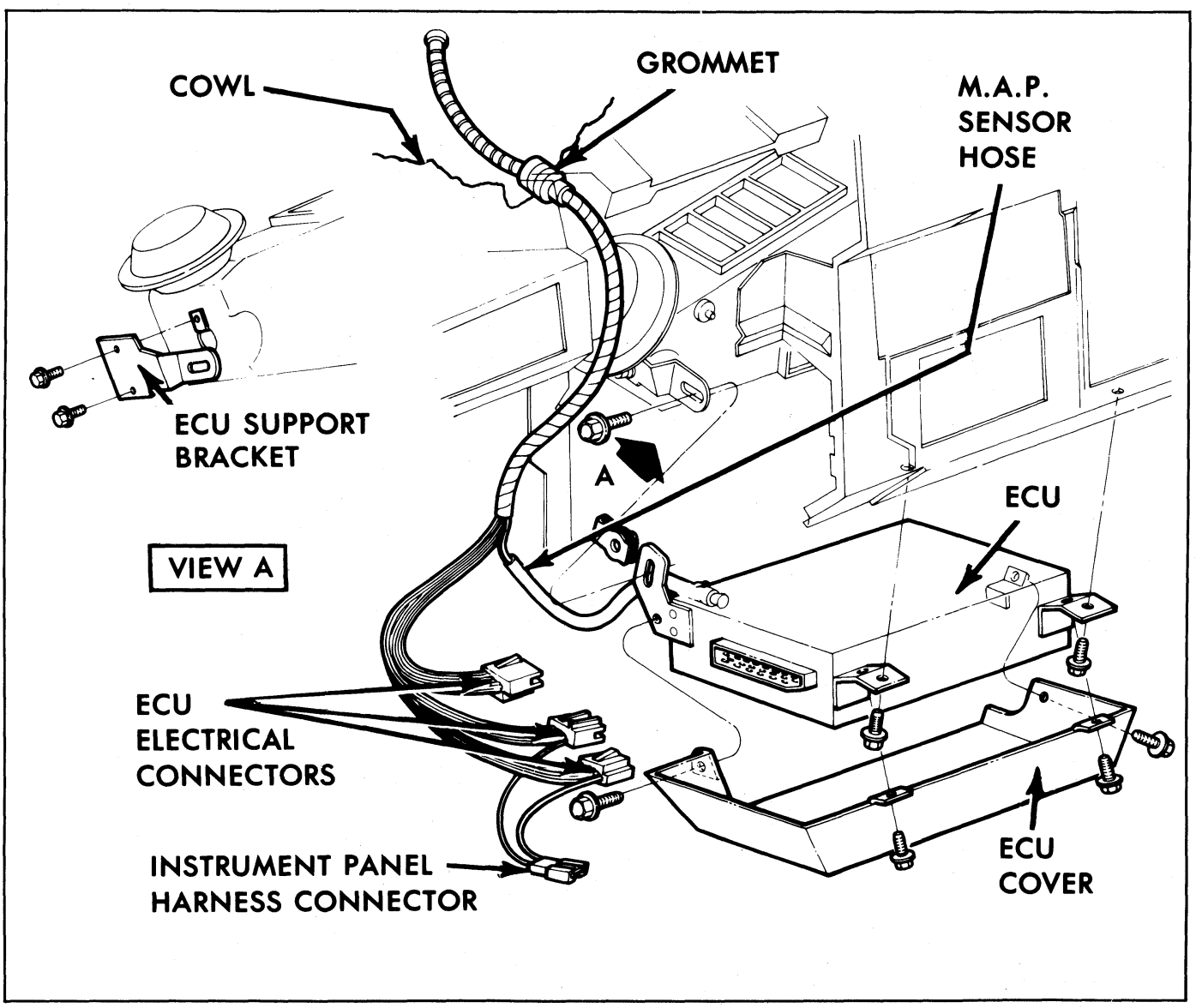


Fig. 6C-118 ECU Mounting - Seville

electrical connector for wiper switch.

5. Install screws securing pad to instrument panel horizontal support.

6. Working through climate control outlet openings, install 3 fasteners securing pad to instrument panel support.

7. Install air outlet grilles.

8. Connect negative battery cable.

Throttle Body Assembly

a. Removal

1. Remove air cleaner.

2. Disconnect throttle return springs (2) from throttle lever.

3. Remove retainer and remove cruise control chain from throttle lever on cars so equipped.

4. Remove "hairpin" clip and disconnect throttle cable from throttle lever.

5. Remove rear throttle body mounting screws and position throttle linkage out of way.

6. Disconnect throttle position switch electrical connector and fast idle valve electrical connector. Slide fast idle valve wiring out of notch in throttle body.

7. Remove vacuum hoses from nipples on throttle body. Use back-up wrench when removing power brake vacuum line.

8. Remove remaining throttle body mounting screws and remove throttle body.

9. Remove gasket material from intake manifold and bottom of throttle body. Clean all foreign material from area around intake manifold throttle bores.

10. The following parts are not included in a new throttle body assembly and should be removed as necessary:

a. Throttle position switch.
b. Fast idle valve seat.
c. Fast idle valve spring.
d. Fast idle valve.
e. Fast idle valve heater assembly.
f. Power brake vacuum fitting.

b. Installation

1. Install throttle position switch to right side of throttle body as described on page 6C-100.

2. Position a new throttle body gasket to intake manifold with identification tab on left.

3. Position throttle body to intake manifold and looselv install front mounting screws.

4. Move throttle linkage bracket into position over rear mounting screws and install rear throttle body mounting screws.

5. Torque screws installed in steps 3 and 4 to 15 ft.lbs.

6. Position throttle cable to throttle lever and secure with "hairpin" clip. Check for proper operation and wide-open-throttle.

7. Position cruise control chain to throttle lever and secure with clip on cars so equipped. Check for proper operation.

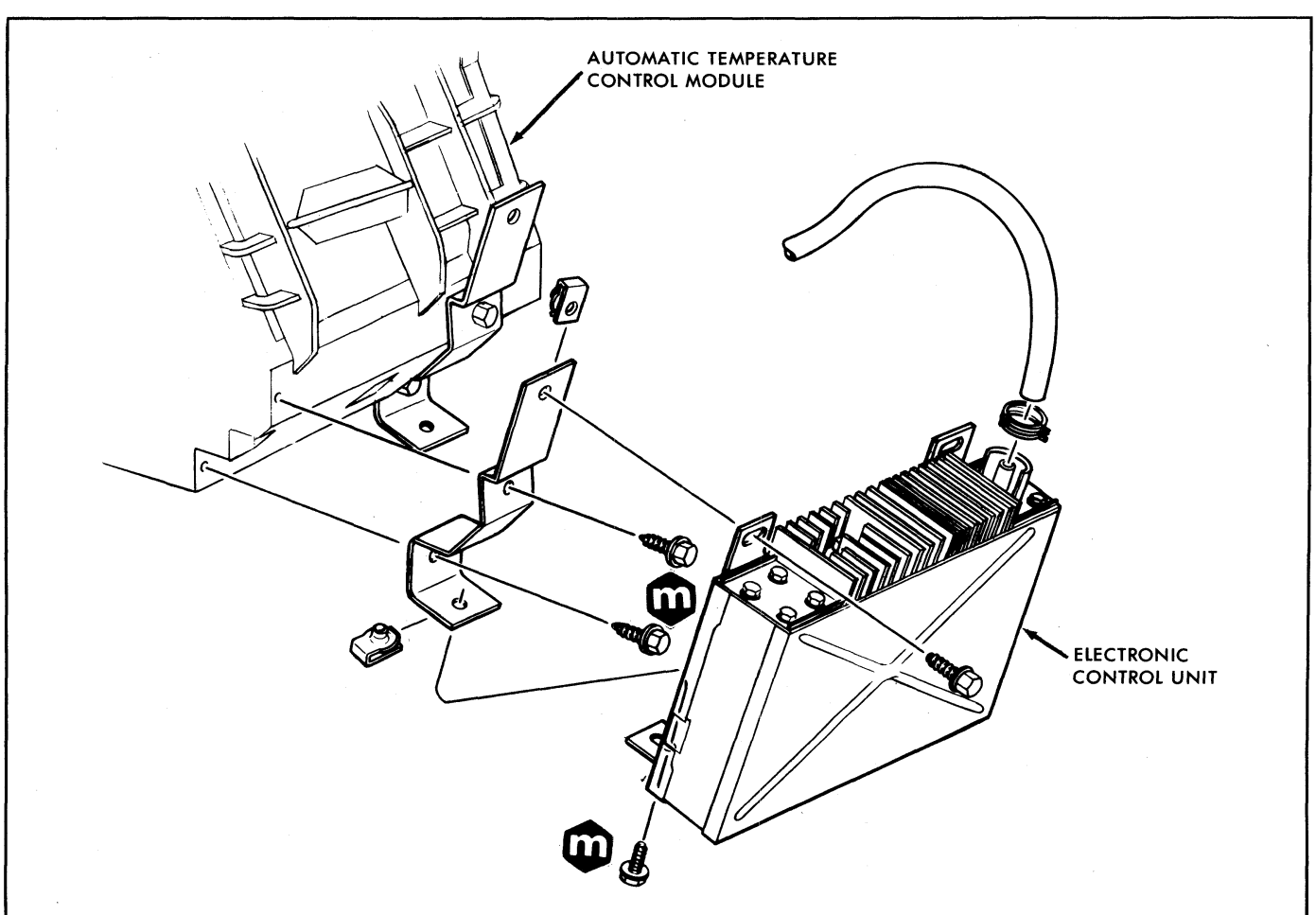


Fig. 6C-119 ECU Mounting - DeVille, Brougham

8. Install power brake vacuum fitting to rear of throttle body and tighten securely. Use back-up wrench.

9. Install throttle return springs (2) between throttle lever and pressure regulator bracket with **open end of spring on outside of throttle lever,** Fig. 6C-135 or 6C-136.

10. Install vacuum hoses to appropriate nipples on throttle body as shown in Figs. 6C-75 through 6C-77. Actual hose routing is shown in Fig. 6C-130 or 6C-132.

11. Install fast idle valve as described on page 6C-00.

12. Install air cleaner, Fig. 6C-121 or 6C-122.

Throttle Position Switch

a. Removal

1. Remove electrical connector from switch.

2. Remove two mounting screws and remove switch from throttle body.

b. Installation

1. Install throttle position switch to right side of throttle body so that tab on switch engages flat on throttle shaft.

2. Install two mounting screws and tighten screws so that switch will still move but is not loose.

3. Install throttle position switch electrical connector.

4. Adjust switch as described on page 6C-97.

Fast Idle Valve

a. Removal

1. Remove air cleaner and disconnect electrical connector from fast idle valve heater.

2. Remove air cleaner stud.

3. To remove fast idle valve heater, push down and twist 90° counter clockwise, Fig. 6C-123.

4. Remove fast idle valve, spring and seat from position in throttle body (refer to Fig. 6C-69 for parts identification).

b. Installation

1. Install fast idle valve seat, spring and valve in position in throttle body. Refer to Fig. 6C-69 for proper arrangement of parts.

2. Position heater on top of fast idle valve and push down to compress spring. Care should be taken to avoid damaging micro-switch contact arm on bottom of heater housing.

3. Align tabs on fast idle valve heater with cut-out portion of throttle body and compress spring further.

4. Rotate heater 90° clockwise to secure in position, Fig. 6C-123.

5. Connect electrical connector.

6. Install air cleaner stud and air cleaner.

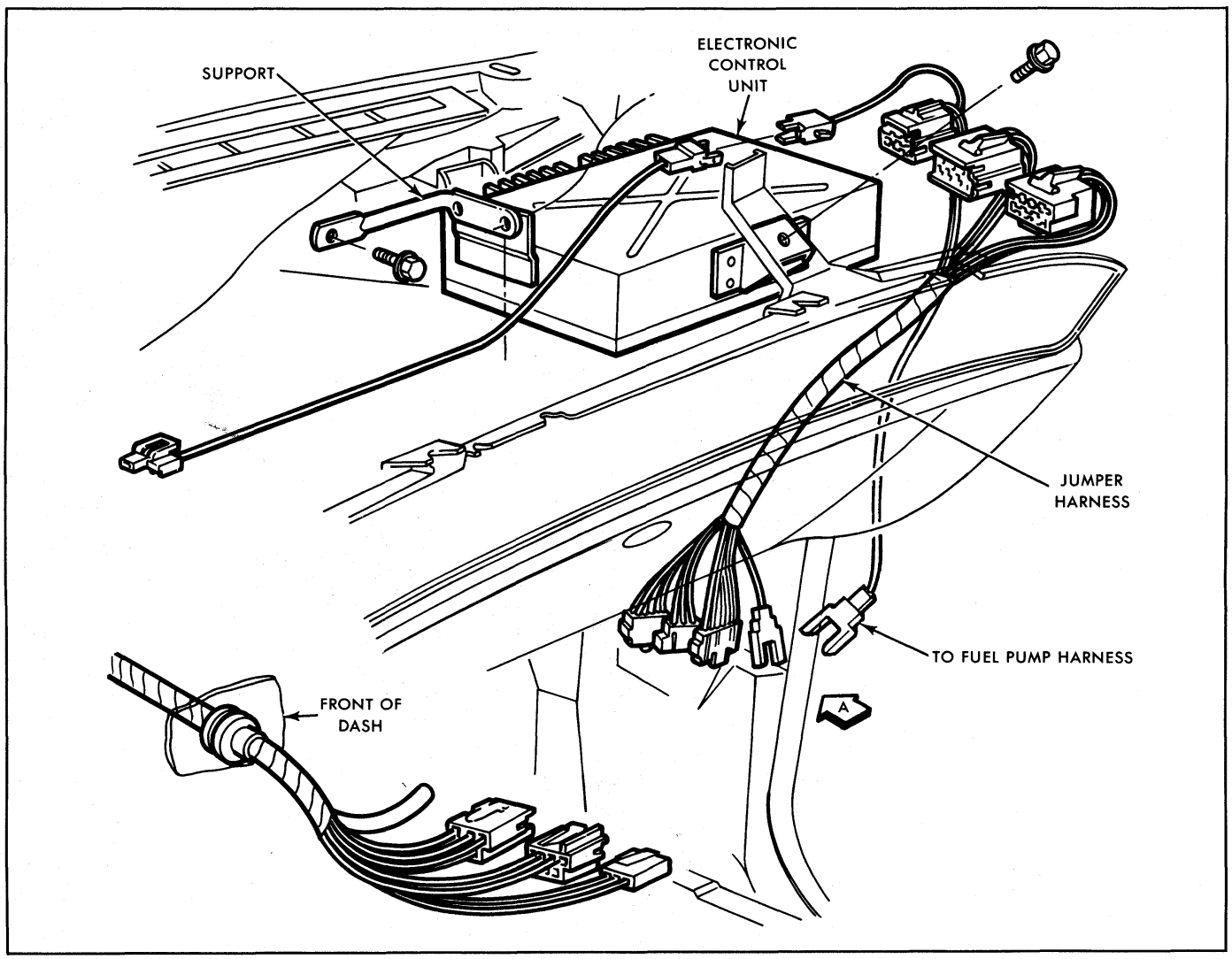


Fig. 6C-120 ECU Mounting - Eldorado

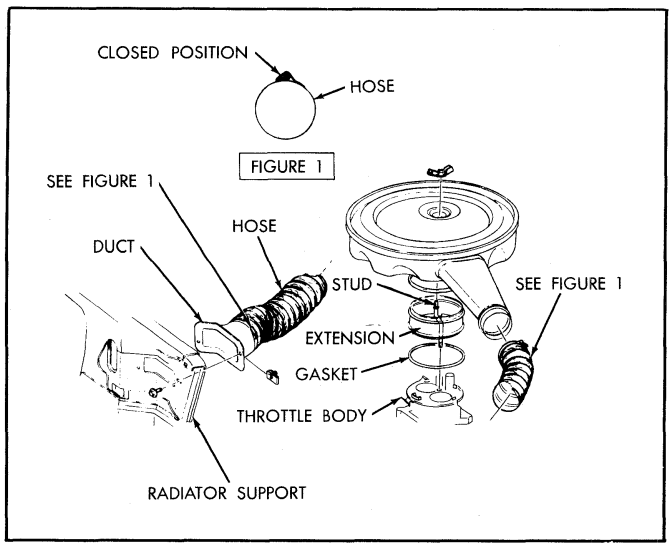


Fig. 6C-121 Throttle Body and Air Cleaner - Seville

Fuel Rail - Except Seville

Fuel rail removal on Seville is the same as injector removal.

a. Front - Removal

WARNING: DO NOT LOOSEN FUEL SYSTEM FITTINGS UNTIL THE PRECAUTIONS DESCRIBED ON PAGE 6C-97 HAVE BEEN TAKEN TO RELIEVE PRESSURE. FUEL IN SYSTEM MAY BE UNDER HIGH PRESSURE WHICH COULD SPRAY OUT AND RESULT IN A FIRE HAZARD AND POSSIBLE PERSONAL INJURY.

1. Remove and discard hose clamp securing pressure regulator hose to front fuel rail.

2. Using a back-up wrench at side rail fitting, remove flare nut from each end of fuel rail.

3. Disengage front rail from pressure regulator hose and remove from vehicle.

b. Front - Installation

1. Install new hose clamp over flexible hose.

2. Position front rail to pressure regulator hose and force hose over nipple.

3. Move rail into position and using a new flair fitting gasket tighten flare nut into fitting on each side rail to 25 foot-pounds. Use a back-up wrench to hold side rail fittings. Do not use teflon tape on flare nuts.

4. Tighten hose clamp securing pressure regulator hose to rail.

5. Turn ignition ON and OFF several times to build up check for fuel leaks.

c. Rear - Removal

WARNING: DO NOT LOOSEN FUEL SYSTEM FITTINGS UNTIL THE PRECAUTIONS DESCRIBED ON PAGE 6C-97 HAVE BEEN TAKEN TO RELIEVE PRESSURE. FUEL IN SYSTEM MAY BE UNDER HIGH PRESSURE WHICH COULD SPRAY OUT AND RESULT IN A FIRE HAZARD AND POSSIBLE PERSONAL INJURY.

1. Using a back-up wrench on fuel rail, remove fuel inlet line from rear rail.

2. Using a back-up wrench on fuel rail, remove flare nut at each side rail and remove rear fuel rail.

d. Rear - Installation

1. Position rear fuel rail and using a new flair fitting gasket thread flare nuts into side rails. Do not use teflon tape on flare nuts.

2. Using a new flair fitting gasket thread fuel inlet line flare nut into rear rail. Do not use teflon tape on flare nut.

3. Using a back-up wrench on fuel rail, tighten flare nuts to 25 foot-pounds.

4. Turn ignition ON and OFF several times to build up fuel rail pressure and check for fuel leaks.

e. Side - Removal

Right or Left side fuel rail removal is the same as injector removal.

Injection Valve - Seville

a. Removal

1. Disconnect electrical lead from all injectors on fuel rail being removed and position harness out of way.

WARNING: DO NOT LOOSEN FUEL SYSTEM FITTINGS UNTIL THE PRECAUTIONS DESCRIBED ON PAGE 6C-97 HAVE BEEN TAKEN TO RELIEVE PRESSURE. FUEL IN SYSTEM MAY BE UNDER HIGH PRESSURE WHICH COULD SPRAY OUT AND RESULT IN A FIRE HAZARD AND POSSIBLE PERSONAL INJURY.

2. Remove fuel inlet line from fuel rail using a backup wrench on fuel rail.

3. Remove return hose and vacuum hose from pressure regulator.

4. Using a back-up wrench on fuel rail, disconnect fuel rail from regulator.

5. Remove screw holding each injector bracket to intake manifold and remove brackets and grommets.

6. Remove fuel rail and injectors from engine as a unit. Some injectors will stick in fuel rail while others may remain in manifold.

7. Remove injectors from fuel rail and from intake manifold as required.

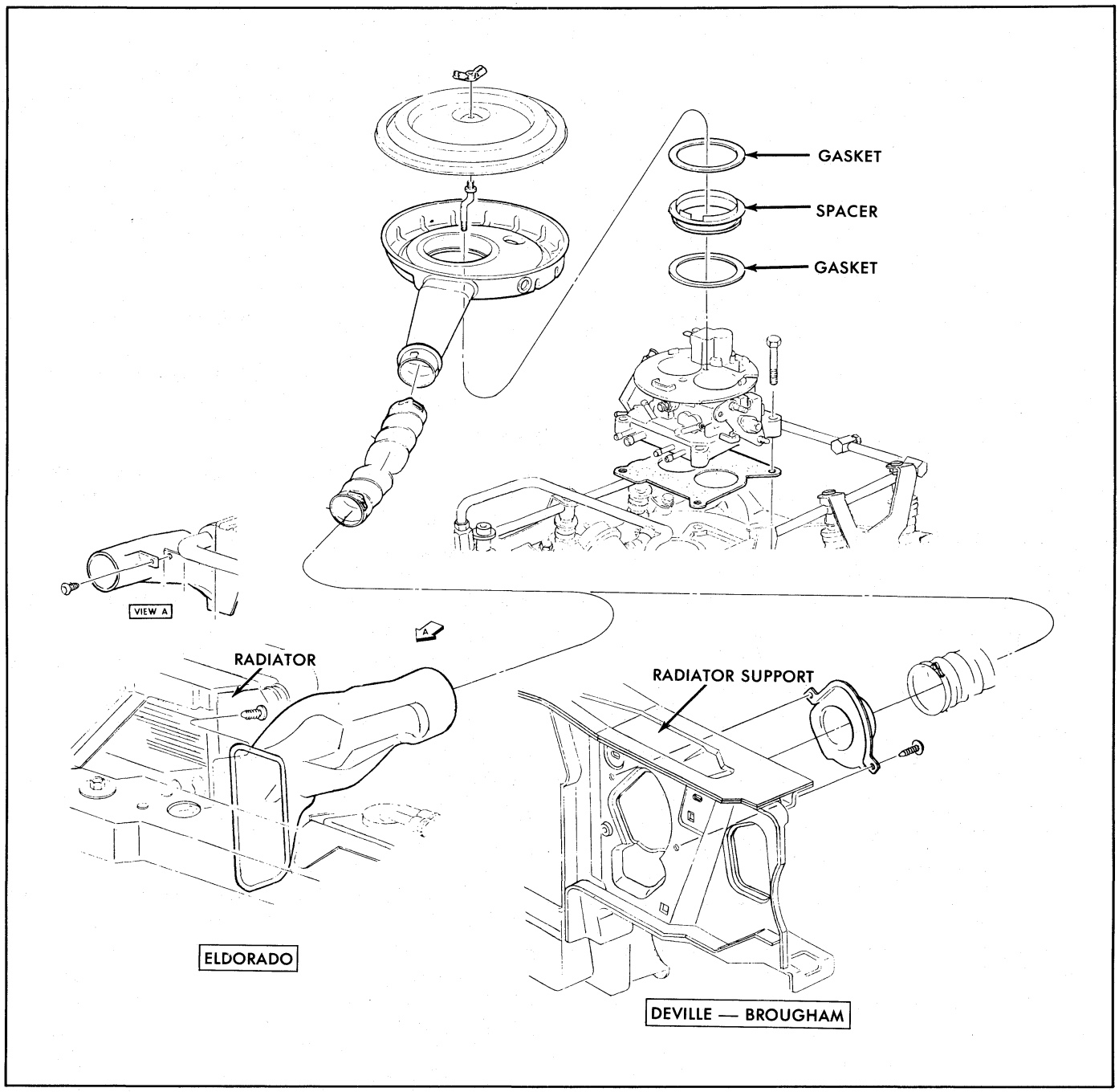


Fig. 6C-122 Throttle Body and Air Cleaner Except Seville

8. Injection valves are sealed by O-rings at both fuel rail and intake manifold. Remove and discard all used O-rings.

b. Installation

1. Lubricate and install a new O-ring on the fuel rail end of each injector.

2. Install injectors into fuel rail with electrical connector facing inboard.

3. Lubricate and install a new O-ring into each injector port in the intake manifold.

4. Install fuel rail-injector assembly to intake manifold making sure that each injector is properly installed in manifold O-ring.

5. Install rubber grommets on fuel rail (flange down) and install injector brackets in position.

6. Secure each bracket with screw. Torque screws to 5 foot-pounds.

7. Route electrical harness along bracket and secure to brackets - 4 positions.

8. Connect injector leads as follows:
Front cylinder - red/black wires
Front-center cylinder - black/white wires
Rear-center cylinder - black/white wires
Rear cylinder - red/black wires
NOTE: Injectors may be rotated to provide proper harness routing. Refer to Fig. 6C-132 or 6C-133.

9. Repeat steps 1 thru 8 for opposite side if necessary.

10. Using a new flare fitting gasket as described on page 6C-97, thread inlet line into fuel rail Do not use teflon tape on flare nut.

11. Repeat step 10 for connection between fuel rail and pressure regulator.

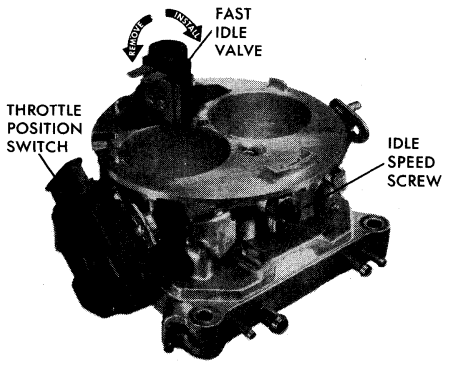


Fig. 6C-123 Throttle Body

12. Using a back-up wrench on fuel rail, tighten flare nut to 25 foot-pounds.

13. Connect return hose and vacuum hose to pressure regulator.

14. Turn ignition ON and OFF several times to build up fuel rail pressure and check for fuel leaks.

Injection Valve - Except Seville

a. Removal

1. Remove front and rear fuel rails as described on page 6C-101.

2. Remove electrical conduit from injector brackets - 4 places each side.

3. Disconnect electrical leads from all injectors on fuel rail being removed.

4. Remove two screws holding each injector bracket to intake manifold and remove brackets and grommets.

5. Remove fuel rail and injector from engine as a unit. Some injectors will stick in fuel rail while others may remain in manifold.

6. Remove injectors from fuel rail and from intake manifold as required.

7. Injection valves are sealed by O-rings at both fuel rail and intake manifold. Remove and discard all used O-rings.

b. Installation

1. Lubricate and install a new O-ring on the fuel rail end of each injector.

2. Install injectors into fuel rail with electrical connector facing inboard.

NOTE: Fuel rails are specific for right and left sides of engine.

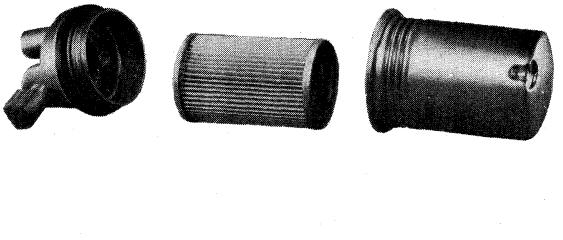


Fig. 6C-124 Fuel Filter Components

3. Lubricate and install a new O-ring into each injector port in the intake manifold.

4. Install fuel rail-injector assembly to intake manifold making sure that each injector is properly installed in manifold O-ring.

5. Install rubber grommets on fuel rail (flange down) and install injector brackets in position.

6. Secure each bracket with two screws. Torque screws to 5 foot-pounds.

7. Route electrical harness along bracket and secure to brackets - 4 positions.

8. Connect injector leads as follows:
Front cylinder - red/black wires
Front-center cylinder - black/white wires
Rear-center cylinder - black/white wires
Rear cylinder - red/black wires
NOTE: Injectors may be rotated to provide proper harness routing.

9. Repeat steps 1 thru 8 for opposite side if necessary.

10. Install front and rear fuel rails as described on page 6C-102.

11. Turn ignition ON and OFF several times to build up fuel rail pressure and check for fuel leaks.

FUEL PRESSURE REGULATOR - SEVILLE

a. Removal

WARNING: DO NOT LOOSEN FUEL SYSTEM FITTINGS UNTIL THE PRECAUTIONS DESCRIBED ON PAGE 6C-97 HAVE BEEN TAKEN TO RELIEVE PRESSURE. FUEL IN SYSTEM MAY BE UNDER HIGH PRESSURE WHICH COULD SPRAY OUT AND RESULT IN A FIRE HAZARD AND POSSIBLE PERSONAL INJURY.

1. Remove vacuum hose from nipple on top of pressure regulator.

2. Using a backup wrench on fuel rail hex and a flare nut wrench, remove flare nut from regulator line at fuel rail.

3. Using a backup wrench on regulator and a flare nut wrench, remove flare nut from return line.

4. Remove one nut securing pressure regulator to bracket and remove regulator.

NOTE: This nut is metric.

b. Installation

1. Using a new flare fitting gasket, position regulator to bracket and loosely install flare nut to fuel rail. Do not use teflon tape on flare nut.

2. Secure regulator to bracket with one nut.

NOTE: This is a metric nut. Use the nut supplied with each new regulator or the nut removed in step 4A.

3. Using a backup wrench on fuel rail hex, tighten flare nut to 25 ft.lbs.

4. Using a new flare fitting gasket, install return hose to regulator. Tighten to 25 ft.lbs. Do not use teflon tape on flare unit.

5. Install vacuum hose to nipple on regulator. Secure with clamp. Actual hose routing is shown in Fig. 6C-130.

6. Turn ignition switch ON and OFF several times to build up pressure in the fuel rail and check for leaks.

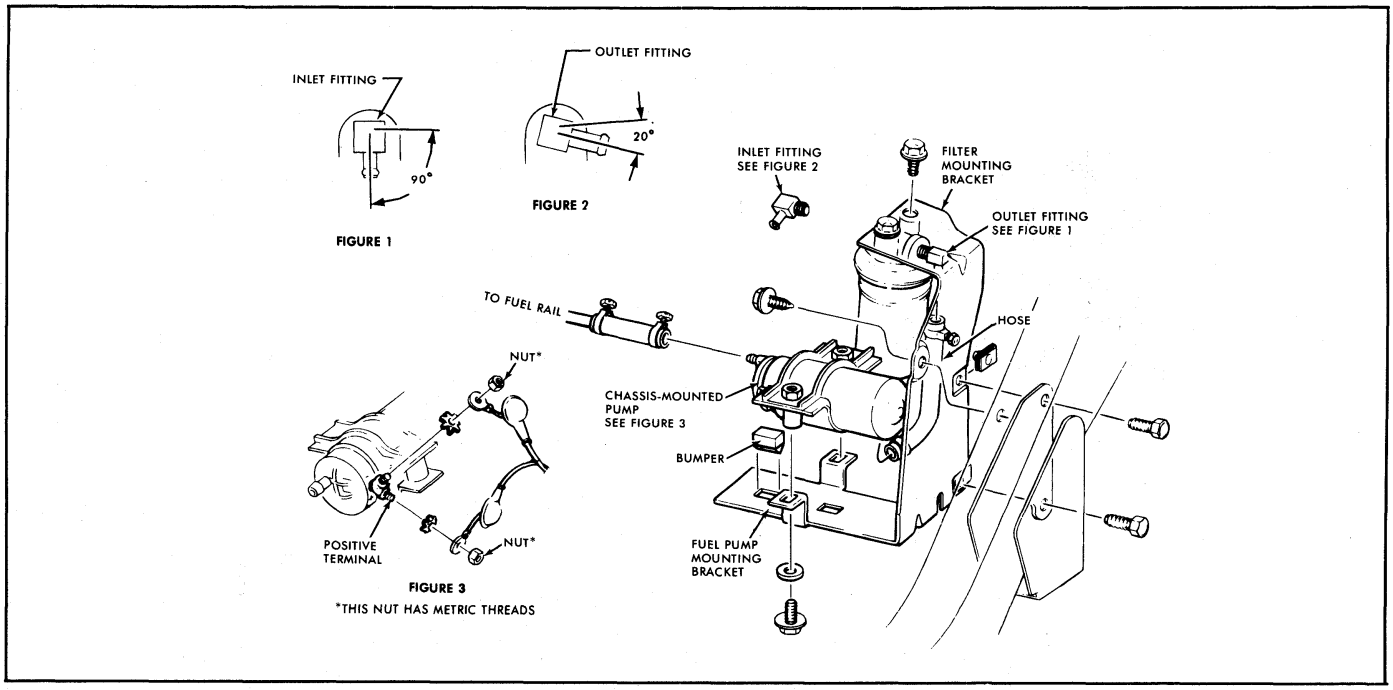


Fig. 6C-125 Chassis - Mounted Fuel Pump and Fuel Filter - Seville

Fuel Pressure Regulator - Except Seville

a. Removal

1. Remove vacuum hose from nipple on top of pressure regulator.

WARNING: DO NOT LOOSEN FUEL SYSTEM FITTINGS UNTIL THE PRECAUTIONS DESCRIBED ON PAGE 6C-97 HAVE BEEN TAKEN TO RELIEVE PRESSURE. FUEL IN SYSTEM MAY BE UNDER HIGH PRESSURE WHICH COULD SPRAY OUT AND RESULT IN A FIRE HAZARD AND POSSIBLE PERSONAL INJURY.

2. Remove and discard clamps securing flexible fuel hose connecting regulator to fuel rail. Remove return line.

3. Remove one nut securing pressure regulator to bracket.

NOTE: This nut has metric threads.

4. Work regulator off of flexible fuel hose and out of bracket.

b. Installation

1. Install new hose clamp over flexible fuel hose.

2. Position regulator to bracket and work flexible fuel hose over nipple on side of regulator. Secure to bracket with one nut.

NOTE: This nut has metric threads. Use the nut supplied with each new regulator or the nut removed in step 3a.

3. Connect return line to fitting on end of regulator.

4. Tighten clamps, securing flexible fuel hose to regulator.

5. Install vacuum hose to remaining nipple on pressure regulator. Actual hose rotating is shown in Fig. 6C-131.

6. Turn ignition key ON and OFF several times to build up pressure in the fuel rail and check for fuel leaks.

Fuel Filter

WARNING: DO NOT LOOSEN FUEL SYSTEM FITTINGS UNTIL THE PRECAUTIONS DESCRIBED ON PAGE 6C-97 HAVE BEEN TAKEN TO RELIEVE PRESSURE. FUEL IN SYSTEM MAY BE UNDER HIGH PRESSURE WHICH COULD SPRAY OUT AND RESULT IN A FIRE HAZARD AND POSSIBLE PERSONAL INJURY.

The fuel filter element is replaced by unscrewing the bottom cover and removing the filter element. Replace element and gasket with AC type GF 157 or equivalent, Fig. 6C-124. Hand tighten bottom cover.

Fuel Filter Assembly - Seville

a. Removal

WARNING: DO NOT LOOSEN FUEL SYSTEM FITTINGS UNTIL THE PRECAUTIONS DESCRIBED ON PAGE 6C-97 HAVE BEEN TAKEN TO RELIEVE PRESSURE. FUEL IN SYSTEM MAY BE UNDER HIGH PRESSURE WHICH COULD SPRAY OUT AND RESULT IN A FIRE HAZARD AND POSSIBLE PERSONAL INJURY.

1. Raise car and locate fuel pump and filter near left rear wheel, Fig. 6C-125.
2. Remove clamp and remove filter inlet hose (from pump). Discard clamp.
3. Remove two screws on top of bracket securing filter to bracket.
4. Move filter down so that outlet hose is accessible and remove hose clamp and hose. Discard hose clamp.

b. Installation

1. Using a new clamp, install outlet hose to fuel filter.
2. Position filter to bracket and secure with two screws.
3. Using a new clamp, install inlet hose to filter.
4. Turn ignition key **ON** and **OFF** several times to build up pressure in the fuel system and check for leaks.

Fuel Filter Assembly - Except Seville

a. Removal

WARNING: DO NOT LOOSEN FUEL SYSTEM FITTINGS UNTIL THE PRECAUTIONS DESCRIBED ON PAGE 6C-97 HAVE BEEN TAKEN TO RELIEVE PRESSURE. FUEL IN SYSTEM MAY BE UNDER HIGH PRESSURE WHICH COULD SPRAY OUT AND RESULT IN A FIRE HAZARD AND POSSIBLE PERSONAL INJURY.

1. Remove fuel inlet hose (flexible line), and discard clamp, Fig. 6C-126.
2. Remove fuel outlet line from fitting of fuel filter.
3. Remove two screws securing fuel filter assembly to bracket and remove fuel filter assembly.
4. Remove inlet and outlet fittings from filter assembly if needed for new assembly.
5. If it is necessary to remove fuel filter bracket, loosen lower mounting screw and remove upper mounting screw. Remove bracket and clean gasket surfaces.

b. Installation

1. If bracket was removed, position gasket to block using gasket cement to hold it in place and start bottom screw, Fig. 6C-126.
2. Position bracket to block and install upper mounting screw and torque both screws to 12 foot-pounds.
3. Install inlet and outlet fittings in fuel filter assembly (refer to Fig. 6C-126 for correct position of fittings). Use sealer #1050805 or equivalent on fitting threads. Do **not** use teflon tape on fittings.
4. Position fuel filter to bracket and secure with two screws. Torque screws to 12 foot-pounds.
5. Connect fuel inlet line (flexible hose) and outlet line (tubing) to fuel filter fittings. Use new clamp on nose and flair fitting gasket on tubing.
6. Turn ignition switch **ON** and **OFF** several times to build up pressure in the fuel system and check for leaks.

Chassis-Mounted Fuel Pump - Seville

a. Removal

1. Raise car and locate fuel pump near left rear wheel, Fig. 6C-125.
2. Peel back rubber boots and remove two nuts, one from each electrical terminal. Remove electrical leads.

NOTE: These nuts have metric threads.

WARNING: DO NOT LOOSEN FUEL SYSTEM FITTINGS UNTIL THE PRECAUTIONS DESCRIBED ON PAGE 6C-97 HAVE BEEN TAKEN TO RELIEVE PRESSURE. FUEL IN SYSTEM MAY BE UNDER HIGH PRESSURE WHICH COULD SPRAY OUT AND RESULT IN A FIRE HAZARD AND POSSIBLE PERSONAL INJURY.

3. Disconnect inlet hose and discard clamp.
4. Disconnect outlet hose at filter and discard clamp.
5. Remove two mounting screws and remove pump.

b. Installation

1. Position pump to mounting bracket and secure with two mounting screws, Fig. 6C-125.
2. Using new clamps, install inlet hose to fuel pump and outlet hose to fuel filter, Fig. 6C-125.
3. Position electrical leads to fuel pump terminals and secure with two nuts. Reposition rubber boots.

NOTE: These nuts have metric threads. Use new nuts supplied with each new pump or use nuts removed in step 2a.

4. Check to insure that fuel pump is resting evenly on its two rubber mounts and that it is not grounding against the bracket.
5. Turn ignition switch **ON** and **OFF** several times to build up pressure in the fuel system and check for leaks.

Chassis-Mounted Fuel Pump - Except Seville

NOTE: The chassis-mounted pump is located forward of the left rear wheel along the frame side rail except on Eldorado, which is located in a similar position on the right side of the car. Refer to Figs. 6C-127 and 6C-128.

a. Removal

WARNING: DO NOT LOOSEN FUEL SYSTEM FITTINGS UNTIL THE PRECAUTIONS DESCRIBED ON PAGE 6C-97 HAVE BEEN TAKEN TO RELIEVE PRESSURE. FUEL IN SYSTEM MAY BE UNDER HIGH PRESSURE WHICH COULD SPRAY OUT AND RESULT IN A FIRE HAZARD AND POSSIBLE PERSONAL INJURY.

1. Remove fuel inlet and outlet hoses from nipples on pump.
2. Peel back rubber boot and remove two nuts, one from each electrical terminal. Remove electrical leads.

NOTE: These nuts have metric threads.

3. Remove two screws with flat washers holding fuel pump to bracket and remove pump assembly.

b. Installation

1. Position fuel pump to mounting bracket as shown in Figs. 6C-127 or 6C-128 and secure with two screws with flat washers.
2. Position electrical leads to fuel pump terminals as

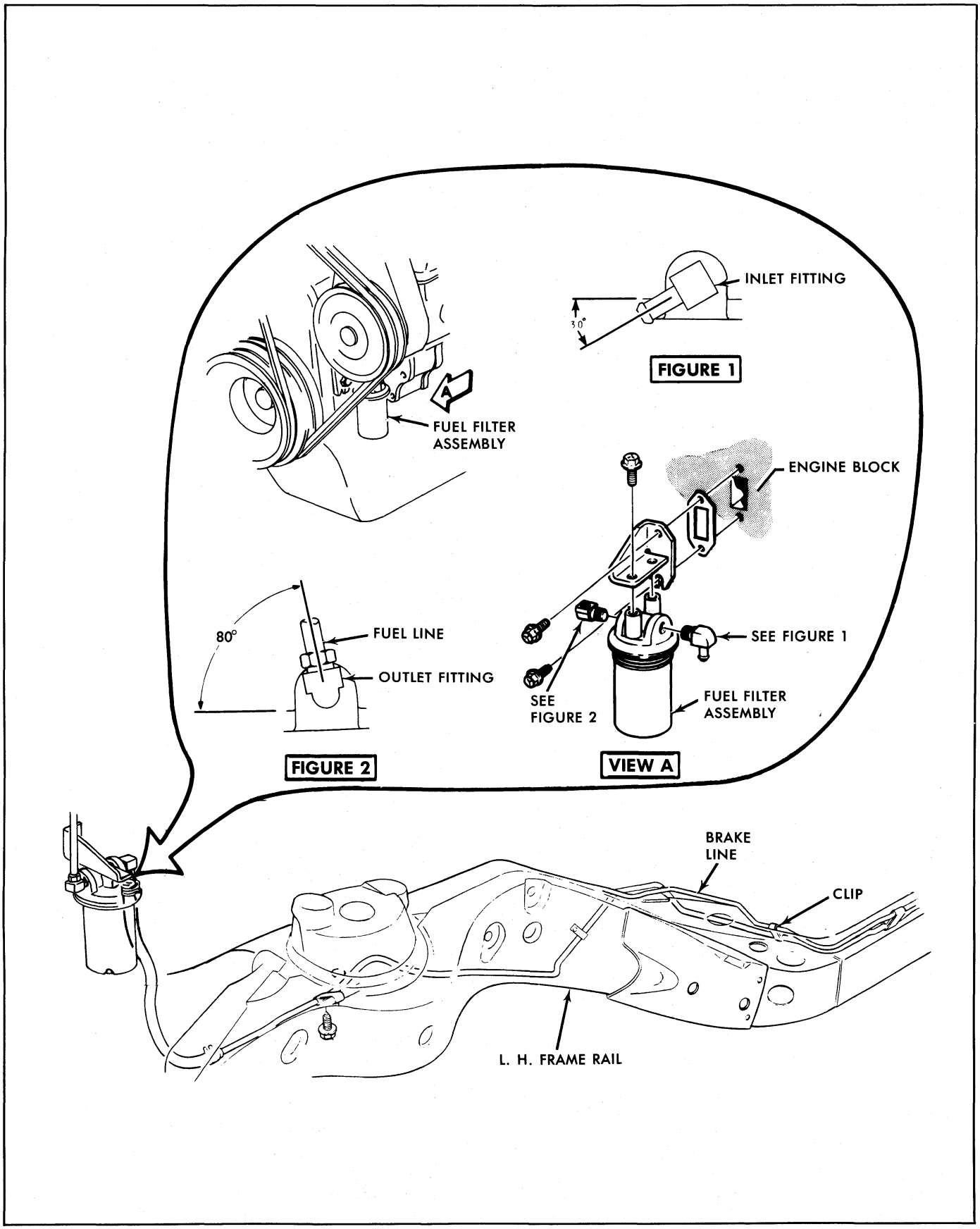


Fig. 6C-126 Fuel Filter Assembly - Except Seville

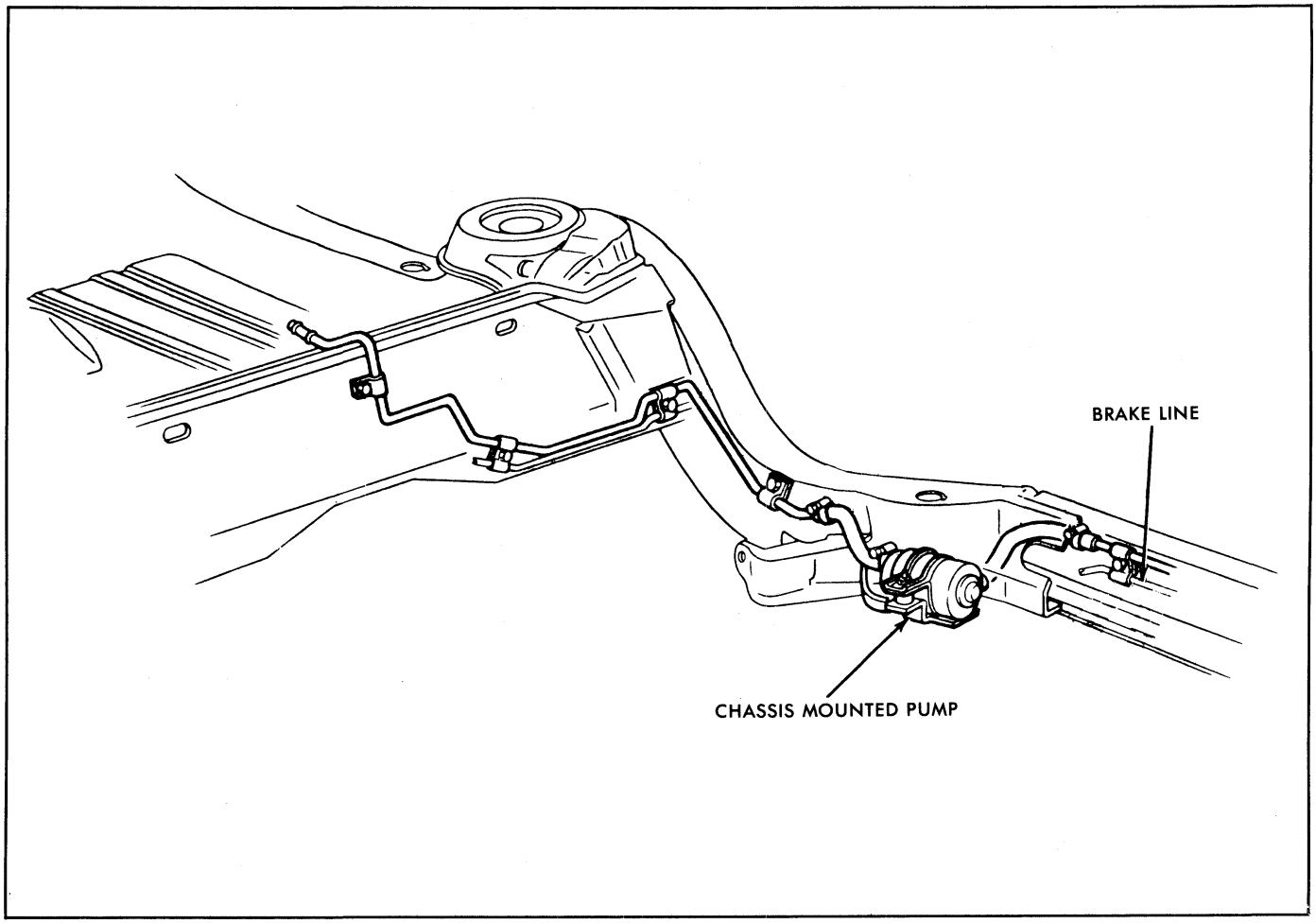


Fig. 6C-127 Chassis Mounted Fuel Pump - DeVille, Brougham

follows: dark green wire to positive terminal and black wire to negative terminal. Secure with two nuts and reposition rubber boot.

NOTE: These nuts have metric threads. Use new nuts supplied with each new pump or use nuts removed in step 2a.

3. Install inlet and outlet hoses to fuel pump.

4. Check to insure that fuel pump is resting evenly on its two mounts and that it is not grounding against the bracket or frame.

5. Turn ignition switch **ON** and **OFF** several times to build up pressure in the fuel system and check for leaks.

In-Tank Fuel Pump

a. Removal

WARNING: DO NOT LOOSEN FUEL SYSTEM FITTINGS UNTIL THE PRECAUTIONS DESCRIBED ON PAGE 6C-97 HAVE BEEN TAKEN TO RELIEVE PRESSURE. FUEL IN SYSTEM MAY BE UNDER HIGH PRESSURE WHICH COULD SPRAY OUT AND RESULT IN A FIRE HAZARD AND POSSIBLE PERSONAL INJURY.

1. Remove fuel tank.

2. Remove wiring harness from fuel gage-in tank pump unit.

3. Install Fuel Tank Sending Unit Remover and Installer, J-24187, on cam locking ring so that tool engages three tabs on ring, Fig. 6C-54.

4. Install ratchet and turn counterclockwise to disengage locking ring from fuel tank. Remove tool and lift fuel gage-in tank pump unit from tank.

b. Installation

1. Install fuel gage-in tank pump unit in fuel tank, using new gasket.

2. Install Fuel Tank Sending Unit Remover and Installer, J-24187, engaging three tabs on cam locking ring.

3. Turn locking ring clockwise until ring is fully engaged in fuel tank, then remove tool.

4. Connect fuel gage and in tank pump wiring to tank unit.

5. Install fuel tank.

Temperature Sensors

a. Removal - Air

1. Locate air temperature sensor on intake manifold and disconnect sensor from car harness.

2. Remove sensor from intake manifold.

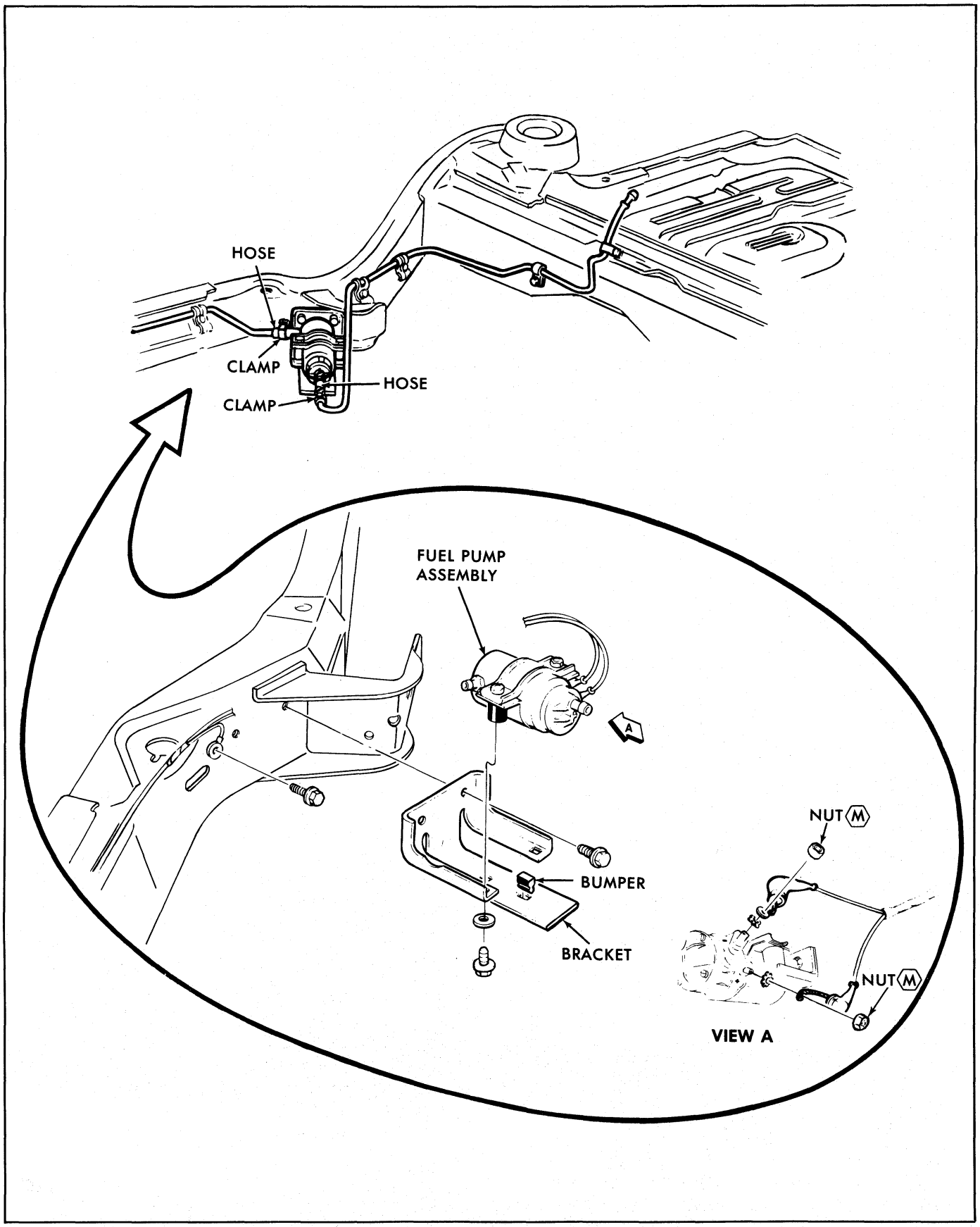


Fig. 6C-128 Chassis Mounted Fuel Pump - Eldorado

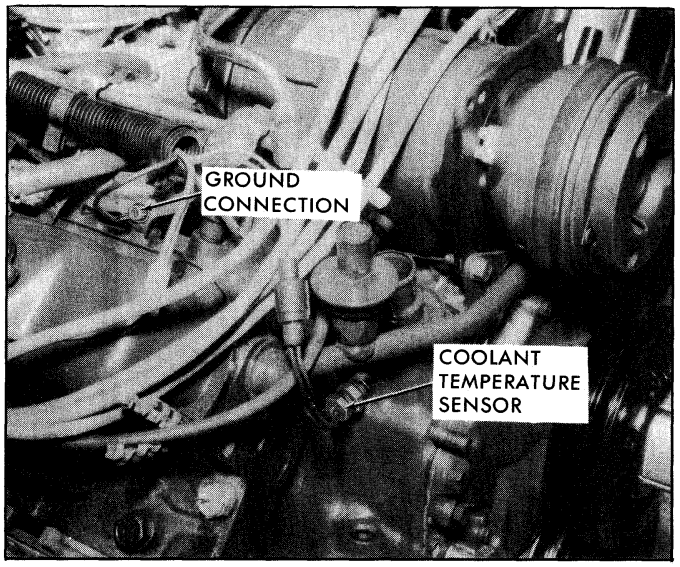


Fig. 6C-129 Coolant Temperature Sensor - Except Seville

b. Installation - Air

1. Apply a non-hardening sealer (such as GM 1050805 or equivalent) to threads of sensor and install sensor in intake manifold.

2. Tighten sensor to 15 foot-pounds.

3. Connect air temperature sensor connector to car harness.

c. Removal - Coolant

1. Drain radiator until coolant level is below level of sensor.

2. Locate water temperature sensor at the left front of the intake manifold on Seville, Fig. 6B-18 and below thermostat housing on the right side of the cylinder block on all other cars, Fig. 6C-129.

Disconnect sensor from car harness.

3. Remove sensor.

d. Installation - Coolant

1. Apply a non hardening sealer (such as GM 1050805 or equivalent) to threads of sensor and install sensor.

2. Tighten sensor to 15 foot-pounds.

3. Connect coolant temperature sensor connector to car harness.

4. Fill cooling system to proper level.

FUEL SYSTEM HOSES

Because of the specific nature of the materials and lengths of EFI fuel hoses, it is important that only recommended and specified EFI fuel hoses, cut to the proper lengths, be used in service replacements.

Hose materials are designed to withstand the effects of gasoline and ambient temperatures. Hose lengths are important because original hose routings should be closely followed for optimum hose retention and durability. Deviation from specified hoses is not acceptable. The chart below is provided to assure proper service hose usage.

The hoses mentioned in chart are replaceable with properly cut lengths of the following bulk hoses or equivalent hoses which conform to appropriate GM spec.:

Size	Part No.	Spec. No.
1/4"	943 2787	6107 M
5/16"	943 6421	6147 M
3/8"	943 6580	6147 M

Reference Drawings

The following illustrations are provided for reference when servicing the Electronic Fuel Injection system and show the proper arrangement of parts and location of components.

APPLICATION	C-CAR	ELDORADO	SEVILLE
Tank pump outlet (fuel tank to Chassis line)	3/8" x 19"	3/8" x 14.5"	3/8" x 4-1/4"
Chassis pump inlet	7/16" x 7"	7/16" x 2-1/4"	7/16" x 13"
Chassis pump outlet	5/16" x 12"	5/16" x 2.75"	None
Chassis pump to filter	None	None	5/16" x 8"
Filter to 39 psi line	None	None	3/8" x 8"
39 psi line (body to frame)	None	None	3/8" x 7"
Frame to engine inlet (frame to filter) on C-car and Eldorado)	3/8" x 10-1/2"	3/8" x 14"	3/8" x 10.5"
Press. Reg. Valve to fuel return line	1/4" x 27"	1/4" x 27"	1/4" x 16"
Fuel return line (frame to body)	None	None	1/4" x 7"
Fuel return line to tank	1/4" x 19")	1/4" x 15-1/2"	1/4" x 5"
Pressure Regulator To Fuel Rail	3/8" x 2 1/2"	3/8" x 2 1/2"	None

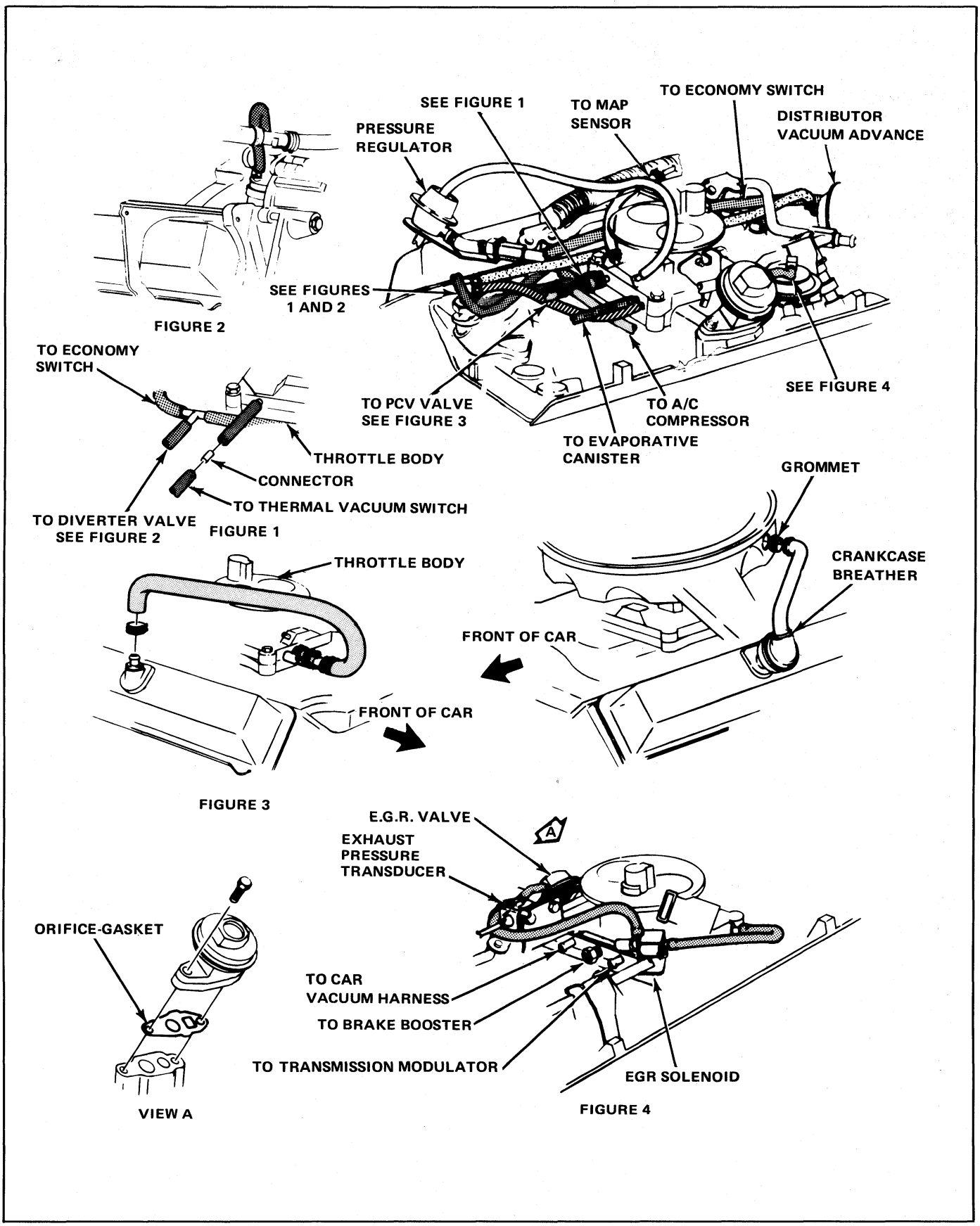


Fig. 6C-130 Vacuum Hose Connections - Seville

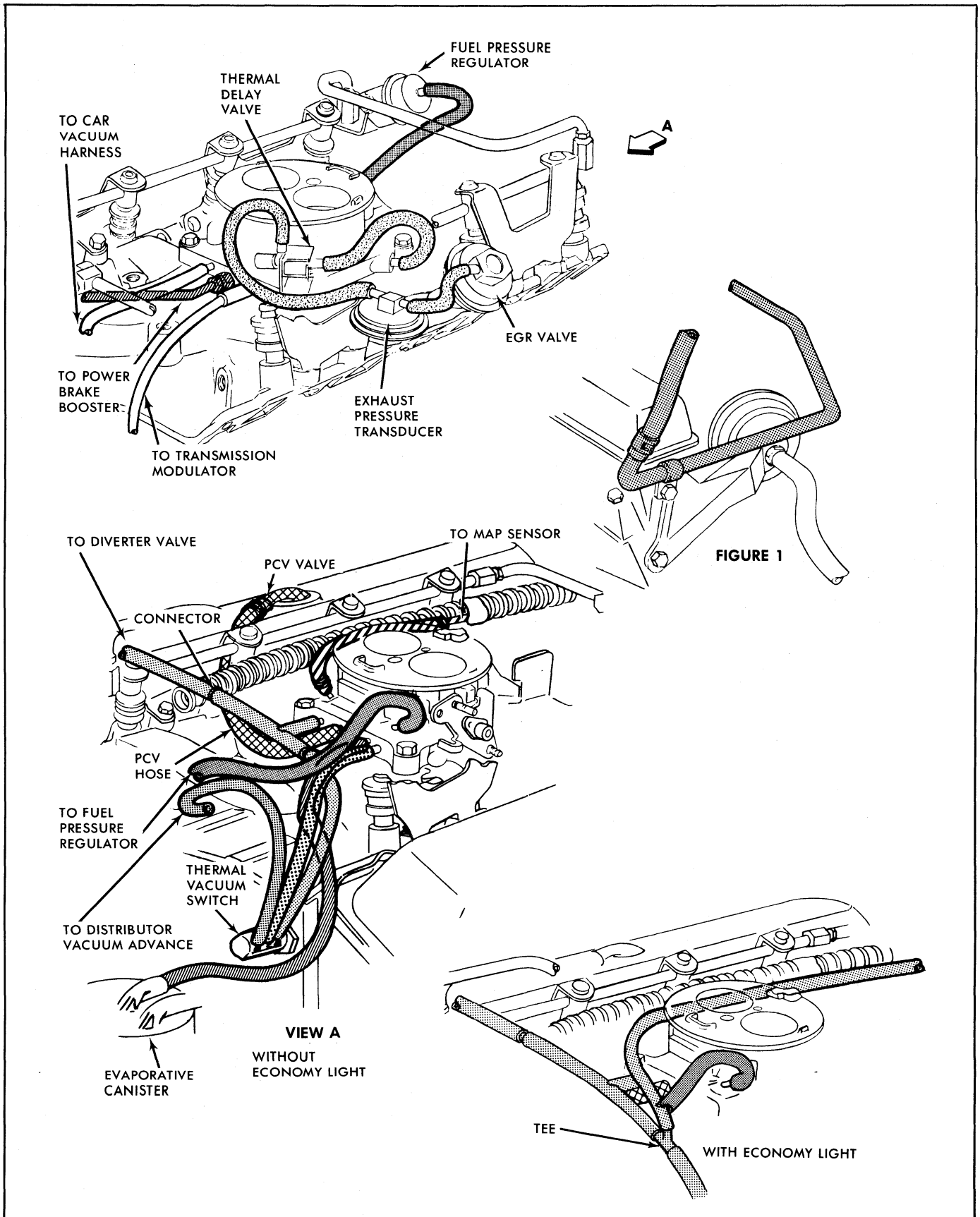


Fig. 6C-131 Vacuum Hose Connections - Except Seville

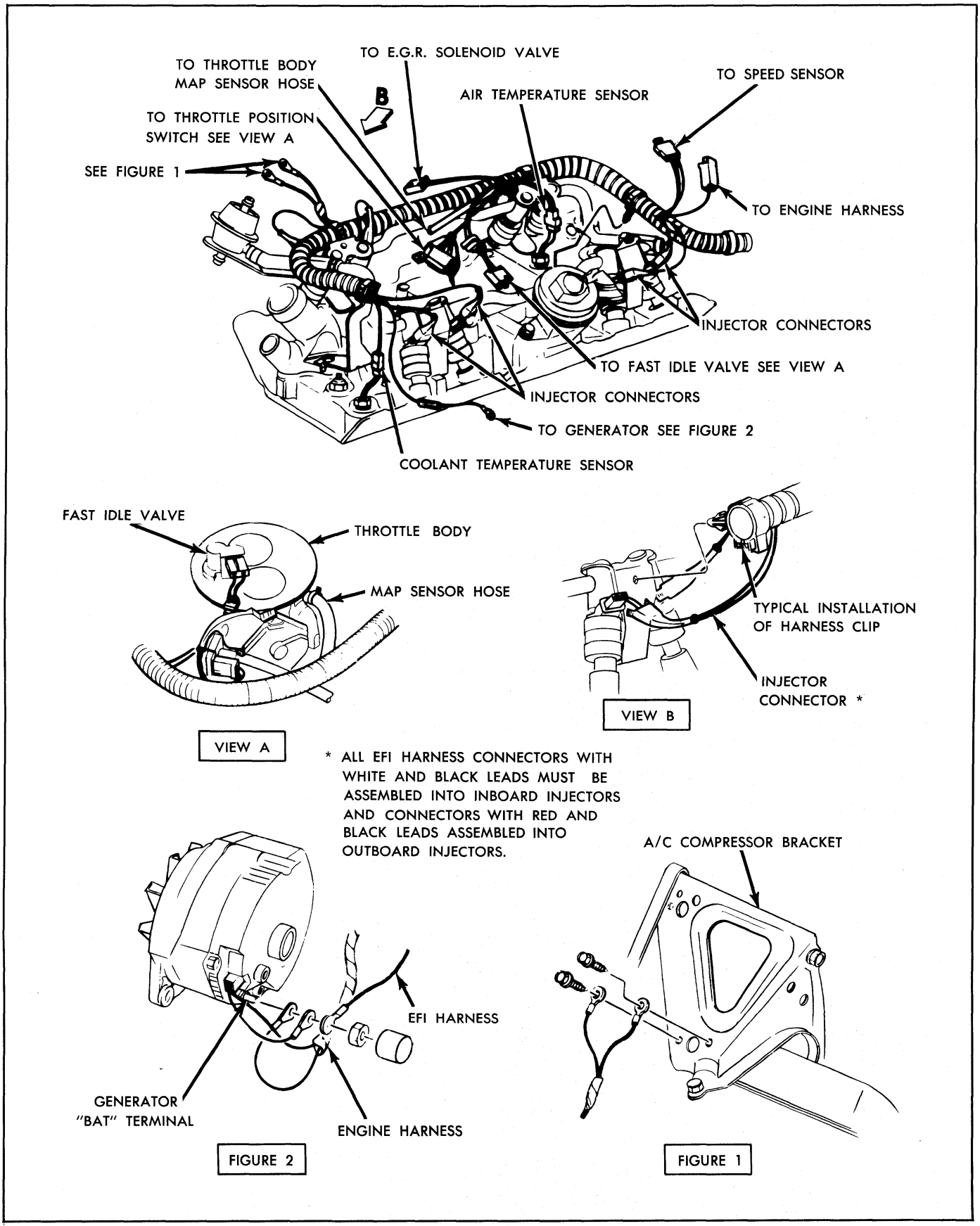


Fig. 6C-132 Engine Harness - Seville

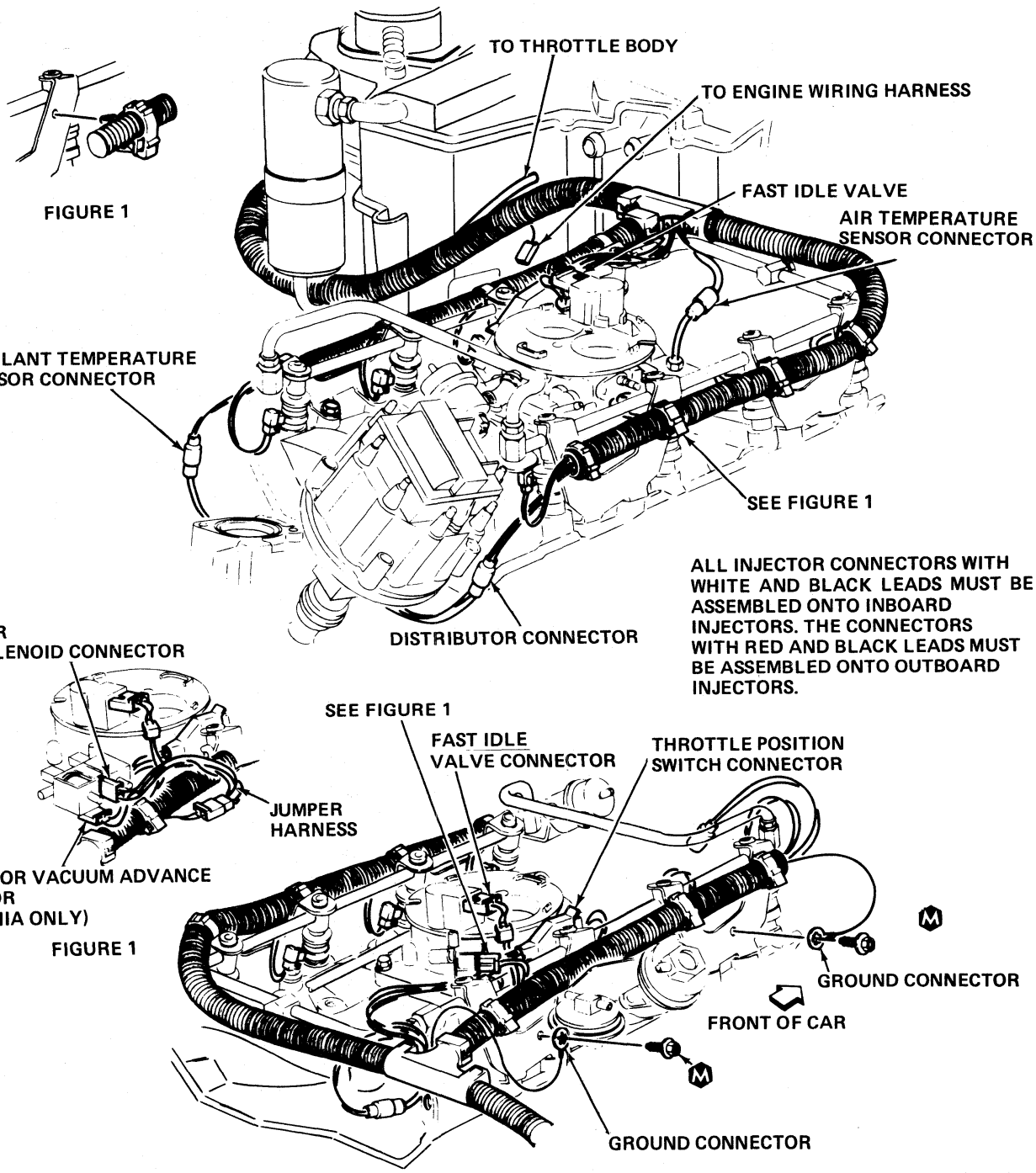


Fig. 6C-133 Engine Harness - Except Seville

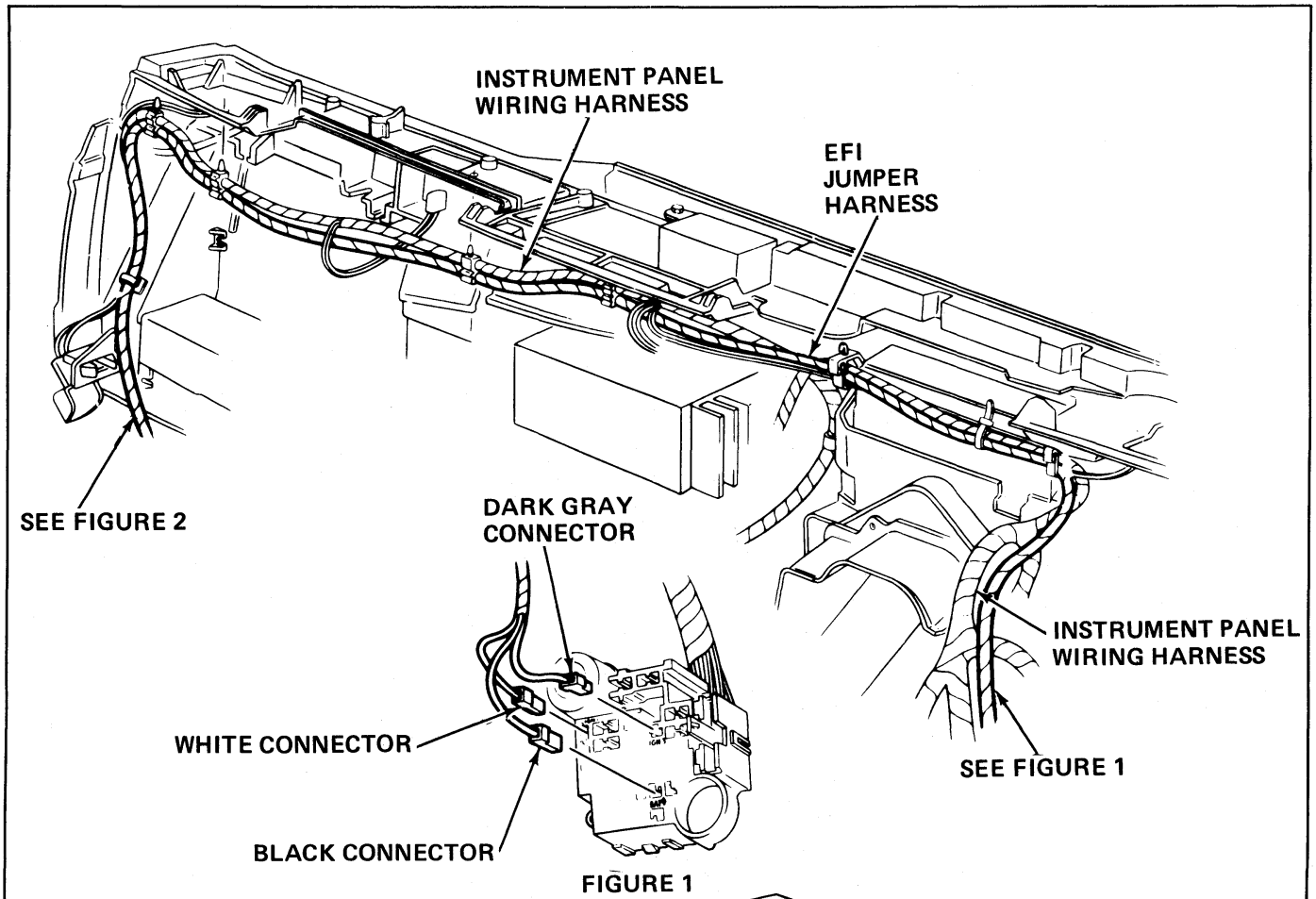


FIGURE 1

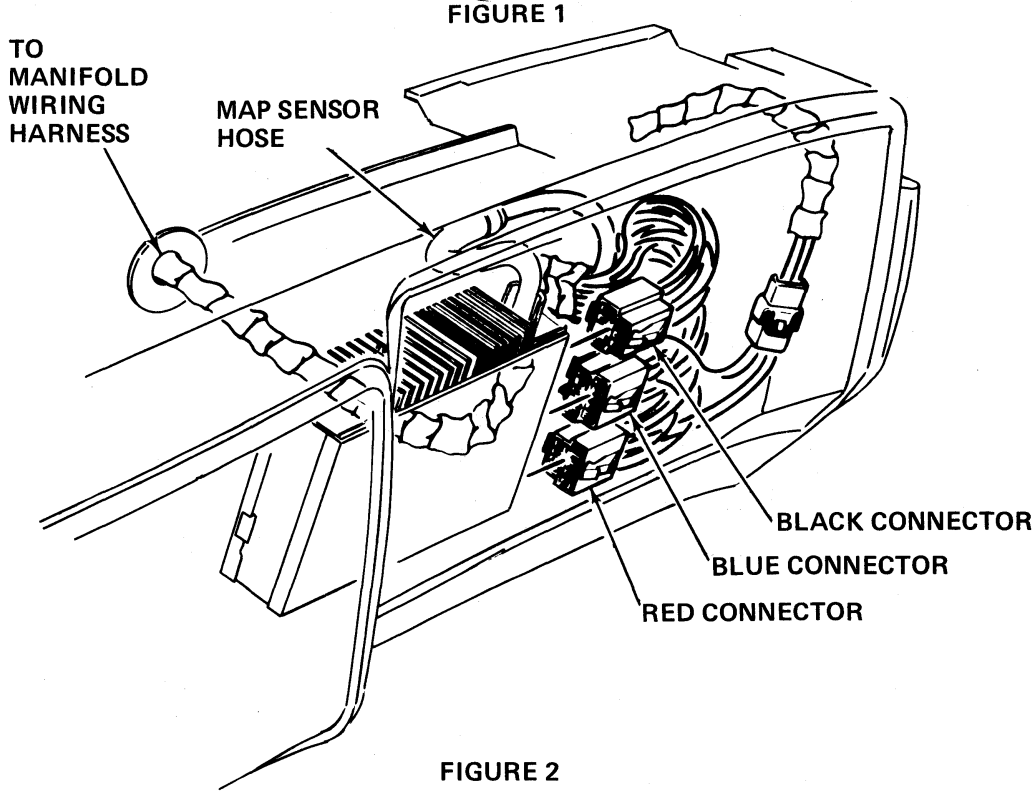


FIGURE 2

Fig. 6C-134 Instrument Panel Wiring - DeVille, Brougham

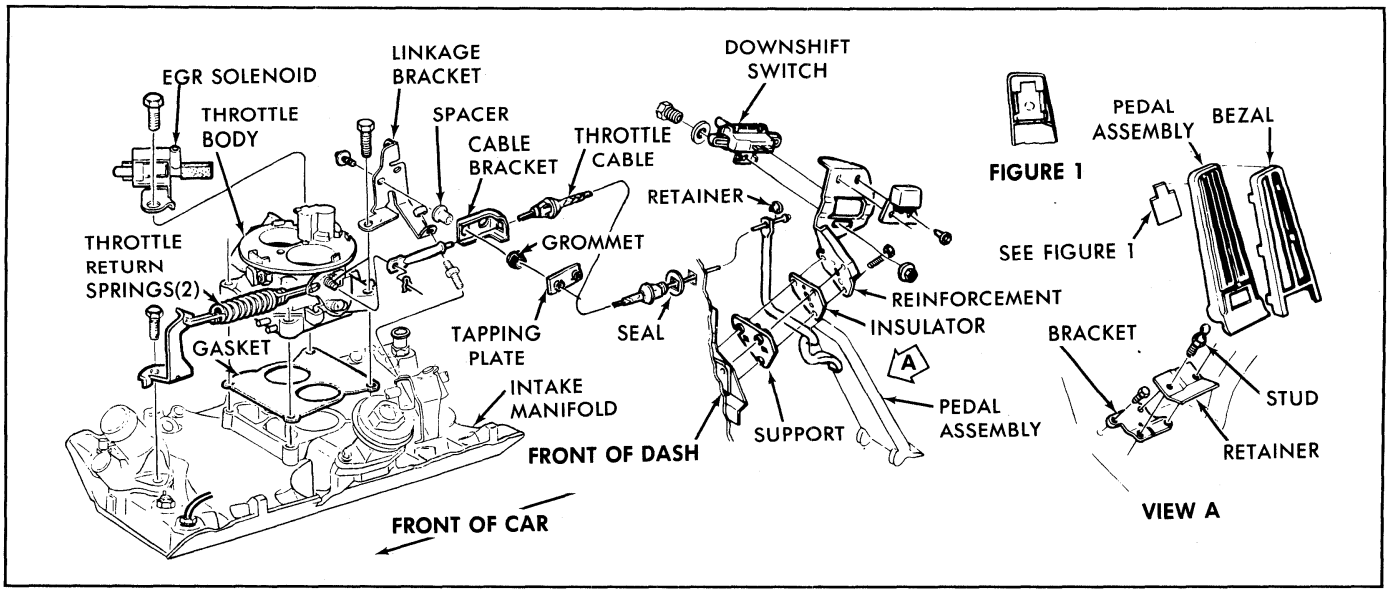


Fig. 6C-135 Throttle Linkage - Seville

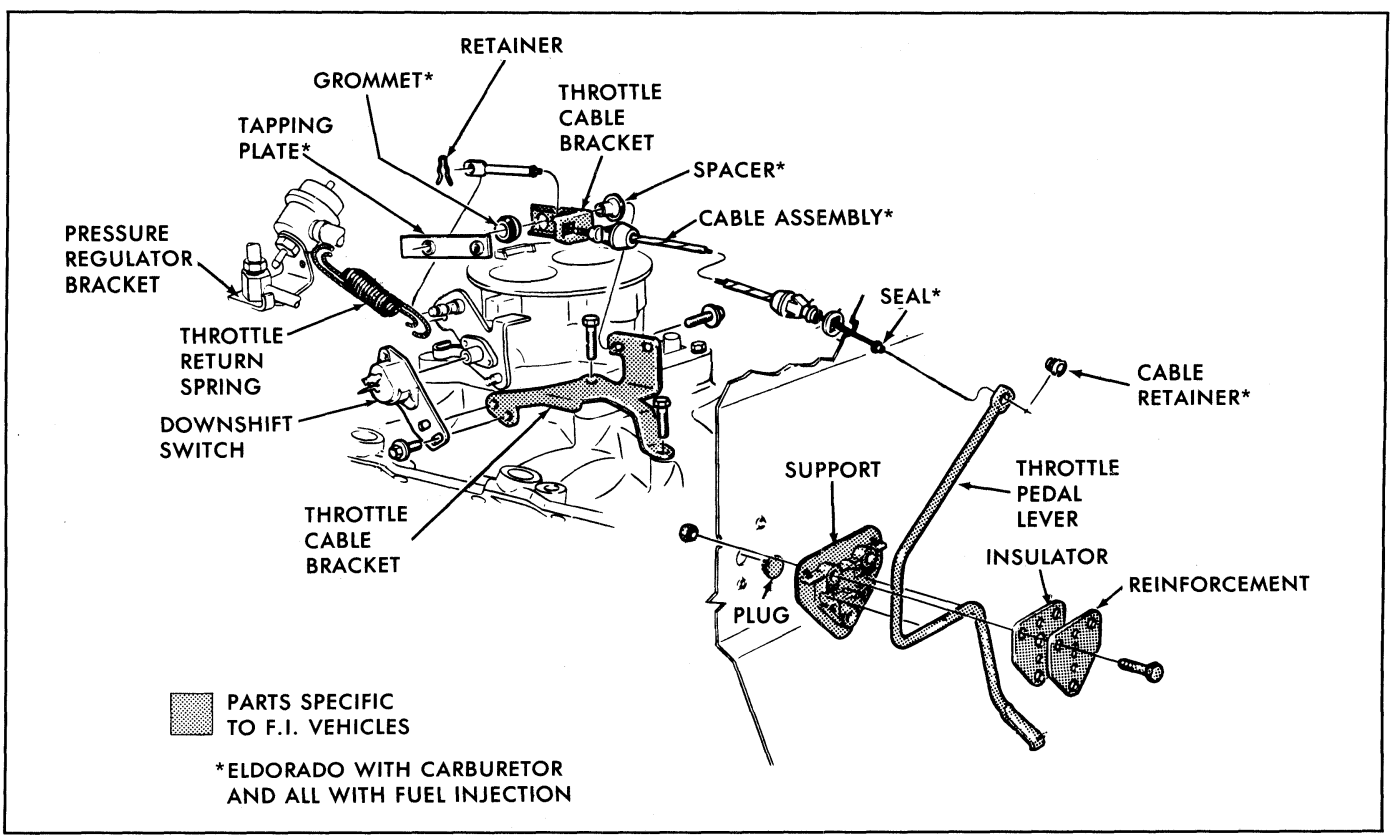


Fig. 6C-136 Throttle Linkage - Except Seville

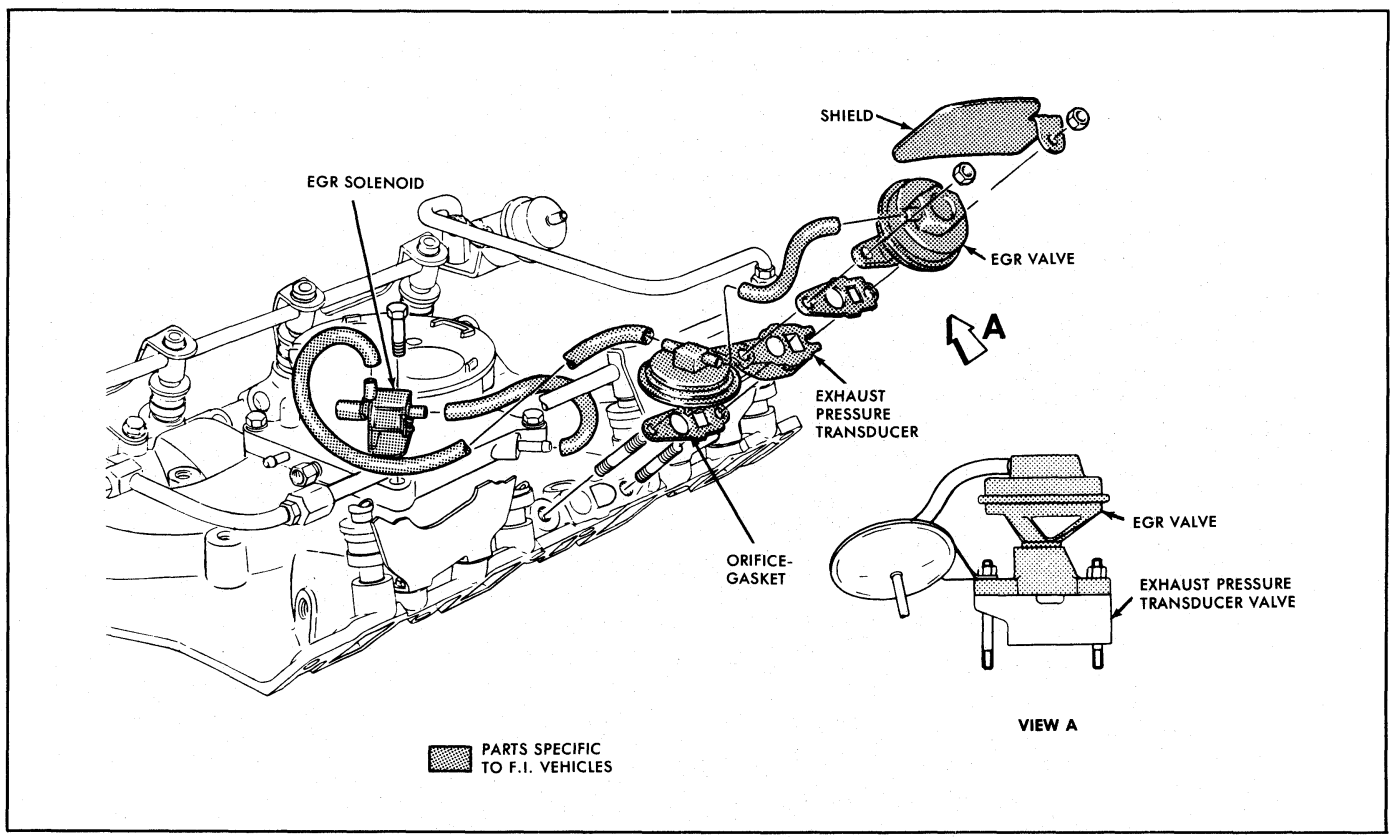


Fig. 6C-137 EGR System - Typical

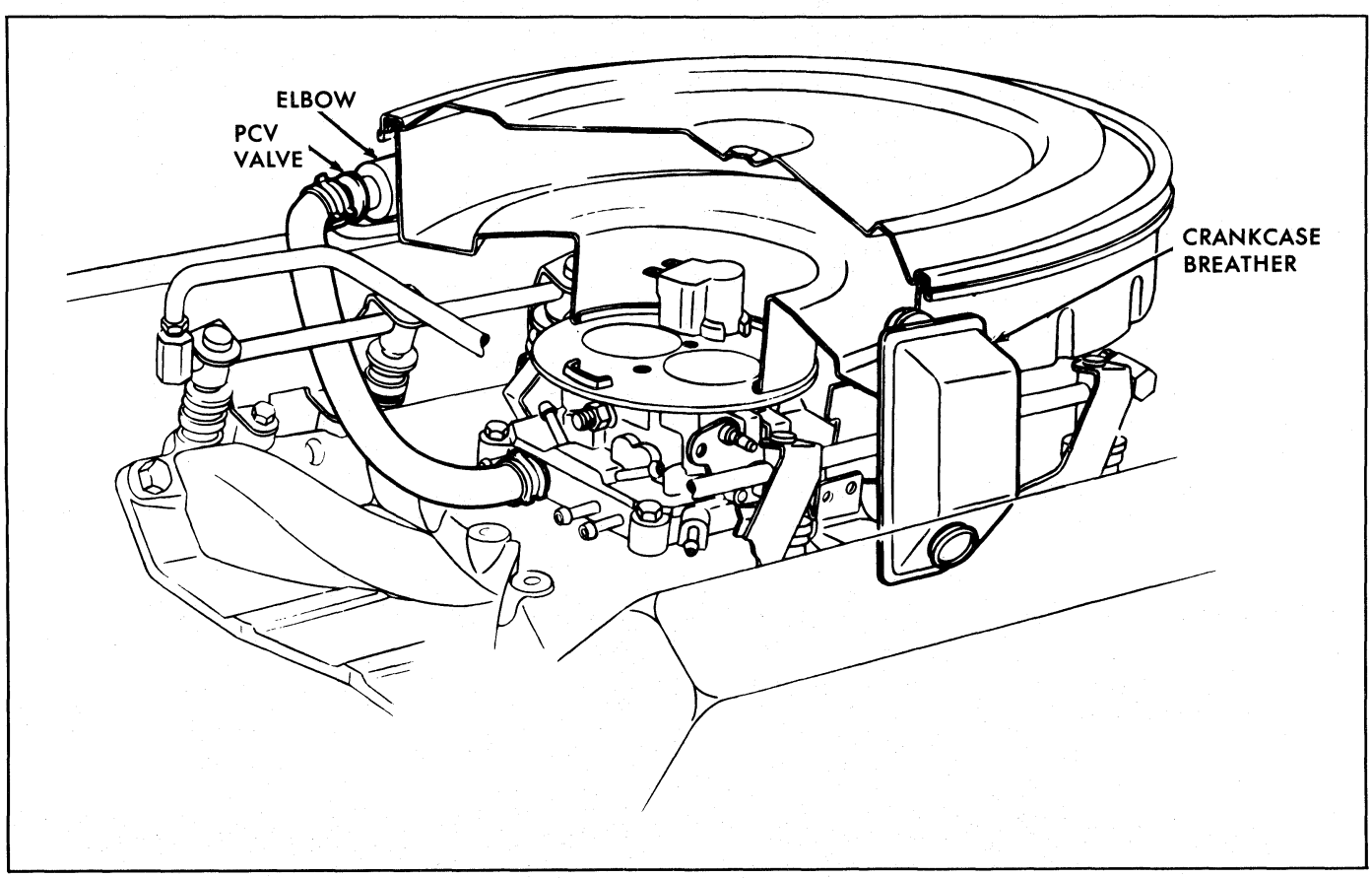


Fig. 6C-138 PCV System - Except Seville

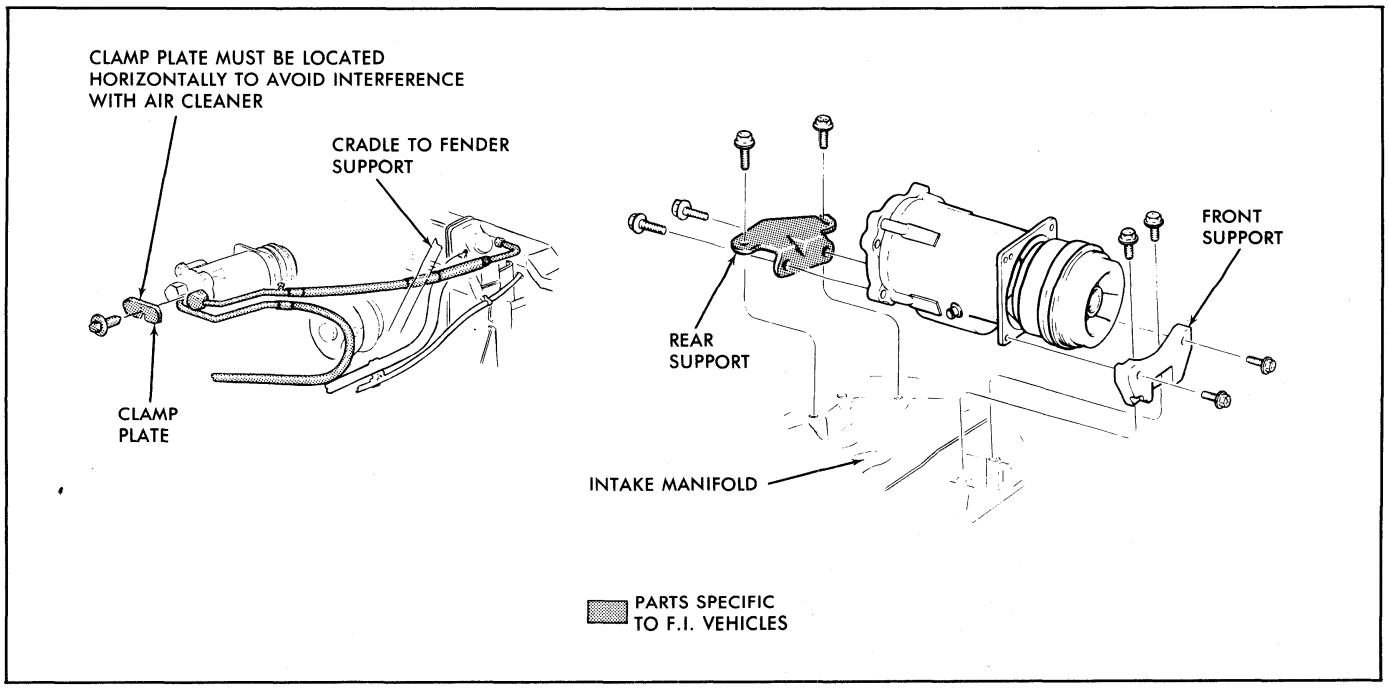


Fig. 6C-139 A/C Compressor - Except Seville

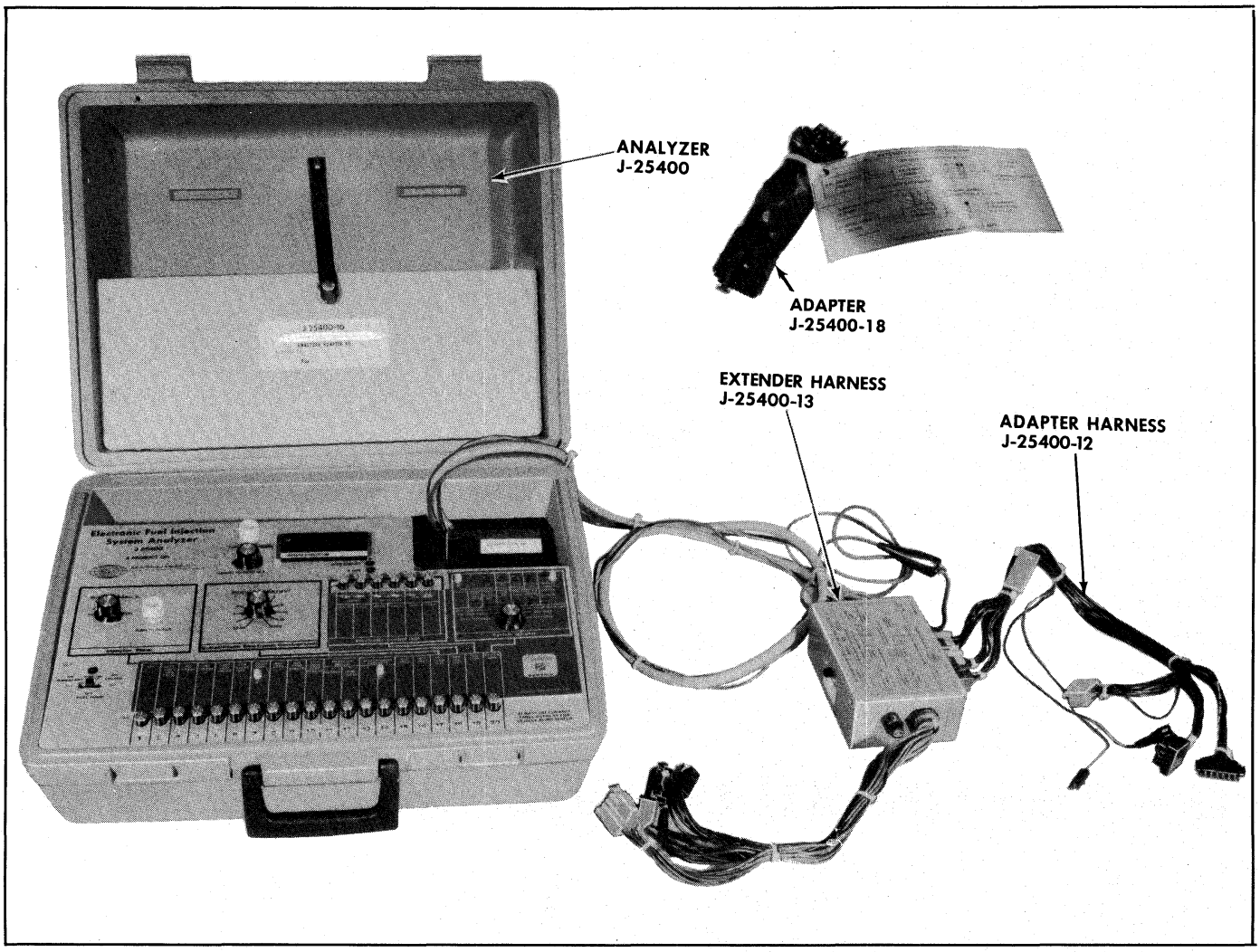


Fig. 6C-141 Special Tools

DISTRIBUTOR SERVICING

Fig. 6C-142 shows the proper relationship between the speed sensor magnets and the dimple on the distributor drive gear for both 350 cu. in. and 425 cu. in. engines with electronic fuel injection. As described in distributor overhaul, the distributor rotor is also aligned with the dimple.



6C-142 Speed Sensor Orientation

TORQUE SPECIFICATIONS

Application	Newton/Meters	Ft./Lbs.
SEVILLE		
Fuel Filter Mounting Screw	20	15
Fuel Pump Bracket to Frame Screw	29	20
Fuel Rail Flare Nuts	34	25
Injector Mounting Bracket Screw	41	30
Temperature Sensors	20	15
Throttle Body Mounting Screw	20	15
Throttle Linkage Bracket to Manifold	41	30
Throttle Linkage Bracket to Thermostat	27	20
		In./Lbs.
ECU Cover Screws	3	25
ECU Mounting Screw	3	25
Fuel Pump Ground Screw	10	90
Fuel Pump Mounting Screw	7	55
Fuel System Hose Clamps	1	10
Idle Speed Screw Locknut	2	20
In-Tank Fuel Pump Electrical Terminal	2	20
Throttle Cable Bracket Screw	2	20
DeVILLE, BROUGHAM		
		Ft./Lbs.
Coolant Sensor Adapter	27	20
Fuel Filter Bracket to Block Screw	20	15
Fuel Filter to Bracket Screw	20	15
Fuel Rail Flare Nuts	34	25
Injector Mounting Bracket Screw	41	30
Temperature Sensors	20	15
Throttle Body Mounting Screw	20	15
		In./Lbs.
ECU Mounting Screw	4	35
Fuel Pump Ground Screw	10	80
Fuel Pump Mounting Screw	3	25
Fuel System Hose Clamps	1	10
Ground Screw at Injector Bracket	7	60
Idle Speed Screw Locknut	2	20
In-Tank Pump Electrical Terminal	2	20
Power Brake Vacuum Fitting	11	100

TORQUE SPECIFICATIONS (Cont'd.)

Application	Newton/Meters	Ft./Lbs.
ELDORADO		
Coolant Sensor Adapter	27	20
Fuel Filter Bracket to Block Screw	20	15
Fuel Filter to Bracket Screw	20	15
Fuel Rail Flare Nuts	34	25
Injector Mounting Bracket Screws	41	30
Temperature Sensors	20	15
Throttle Body Mounting Screw	20	15
		In./Lbs.
ECU Mounting Screw	9	75
Fuel Pump Bracket to Frame Screw	22	180
Fuel Pump Ground Screw	15	120
Fuel Pump Mounting Screw	3	25
Fuel System Hose Clamps	1	10
Ground Screw at Injector Bracket	7	60
Idle Speed Screw Locknut	2	20

BATTERY

TABLE OF CONTENTS

General Description 6D-1
Common Causes of Battery Trouble 6D-1
Carrier and Hold Down 6D-1
Cleaning 6D-1
Ratings 6D-1
Test Indicator 6D-2
Diagnosis 6D-2
On-Car Service 6D-2
Charging Procedures 6D-2
Jump Starting 6D-3
Battery - Removal and Installation 6D-3
Battery Cable Service 6D-3

GENERAL DESCRIPTION

A sealed battery, Fig. 6D-1, is used on all 1977 Cadillac cars. The battery is designed to be maintenance-free, through two unique characteristics: first, it has an extra reserve volume of electrolyte which lasts the battery all its normal life; and second, it is much less likely to boil this liquid away, through a different chemistry than other batteries.

The battery grids are made up of a lead-calcium compound rather than lead-antimony. This compound is less susceptible to gassing, overcharge and self-discharge, which gives this battery the following advantages:

1. No water addition for the life of the battery. This improvement makes the sealed battery possible.

2. Overcharge protection. If too much voltage is applied to the battery, it simply will not charge further. In a conventional battery, the excess voltage will still try to charge the battery, leading to gassing, which causes liquid loss.

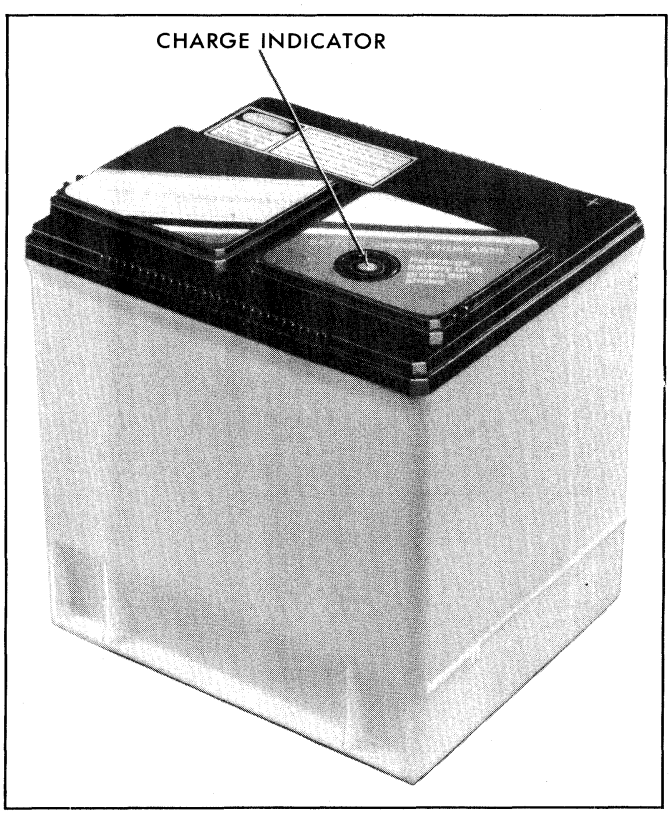


Fig. 6D-1 Battery

3. Reduced susceptibility to self-discharge. This is particularly important when a battery is left standing for long periods of time.

4. More power available in a lighter and smaller case.

COMMON CAUSES OF BATTERY TROUBLE

If the battery tests good but fails to perform satisfactorily in service for no apparent reason, the following are some of the more important factors that may point to the cause of trouble.

1. Vehicle accessories inadvertently left on overnight.

2. Slow speed driving of short duration.

3. A vehicle electrical load exceeding the generator capacity, particularly with the addition of after market equipment.

4. Defects in the charging system such as high resistance, slipping fan belt, faulty generator, or voltage regulator.

5. Battery abuse, including failure to keep the battery cable terminals clean and tight, loose battery hold-down.

6. Mechanical defects in the electrical system, such as shorted or pinched wires.

CARRIER AND HOLD-DOWN

The battery carrier and hold-down should be clean and free from corrosion before installation.

The carrier should be in a sound mechanical condition so that it will support the battery securely and keep it level.

To prevent the battery from shaking in its carrier, the hold-down bolts should be tight. However, the bolts should not be tightened to the point where the battery case or cover will be placed under a severe strain.

CLEANING

The external condition of the battery should be checked periodically for damage such as cracked cover, case, or for the presence of dirt and corrosion. The battery should be kept clean in the area of the terminals. An accumulation of acid film and dirt may permit current to flow between the terminals, which will slowly discharge the battery. For best results when cleaning batteries, wash first with a soda solution to neutralize any acid present; then flush with clean water.

RATINGS

A battery generally has two classifications of ratings: (1) a 20 hour reserve capacity rating at 80° F. (26.5°C.), and (2) a cold rating at 0° F. (-17.8°C.) which indicates the cranking load capacity (see specifications Section at end of 6D for specific battery rating).

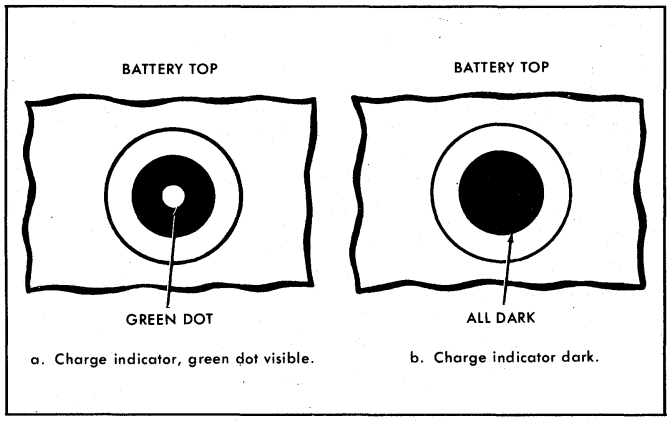


Fig. 6D-2 Charge Indicator

TEST INDICATOR

The sealed battery includes a test indicator in the top of the battery. This indicator is to be used with accepted diagnostic procedures only. It is NOT to be used to determine if the battery is good or bad, or charged or discharged, except in conjunction with an acceptable diagnosis procedure. The indicator is a built-in hydrometer in one cell and provides visual information for battery testing.

It is important when observing the indicator that the battery be relatively level and have a clean indicator top to see the correct indication. A light may be required in some poorly-lit areas.

Under normal operation, two indications can be observed, Fig. 6D-2.

1. DARK: GREEN DOT VISIBLE

Any green appearance is interpreted as a "green dot" and the battery is ready for testing. On rare occasions following prolonged cranking, the green dot may still be visible. Should this occur, charge battery as described in "Charging Procedure" section.

2. DARK: GREEN DOT NOT VISIBLE

If there is a cranking complaint, the battery should be tested as described in the "Diagnosis" section.

3. LIGHT

On rare occasions, the indicator will turn light (all clear). Normally, the battery is capable of further service; however, if a cranking complaint has been reported, replace the battery. DO NOT CHARGE, TEST OR JUMP-START.

DIAGNOSIS

The following procedure should be used for testing batteries:

1. VISUAL INSPECTION

Check for obvious damage, such as cracked or broken case or cover, that could permit loss of electrolyte. If obvious physical damage is noted, replace the battery. If not, proceed to Step 2.

2. CHECK CHARGE OF BATTERY

a. DARK: GREEN DOT VISIBLE Fig. 6D-2

If the indicator is dark and has a GREEN DOT in the center, the battery is ready for testing. Proceed to Step 3. On rare occasions, such as after prolonged cranking, the GREEN DOT may still be visible. Should this occur, charge battery as described in "Charging Procedure" section.

b. DARK: GREEN DOT NOT VISIBLE

If the indicator is dark and the green dot is NOT visible, charge the battery as outlined under "Charging Procedure" section and proceed to Step 3.

c. LIGHT

On rare occasions the indicator will turn light (all clear) and the battery should NOT be tested. Replace the battery.

3. LOAD TEST BATTERY

a. Remove surface charge by placing a 300 amp. load across the terminals for 15 seconds.

1. Load testing requires use of battery side terminal adapter to insure good connections.

b. Connect a voltmeter and a 210 amp. load across the terminals.

c. Read voltage after 15 seconds with load connected, then disconnect load.

d. If voltage does not drop below the minimum listed in Fig. 6D-3, the battery is good and should be fully charged, cleaned, and returned to service.

e. If voltage drops below the minimum listed, replace the battery.

Temperature °F	Temperature °C	Minimum Voltage
70° or Greater	21° or Greater	9.6
60° to 69°	16° to 20°	9.5
50° to 59°	10° to 15°	9.4
40° to 49°	4° to 9°	9.3
30° to 39°	-1 to 4°	9.1
20° to 29°	-7 to -1°	8.9
10° to 19°	-12 to -7°	8.7
0° to 9°	-18 to -12°	8.5

Fig. 6D-3 Voltage Chart

ON-CAR SERVICE

CHARGING PROCEDURES

When it is necessary to charge a battery, the following safety precautions must be followed:

1. If the battery case feels hot (125°F. - 51°C.) discontinue charging or reduce charging rate.

2. If violent gassing or spewing of electrolyte through the vent holes occurs, discontinue charging or reduce charging rate.

3. Charging should also be stopped when green dot is visible.

When the maximum time in Fig. 6D-4 is reached for charging the battery, charging should be stopped even if the

BATTERY CHARGING GUIDE		
Stop charging when the green dot appears or when the maximum charge shown below is reached.		
Battery Model	**Slow Charging Rate**	**Fast Charging Rate**
87-5	5A @ 15 Hrs. 10A @ 7½ Hrs.	20A @ 3¾ Hrs. 30A @ 2½ Hrs. 40A @ 2 Hrs. 50A @ 1½ Hrs.

Fig. 6D-4 Battery Charging Guide

green dot is not visible.

Charge the battery according to Fig. 6D-4 above. It should be noted that these times are approximate and for reference only. Temperature of the battery, as well as age and condition of the battery, will affect the charging time. Also, most charging equipment will not charge at a constant amperage. The most satisfactory charging is accomplished at a slow charging rate. Whenever possible, the slow rate should be used.

JUMP STARTING IN CASE OF EMERGENCY WITH AUXILIARY (BOOSTER) BATTERY

NOTE: Do not push or tow vehicle to start. Damage to the emission system and/or to other parts of the vehicle may result.

Both booster and discharge battery should be treated carefully when using jumper cables. Follow the procedure outlined below, being careful not to cause sparks:

WARNING: DEPARTURES FROM THESE CONDITIONS OR THE PROCEDURE BELOW COULD RESULT IN (1) SERIOUS PERSONAL INJURY (PARTICULARLY TO EYES) OR PROPERTY DAMAGE FROM SUCH CAUSES AS BATTERY EXPLOSION, BATTERY ACID, OR ELECTRICAL BURNS: AND/OR (2) DAMAGE TO ELECTRONIC COMPONENTS OF EITHER VEHICLE.

Never expose battery to open flame or electric spark - batteries generate a gas which is flamable and explosive.

Remove rings, watches, and other jewelry. Wear approved eye protection.

Do not allow battery fluid to contact eyes, skin, fabrics, or painted surfaces - fluid is a corrosive acid. Flush any contacted area with water immediately and thoroughly. Be careful that metal tools or jumper cables do not contact the positive battery terminal (or metal in contact with it) and any other metal on the car, because a short circuit could occur. Batteries should always be kept out of the reach of children.

1. Set parking brake and place transmission in "PARK". Turn off lights, air conditioner and other electrical loads.

2. Check the battery to insure that it is in proper condition, as described on page 6D-2, to allow safe starting. If it is not, do not attempt jump starting.

a. Check the test indicator. If it is light (all clear), replace the battery, and do not attempt to jump start.

3. Only 12 volt batteries can be used to start engine.

4. Attach the end of one jumper cable to the positive terminal of the booster battery and the other end of the same cable to the positive terminal of the discharged battery. DO NOT PERMIT vehicles to touch each other as this could cause a ground connection and counteract the benefits of this procedure.

5. Attach one end of the remaining negative cable to the negative terminal of the booster battery, and the other end of a solid engine ground (such as A/C compressor or generator mounting bracket) at least 12 inches from the battery of the vehicle being started (DO NOT CONNECT DIRECTLY TO THE NEGATIVE POST OF THE DEAD BATTERY).

6. Start the engine of the vehicle that is providing the jump start and turn off electrical accessories. Then start the engine in the car with the discharge battery.

7. Reverse these directions **exactly** when removing the jumper cables. The negative cable must be disconnected from the engine that was jump started **first.**

BATTERY REMOVAL AND INSTALLATION (Fig. 6D-5)

When handling a battery, the following safety precautions should be observed:

1. Hydrogen gas is produced by the battery. A flame or spark near the battery may cause the gas to ignite.

2. Battery fluid is highly acidic. Avoid spilling on clothing or other fabric. Any spilled electrolyte should be flushed with large quantities of water and cleaned immediately.

To remove or replace a battery, always disconnect the negative cable first then the positive cable.

BATTERY CABLE SERVICE (Fig. 6D-5)

Improperly torqued side terminal battery cables can cause high resistances to develop which may lead to hard starting conditions. The following procedure is recommended should this condition be encountered:

1. Remove negative battery cable.

2. Clean threads and end of cable screw with a wire brush. Cleaning of the screw end is particularly important.

3. Clean the internal threads in the battery case and the end of the hole where the cable screw makes contact. A 3/18-16 bottoming tap can be used to clean the threads, however, extreme caution should be exercised to see that the 90 inch-pound torque limit is not exceeded.

4. Repeat Steps 1 thru 3 for the positive cable.

5. Install positive cable and torque to 90 inch-pounds. Install protective cover.

6. Install negative cable and torque to 90 inch-pounds. Install protective cover.

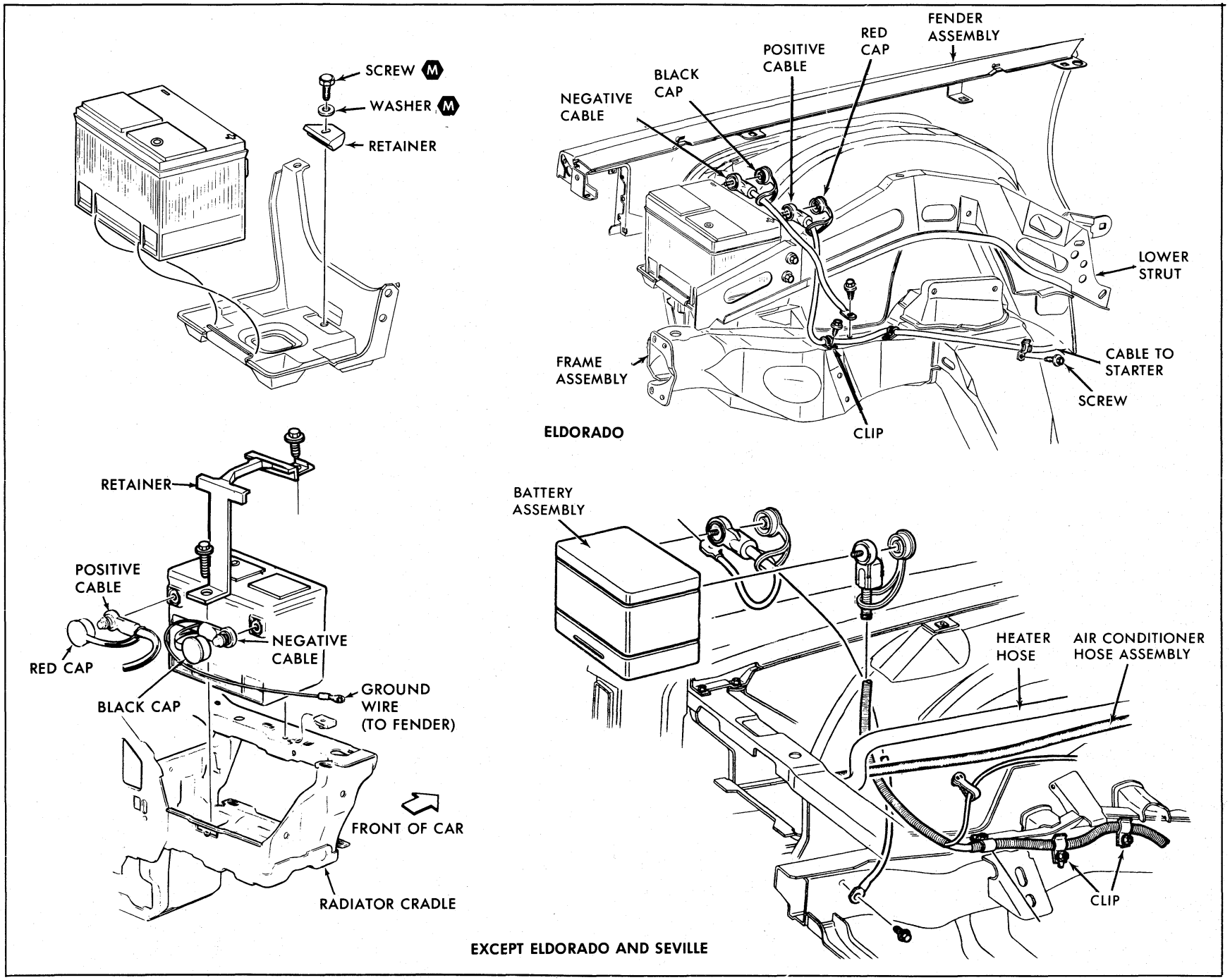


Fig. 6D-5 Battery Cables

CHARGING SYSTEM
TABLE OF CONTENTS

General Description 6D-5
Diganosis 6D-8
Faulty Indicator Lamp Operation 6D-8
Undercharged Battery 6D-8
Overcharged Battery 6D-9
On-Car Service 6D-11
Overhaul 6D-13
Disassembly 6D-13
Rotor Field Winding Checks 6D-13
Diode Trio Check 6D-15
Rectifier Bridge Check 6D-15
Stator Checks 6D-15
Brush Holder and Regulator Replacement 6D-21
Slip Ring Servicing 6D-17
Bearing Replacement and Lubrication 6D-17
Reassembly 6D-13

GENERAL DESCRIPTION

The basic charging system is the SI integral regulator charging system, Fig. 6D-6. The components are connected electrically as shown in Fig. 6D-7.

Although several models are available with different outputs at Idle and different maximum outputs, their basic operating principles are the same.

The Delcotron generator features a solid state regulator that is mounted inside the generator slip ring end frame. All regulator components are enclosed into a solid mold, and this unit along with the brush holder assembly is attached to the slip ring end frame. The regulator voltage setting never needs adjusting, and no means for adjustment is provided.

The generator rotor bearings contain a supply of lubricant sufficiently adequate to eliminate the need for periodic lubrication. Two brushes carry current through the two slip rings to the field coil mounted on the rotor, and under normal conditions will provide long periods of attention-free service.

The stator windings are assembled on the inside of a laminated core that forms part of the generator frame. A rectifier bridge connected to the stator windings contains six diodes, and electrically changes the stator a.c. voltages to a d.c. voltage which appears at the generator output terminal. Generator field current is supplied through a diode trio which also is connected to the stator windings. A capacitor, or condenser, mounted in the end frame protects the rectifier bridge and diode trio from high voltages, and suppresses radio noise.

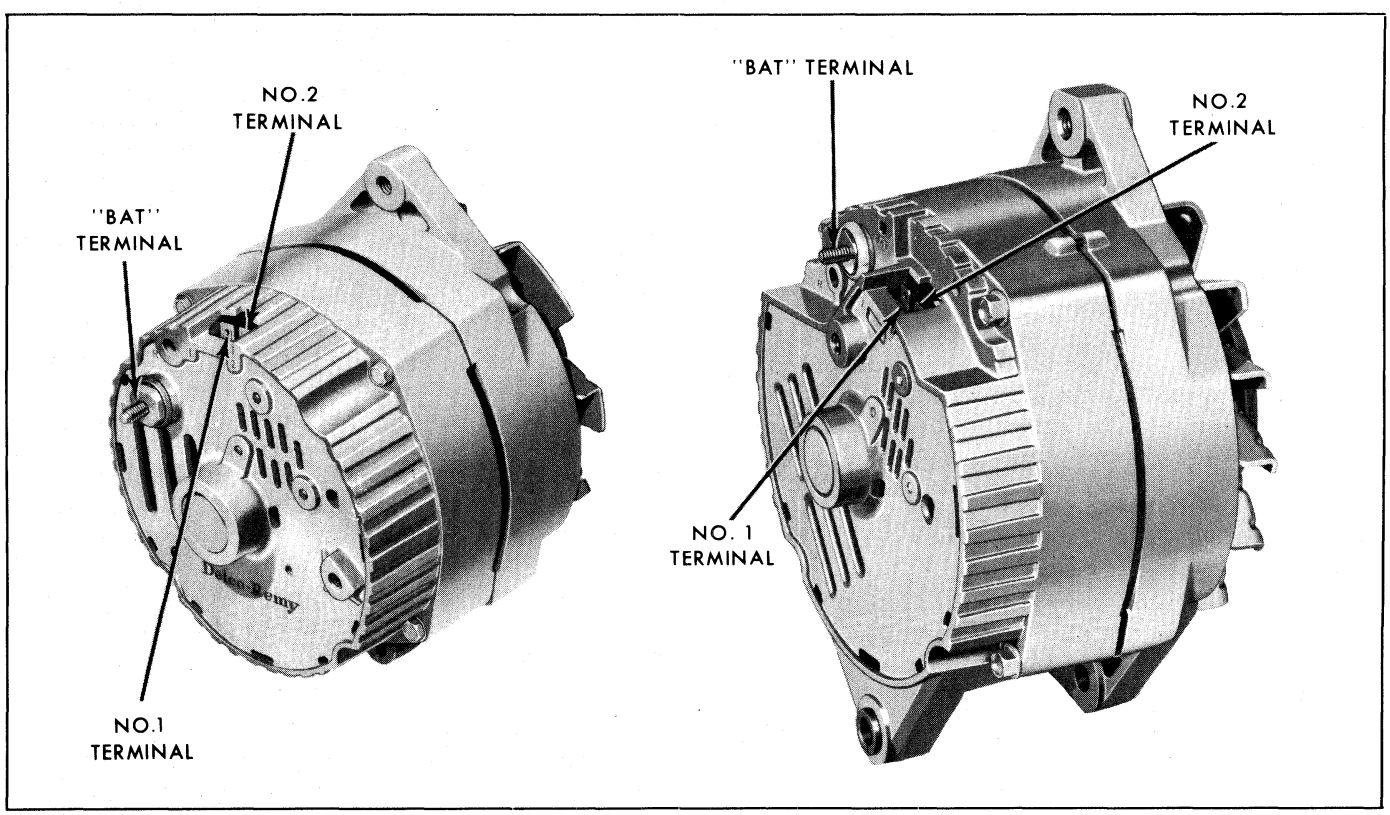


Fig. 6D-6 Generators

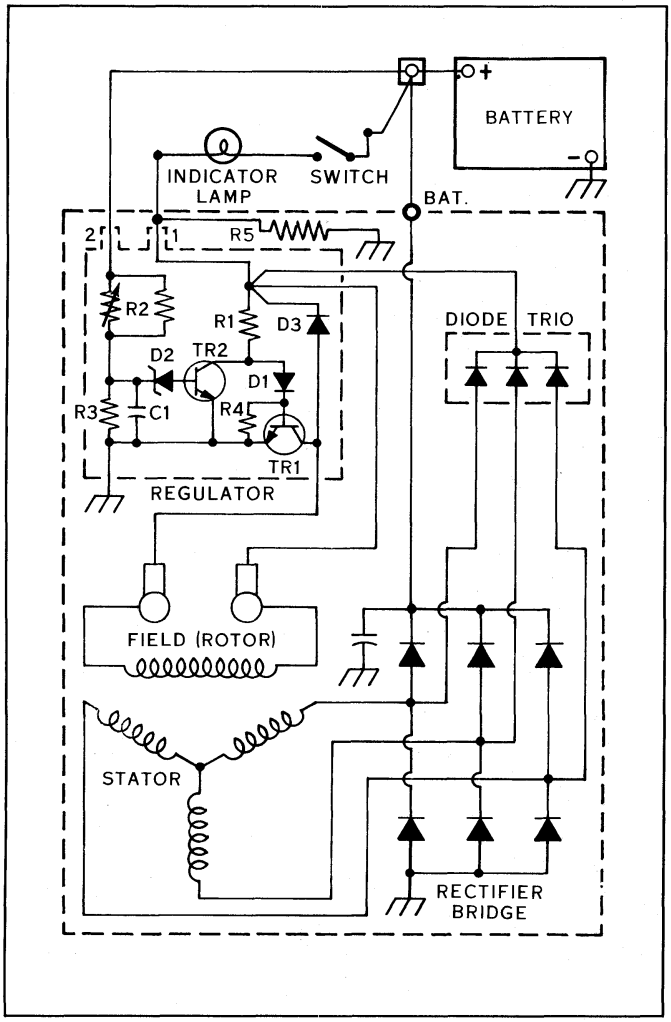


Fig. 6D-7 - Charging Circuit Wiring - Except H.D.

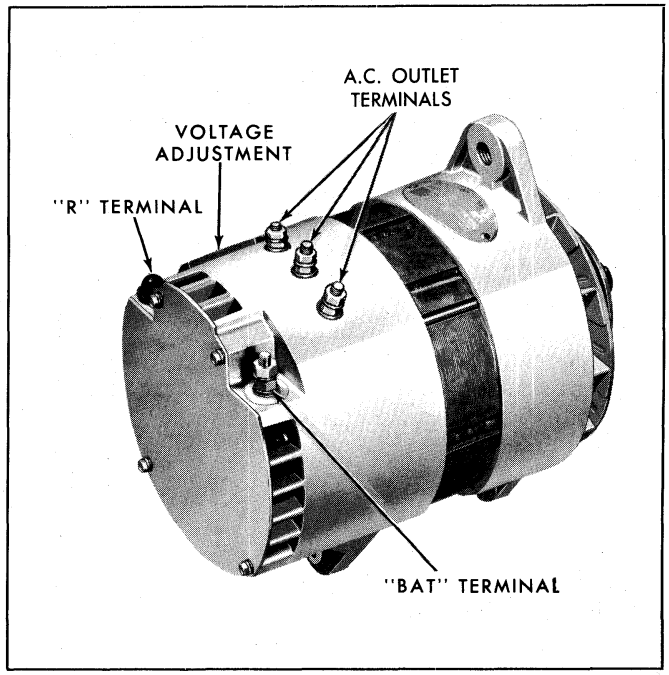


Fig. 6D-8 Heavy Duty Generator

No periodic adjustments or maintenance of any kind are required on the entire generator assembly.

Heavy Duty Generator

The optional heavy duty integral charging system for the Commercial Chassis is illustrated in Fig. 6D-8 and features a solid state regulator that is mounted inside the slip ring end frame. The regulator voltage setting can be adjusted externally by repositioning a voltage adjustment cap in the slip ring end frame. This feature is covered in detail in Fig. 6D-14. Only one wire is needed to connect the Integral Charging System to the battery, along with an adequate ground return. To operate auxiliary equipment, three a.c. terminals are provided to which a transformer-rectifier combination may be connected for conversion to 110 volts d.c.

The rotor bearing in the slip ring end frame contains a supply of lubricant sufficiently adequate to eliminate the need for periodic lubrication. The drive end frame bearing is sealed on both sides and is serviced by complete replacement. Two brush[illegible] carry current through the two slip rings to the field c[illegible]nted on the rotor, and under normal conditions will [illegible]ng periods of attention-free service.

[illegible]tor windings are assembled on the inside of a [illegible]e that forms part of the frame. Rectifier bridges connected to the stator windings each contain six diodes, and electrically change the stator a.c. voltages to a d.c. voltage which appears at the output terminal. Field current is supplied through a diode trio which also is connected to the stator windings. A capacitor, or condenser, mounted in the end frame protects the rectifier bridges and diode trio from high voltages, and suppresses radio noise.

The internal wiring diagram is illustrated in Fig. 6D-9. The basic operating principles are explained as follows.

With the Integral Charging System operating, a.c. voltages initially are generated in the stator windings by residual magnetism in the rotor. Current then flows through the diode trio, resistor R1, and resistor R4 to turn transistor TR1 on. The stator then supplies d.c. field current through the diode trio, the field, TR1, and then through the grounded diodes in the rectifier bridges back to the stator. Also, the diodes in the rectifier bridges change the stator a.c. voltages to a d.c. voltage which appears between ground and the "BAT" terminal. As speed increases, current is provided for charging the battery and operating electrical accessories.

As the speed and voltage increase, the voltage between R2 and R3 increases to the value where zener diode D1 conducts. Transistor TR2 then turns on and TR1 turns off. With TR1 off, the field current and system voltage decrease, and D1 then blocks current flow causing TR1 to turn back on. The field current and system voltage increase, and this cycle then repeats many times per second to limit the voltage to the adjusted value.

Capacitor C1 smooths out the voltage across R3, resistor R4 prevents excessive current through TR1 at high temperatures, and diode D2 prevents high-induced-voltages in the field windings when TR1 turns off.

NOISY GENERATOR

Noise from a generator may be caused by a loose drive pulley, loose mounting bolts, worn or dirty bearings, defective diode, out-of-round or rough slip rings, hardened brushes or defective stator.

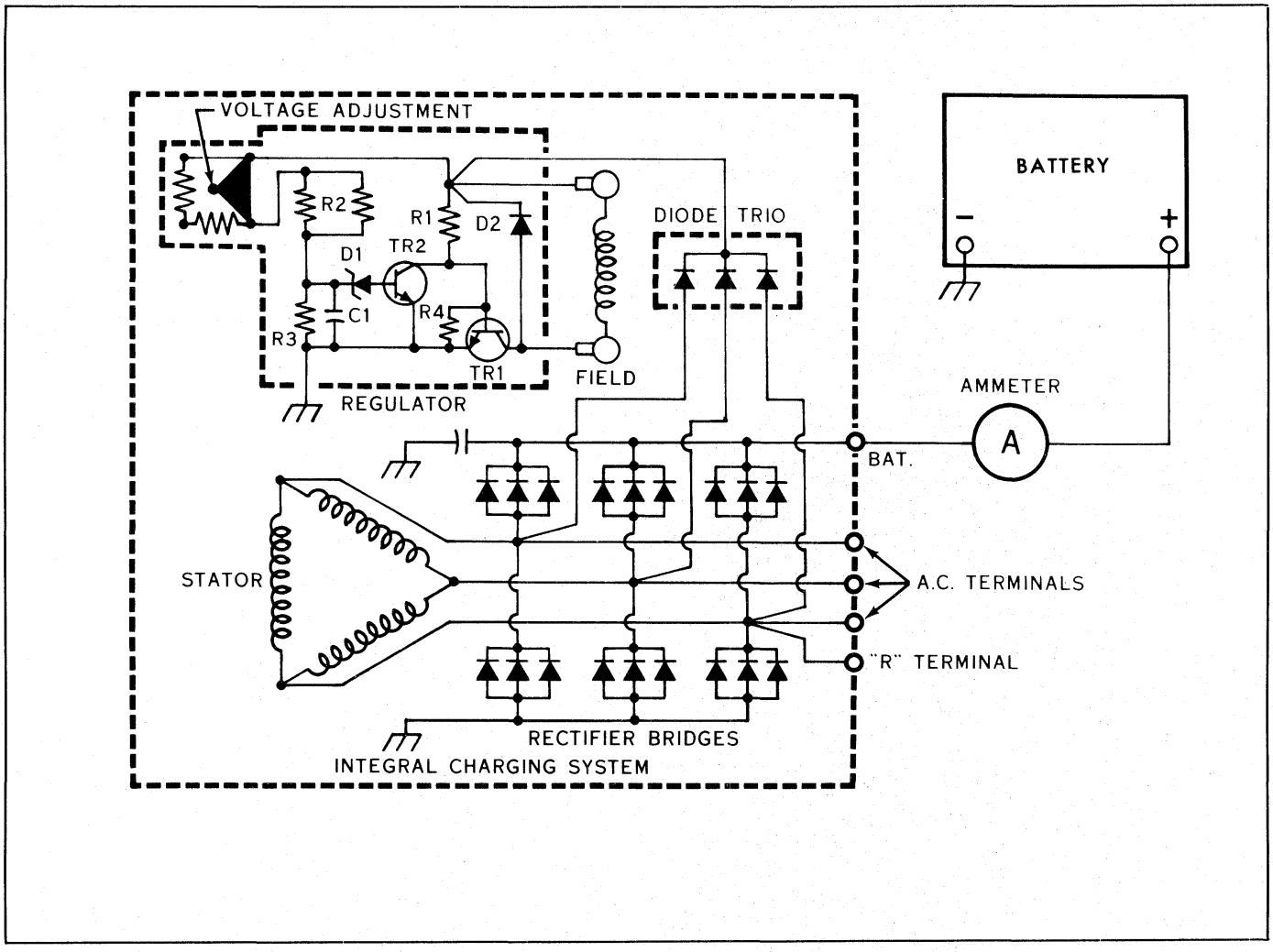


Fig. 6D-9 Internal Wiring Diagram - Heavy Duty Generator

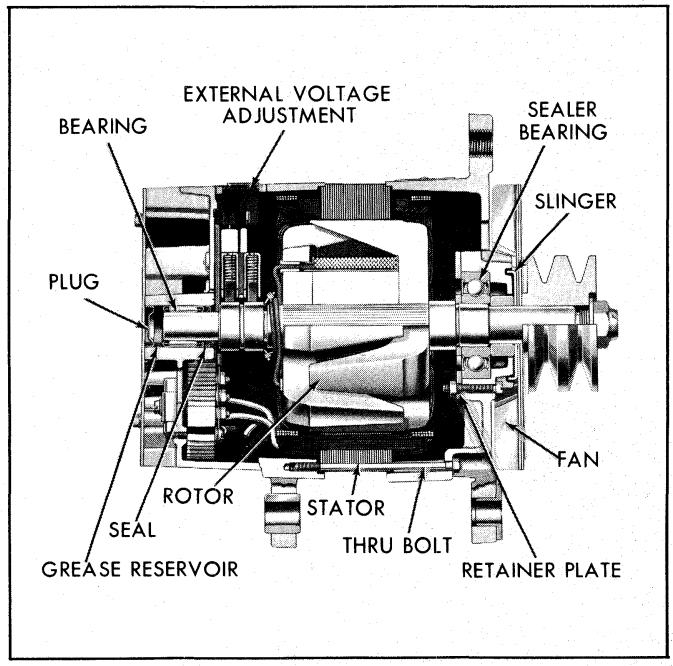


Fig. 6D-10 Cutaway View of Heavy Duty Generator

DIAGNOSIS CHARGING SYSTEMS - EXCEPT HEAVY DUTY

a basic wiring diagram showing lead connections is shown in Fig. 6D-11. To avoid damage to the electrical equipment, always observe the following preprecautions:

- Do not polarize the generator.
- Do not short across or ground any of the terminals in the charging circuit except as specifically instructed.
- Never operate the generator with the output terminal open-circuited.
- Make sure the generator and battery have the same ground polarity.
- When connecting a charger or booster battery to the vehicle always follow instructions as described in the battery section.

Trouble in the charging system will show up as one or more of the following conditions:

A. Faulty indicator lamp operation.

B. An undercharged battery as evidenced by slow cranking.

Switch	Lamp	Engine
OFF	OFF	STOPPED
ON	ON	STOPPED
ON	OFF	RUNNING

A. Faulty Indicator Lamp Operation

Check the indicator lamp for normal operation as shown in the lamp chart.

If the indicator lamp operates normally, proceed to "Undercharged Battery" section. Otherwise, proceed to **either one** of the following three **abnornal** conditions.

1. **Switch off, lamp on-In** this case, disconnect the two leads from the generator No. 1 and No. 2 terminals. If the lamp stays on, there is a short between these two leads. If the lamp goes out, replace the rectifier bridge as covered in the "GENERATOR UNIT REPAIR" section. This condition will cause an undercharged battery.

2. **Switch on, Lamp off, Engine Stopped-** This problem can be caused by the conditions listed in Part 1 above, or by an open in the circuit. To determine where an open exists, proceed as follows:

a. Check for a blown fuse, a burned out bulb, defective bulb socket, or an open in No. 1 lead circuit between generator and ignition switch.

b. If no defects have been found, proceed to "Undercharged Battery" section.

3. **Switch on, Lamp on, Engine Running** check for a blown 20 amp. A/C fuse between indicator lamp and switch. The other possible causes of this condition are covered in the"UNDERCHARGED BATTERY" section.

If a defect has been found and corrected at this point, no further checks need be made.

B. Undercharged Battery

This condition, as evidenced by slow cranking and battery test indicator dark green, can be caused by one or more of the following conditions even though the indicator lamp may be operating normally.

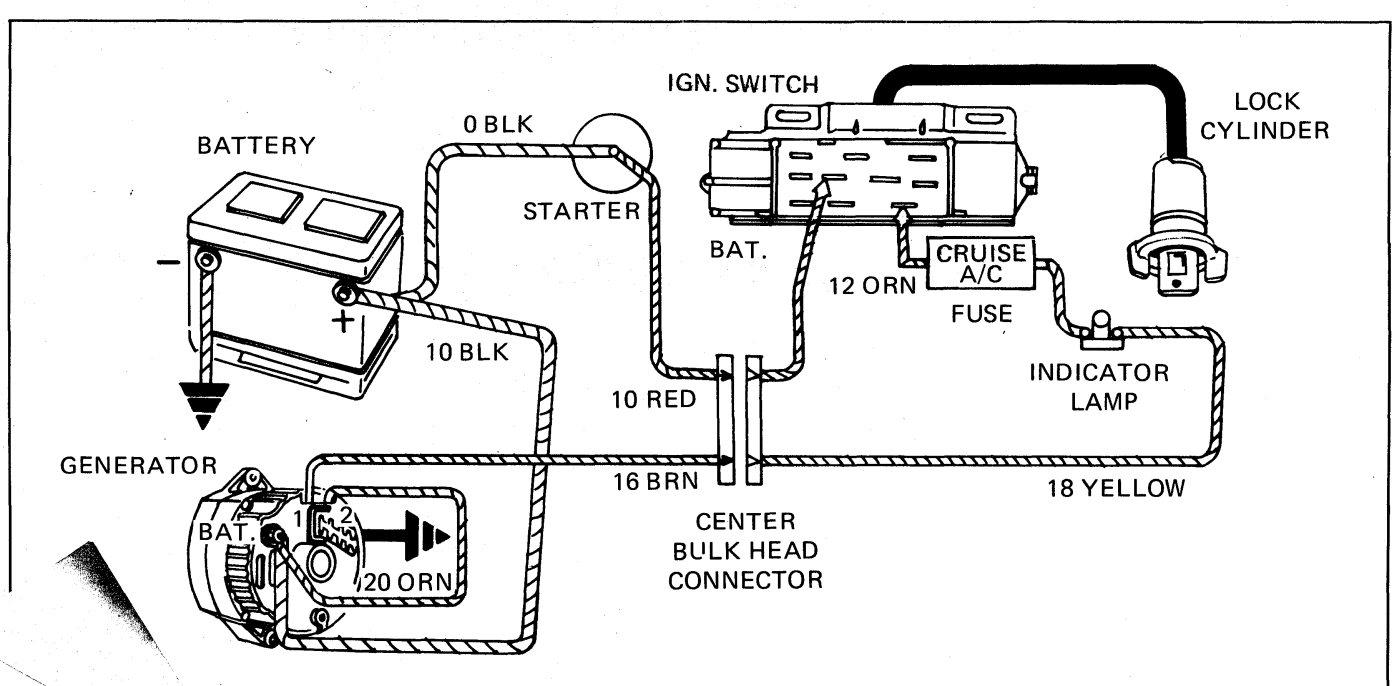


Fig. 6D-11 Charging Circuit - Except H.D.

1. Insure that the undercharged condition has not been caused by accessories having been left on for extended periods.

2. Check the drive belt for proper tension. Section 6B Page 6B-12 and 21.

3. If a battery defect is suspected, refer to Battery Section Page 6D-2.

4. Inspect the battery and charging system wiring for defects. Check all connections for tightness and cleanliness, including the slip connectors at the generator and firewall, and the cable clamps and battery posts.

5. With ignition switch on and all wiring harness leads connected (refer to Fig. 6D-6) connect a voltmeter from:

a. generator "BAT" terminal to ground

b. generator No. 1 terminal to ground

c. generator No. 2 terminal to ground

A zero reading indicates an open between voltmeter connection and battery. Generators have a built-in feature which avoids overcharge and accessory damage by preventing the generator from turning on if there is an open in the wiring harness connected to the No. 2 generator terminal. Opens in the wiring harness connected between the No. 2 generator terminal and battery may be between the terminals, at the crimp between the harness wire and terminal, or in the wire.

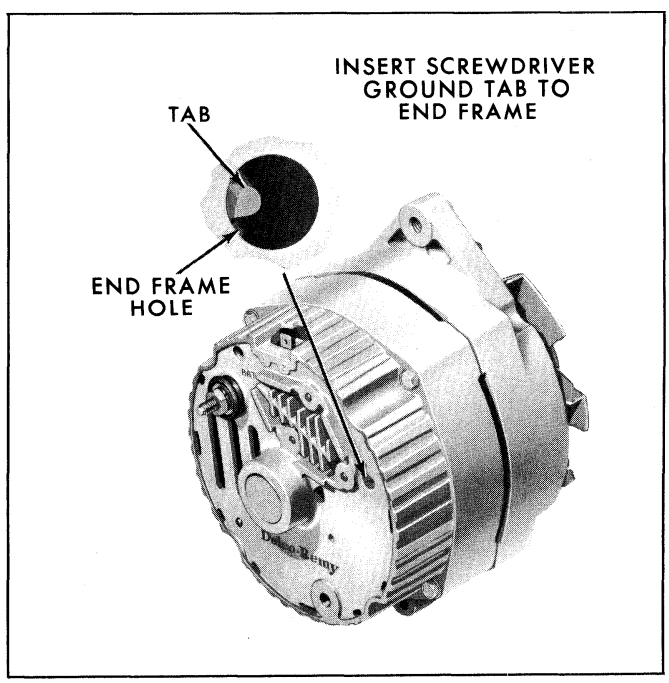


Fig. 6D-12 Generator Test Hole

6. If previous steps 1 through 5 check satisfactorily, check generator as follows:

a. Disconnect battery ground cable.

b. Connect an ammeter in the circuit at the "BAT" terminal of the generator.

c. Reconnect battery ground cable.

d. Turn on radio, windshield wipers, lights high beam and blower motor high speed. Connect a carbon pile across the battery.

e. Operate engine at moderate speed as required, and adjust carbon pile as required, to obtain maximum current output.

f. If ampere output is within 10 amperes of rated output as stamped on generator frame, generator is not defective; recheck Steps 1 through 5.

g. If ampere output is not within 10 amperes of rated output, go to Step h.

h. Ground the field winding by inserting a screwdriver into the test hole Fig. 6D-12.

CAUTION: *Tab is within 3/4 inch of casting surface. Do not force screwdriver deeper than one inch into end frame.*

i. Operate engine at moderate speed as required, and adjust carbon pile as required to obtain maximum current output.

j. If output is within 10 amperes of rated output, check field winding as covered in "GENERATOR UNIT REPAIR" section, and test regulator with regulator tester.

k. If output is not within 10 amperes of rated output, check the field winding, diode trio, rectifier bridge, and stator as covered in "GENERATOR UNIT REPAIR" section.

l. If test hole is not accessible, disassemble generator and make tests listed in "GENERATOR UNIT REPAIR" section.

Generator Tester - Many testers a such as J-26290 re available to check the generator. They provide a quick on-car test, and can save time over conventional diagnostic methods. Consult manufacturer's instructions for usage.

C. Overcharged Battery

1. To determine battery condition, refer to Battery Section Page 6D-2.

2. Connect a voltmeter from generator No. 2 terminal to ground. If reading is zero, No. 2 lead circuit is open.

3. If battery and No. 2 lead circuit check good, but an obvious overcharge condition exists. Proceed to "Disassembly" section of "GENERATOR UNIT REPAIR", and check field winding for grounds and shorts. If defective replace rotor, and test regulator with regulator tester.

CHARGING SYSTEM - WITH H.D. GENERATOR

Analyzing Charging System Trouble

Close adherence to the following procedures in the order presented will lead to the location and correction of charging system malfunctions in the shortest possible time. Only a portion of these procedures need be performed. It will seldom be necessary to perform all the procedures in order to locate the trouble.

A basic wiring diagram showing lead connections is shown in Fig. 6D-13. To avoid damage to the electrical equipment always observe the following precautions:

- Do not polarize the Integral Charging System.
- Do not short across or ground any of the terminals in the charging circuit except as specifically instructed herein.
- Make sure the Integral Charging System and battery have the same ground polarity.
- When connecting a charger or a booster battery to the vehicle battery, always follow procedure described on Page 6D-3.

Trouble in the charging system will show up as one or more of the following conditions:

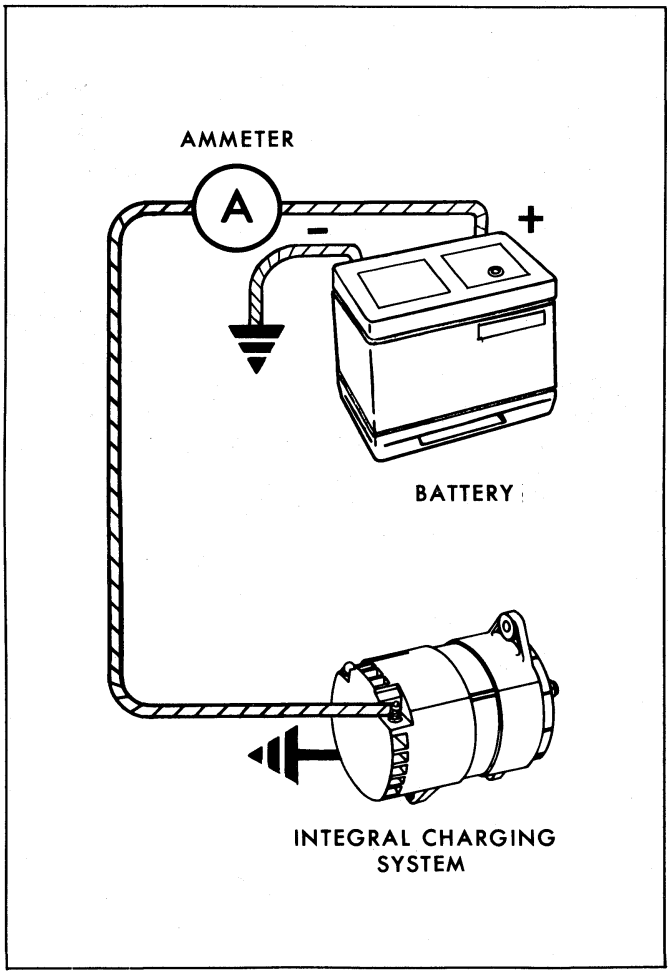


Fig. 6D-13 Wiring Diagram - Heavy Duty Generator

a. Undercharged Battery

This condition, as evidenced by slow cranking and can be caused by one or more of the following conditions:

1. Insure that the undercharged condition has not been caused by accessories having been left on for extended periods.
2. Check the drive belt for proper tension.
3. If a battery malfunction is suspected, proceed with checks.
4. Inspect the wiring. Check all connections for tightness and cleanliness, including the battery posts.
5. Connect a voltmeter from "BAT" terminal on Integral Charging System to ground. A zero reading indicates an open between voltmeter connection and battery.
6. If previous Steps 1 through 5 check satisfactorily, check Integral Charging System as follows:
7. Disconnect positive battery cable.
8. Install knife blade switch between battery positive post and battery cable terminal.
9. Connect AT-20 tester as follows:
   a. Set ground polarity switch to negative position.
   b. Set load control to direct **position.**

   Connect BAT lead of ammeter to knife blade switch terminal stud and connect REG lead to positive battery cable on the knife blade switch.
   d. Connect ammeter GRD terminal to negative battery terminal.
10. On air conditioned cars, disconnect the 18T wire from the blower motor.
11. Close knife blade switch and start engine.
12. Turn off all accessories and close car doors.

    CAUTION: *The following specifications are critical and given values must be adhered to.*
13. Open knife blade switch and raise engine speed to 750 rpm.

    NOTE: Voltage should not be allowed to rise above 16 volts.
14. Adjust load control for highest ammeter reading.
15. Reading should be 95 amps. plus or minus 10 percent.

    CAUTION: *In no case should engine speed to above 750 rpm as generator is capable of producing 145 to 150 amps and will destroy ammeter.*
16. If reading given in Step 15 is correct, generator is functioning normally. In this case, an adjustment of the voltage setting may correct the undercharged condition. Raise the setting by removing the voltage adjusting cap, rotating in increments of 90°, and then re-inserting the cap in the connector body. As illustrated in Fig. 6D-14 the cap is set for low voltage. With position 2 aligned with the arrow, the setting is increased to medium low, position 3 is medium high, and position "HI" is the highest regulator setting. After adjusting the setting, check for an improved battery condition after a service period of reasonable length, such as one week.

    NOTE: The voltage adjustment in Fig. 6D-14, is for purposes of illustration only. The actual adjustment as shipped from the factory may be in some other position such as position 3, depending on the application requirement.

    NOTE: High underhood temperatures may cause

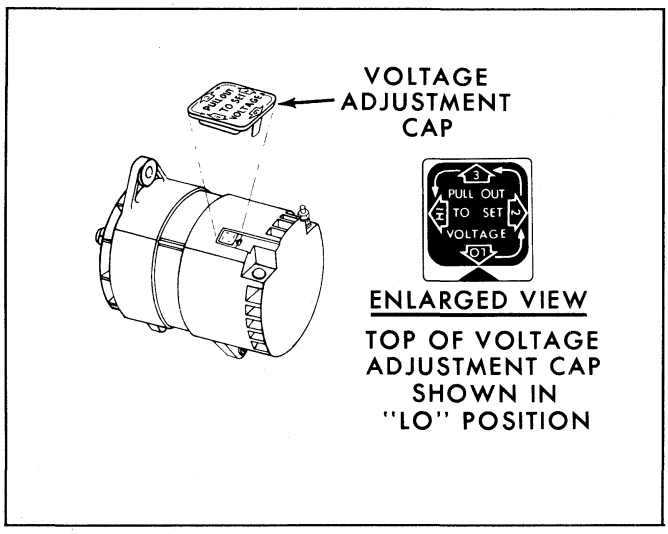


Fig. 6D-14 Voltage Adjustment Cap - Heavy Duty Generator

amperage reading to be slightly lower than rated.

17. If reading obtained is not correct, record amps for future reference and remove generator for repair as described on Page 6D-17.

b. Overcharged Battery

1. Check the battery. Remember that an overheated battery will be overcharged even though no charging circuit defects are present.

2. If battery is not defective or overheated, connect a voltmeter between Integral Charging System "BAT" terminal and ground.

3. With all accessories turned off, increase engine speed as required to obtain maximum voltage reading.

4. If voltage exceeds 15 volts, remove Integral Charging System for repair as described on Page 6D-17.

5. If voltage does not exceed the values listed in Step 4 preceding, adjust voltage to a lower value by removing voltage adjusting cap and re-inserting into connector body. Then check battery condition after a service period of reasonable length, such as one week. Fig. 6D-14 is for purposes of illustration only, and shows the cap adjusted for the lowest setting. The actual adjustment as shipped from the factory may be in some other position, such as position 3, depending on the application requirement. The lowest setting is with "LO" aligned with the arrow, position 2 is medium low, position 3 is medium high, and "HI" is the highest setting.

ON-CAR SERVICE

The generator does not require periodic lubrication. The rotor shaft is mounted on ball bearings at the drive end and roller bearings at the slip ring end, and each contains a permanent grease supply. At periodic intervals, check mounting bolts for tightness and adjust belt tension.

CAUTION: *When adjusting belt tension, apply pressure at center of generator, never against either end frame (see Engine Cooling Section).*

Generator Removal and Installation - Except H.D. and Seville (Fig. 6D-15)

a. Removal

1. Raise hood and disconnect negative battery cable.

2. Remove protective cap from generator battery terminal and remove wire from terminal.

3. Disconnect double connector from top of generator.

4. Remove screw from generator adjusting link.

5. Remove screw from rear of generator and retain shims for installation.

6. Loosen generator pivot bolt and remove generator drive belt.

7. Loosen A.I.R. pump pivot bolt behind pulley using a "starter wrench" if so equipped.

8. Loosen two screws securing front bracket to engine.

9. Generator, spacer and lower through bolt may now be removed by twisting generator towards fender for bolt clearance.

b. Installation

1. Install lower through bolt and spacer on generator and swivel assembly into position. Start bolt threads into rear bracket.

2. Tighten two screws securing front bracket to engine, and one A.I.R. pump pivot bolt.

3. Loosely install adjustment link screw, install belt and tension generator belt as described on Page 6B-12. Tighten generator pivot bolt.

4. Install enough shims at rear of generator to completely fill space between bracket and generator. Install screw and tighten to 20 foot-pounds (27.1 N·m).

5. Connect double connector at top of generator.

6. Connect wire to generator battery terminal and install protective cap.

7. Connect battery cable.

CAUTION: *Take care not to reverse polarity.*

Generator-Removal and Installation Seville (Fig. 6D-16)

a. Removal

1. Raise hood and disconnect negative battery cable.

2. Remove protective cap from generator battery terminal and remove wires from terminal.

3. Disconnect double connector from top of generator.

4. Remove screw from generator adjusting link.

5. Loosen generator pivot bolt and remove generator drive belt.

6. Generator, spacer and through bolt may now be removed.

b. Installation

1. Install through bolt and spacer on generator. Start bolt threads.

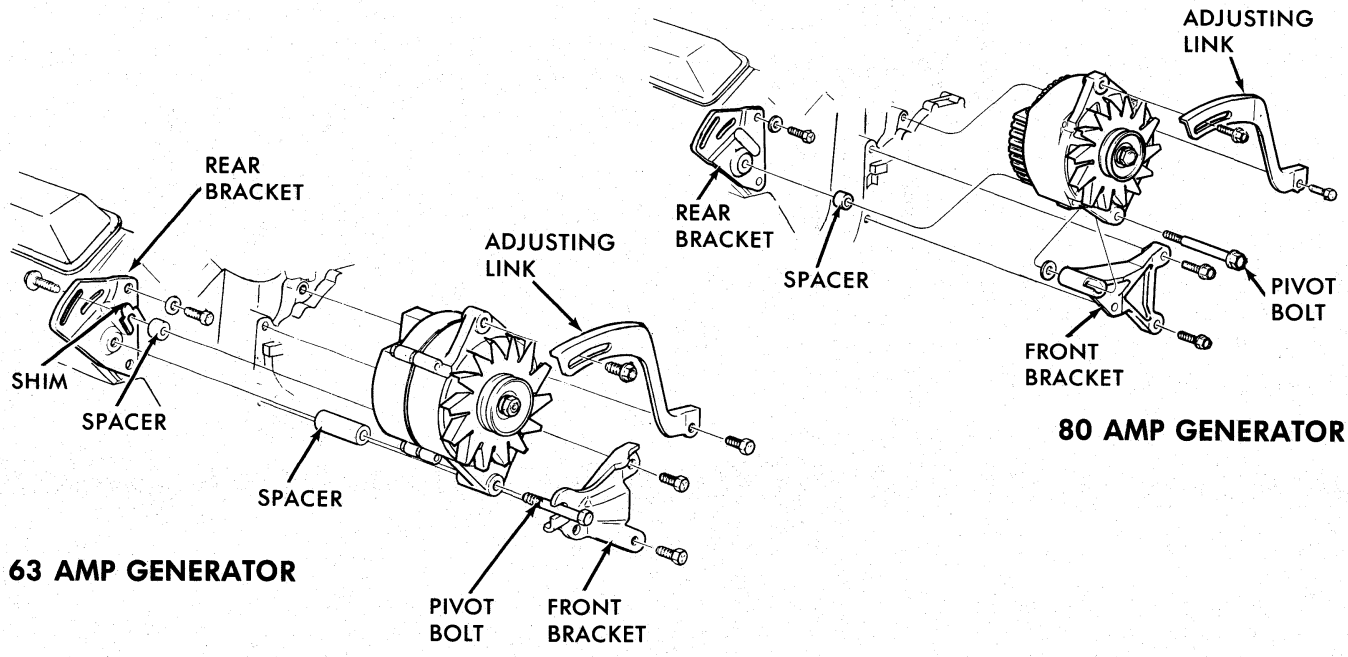
2. Loosely install adjustment link screw, install belt and tension generator belt as described on Page 6B-18. Tighten generator pivot bolt.

3. Connect double connector at generator.

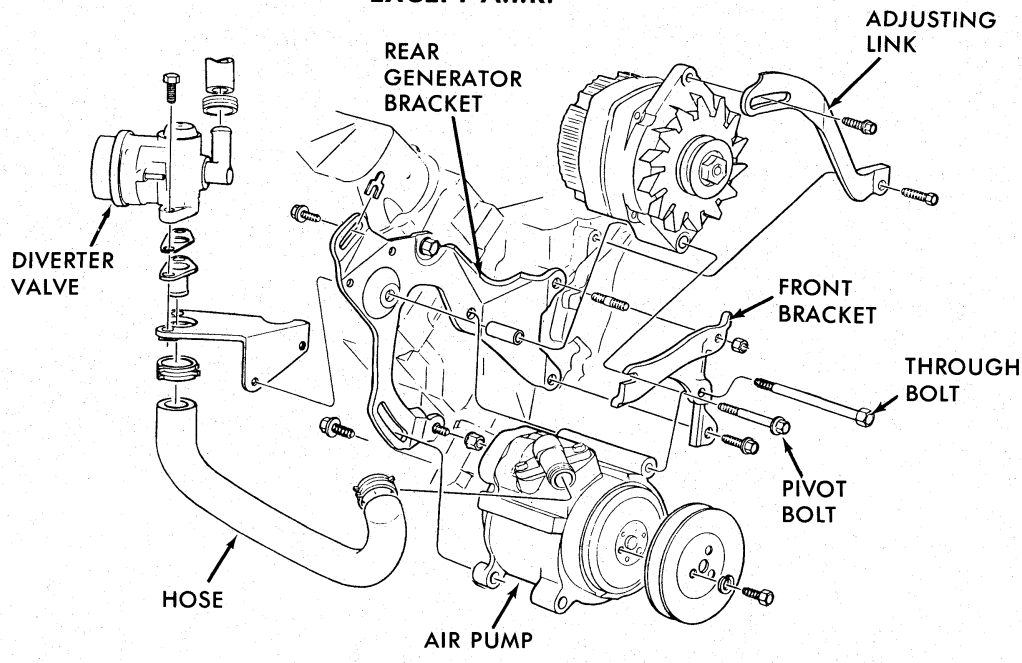
4. Connect wires to generator battery terminal and install protective cap.

5. Connect battery cable.

CAUTION: *Take care not to reverse polarity.*



EXCEPT A.I.R.



A.I.R.

Fig. 6D-15 Generator Attaching Parts-Except Seville

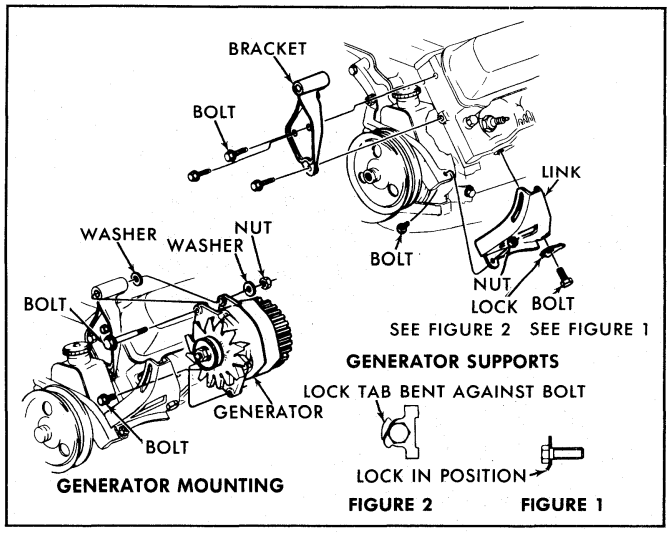


Fig. 6D-16 Generator Attaching Parts-Seville

Generator Disassembly and Assembly Except H.D. Generator (Fig. 6D-18)

a. Disassembly

1. Scribe an alignment mark on both end frames to locate parts during assembly, Fig. 6D-17.

2. Remove four through bolts securing drive end frame to slip ring end frame.

3. Separate drive end frame and rotor from slip ring end frame and stator.

CAUTION: *Brushes should be cleaned as soon as possible to prevent grease from soaking into brushes.*

4. Remove brush springs which will now be loose.

5. Place a piece of tape (pressure sensitive tape, not friction tape) over the slip ring end bearing and the bearing shaft on the rotor.

6. Remove three nuts holding stator leads to rectifier bridge and remove stator.

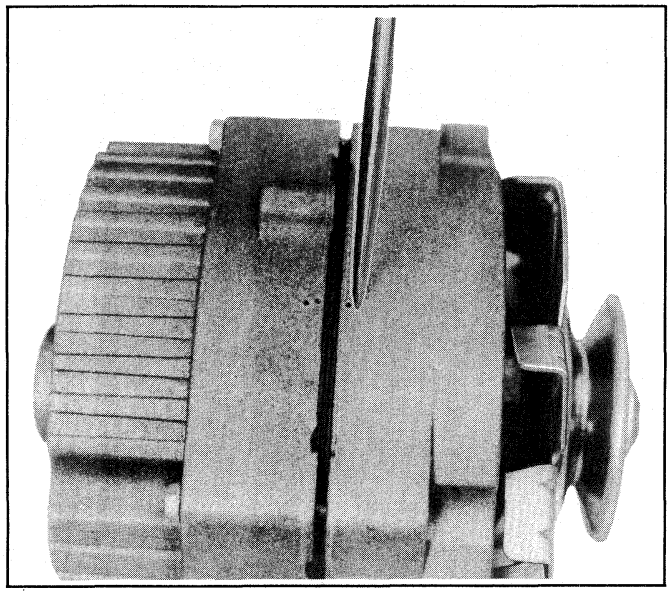


Fig. 6D-17 Marking End Frames

7. Remove one screw with plastic insulator holding diode trio to brush holder and remove diode trio.

8. Remove screws securing regulator and brush holder. Remove indicator lamp resistor, brush holder and regulator.

9. Remove rectifier bridge by removing the following fasteners: one screw with washer; one screw at capacitor lead; one nut and washer from "BAT" terminal stud.

10. Remove insulator and "BAT" terminal stud.

11. Remove one screw securing capacitor to end frame and remove capacitor.

12. To remove rotor from drive end frame, install rotor in a vise and tighten only enough to permit removal of shaft nut.

CAUTION: *Avoid excessive tightening as this may cause distortion of the rotor.*

13. Remove shaft nut, washer, pulley and fan. Separate end frame from rotor.

b. Assembly

1. Position "BAT" terminal stud in end frame with molded plastic insulator outside and fiber insulator inside.

2. Position rectifier bridge to end frame and secure with nut and washer at one end and screw with washer at opposite end.

3. Install capacitor and secure to end frame and heat sink with screws, Fig. 6D-19.

4. Position regulator in slip ring end frame. Position indicator lamp resistor and brush holder over regulator. Install two regulator mounting screws shown in Fig. 6D-19.

5. Position diode trio on rectifier bridge and secure to regulator with insulated screw.

6. Position stator to end frame with leads over rectifier bridge studs and secure with three nuts.

7. Install brush springs and brushes in brush holder and insert a straight wire or pin through hole in end frame and holes in bottom of brush holder. This will hold brushes until rotor is assembled into frame.

8. Install rotor in vise with drive end up. Tighten vise firm but not tight.

CAUTION: *Avoid excessive tightening as this may cause distortion of the rotor.*

9. Position end frame, fan, pulley and washer over rotor shaft, Fig. 6D-18, secure with nut.

10. Install rotor to slip ring end frame aligning scribe marks when installing. Remove brush holding wire.

11. Secure drive end frame to slip ring end frame with four through bolts.

GENERATOR INSPECTION AND TEST - EXCEPT HEAVY DUTY

a. Rotor Field Winding Checks (Fig. 6D-20)

To check for opens, connect the test lamp or ohmmeter to each slip ring. If the lamp fails to light, or if the ohmmeter reading is high (infinite), the winding is open (Fig. 6D-20).

Connect test lamp or ohmmeter from one slip ring to shaft. If lamp lights, or if reading is low, the rotor winding is grounded.

The winding is checked for short circuits or excessive resistance by connecting a battery and ammeter in series with the edges of the two slip rings. The field current at 12 volts and 80°F (26°C.) should be between 4.0 - 4.5 amperes. As an alternate method, an ohmmeter can be used, and readings should be approximately 2.5 to 3.0 ohms. An ammeter

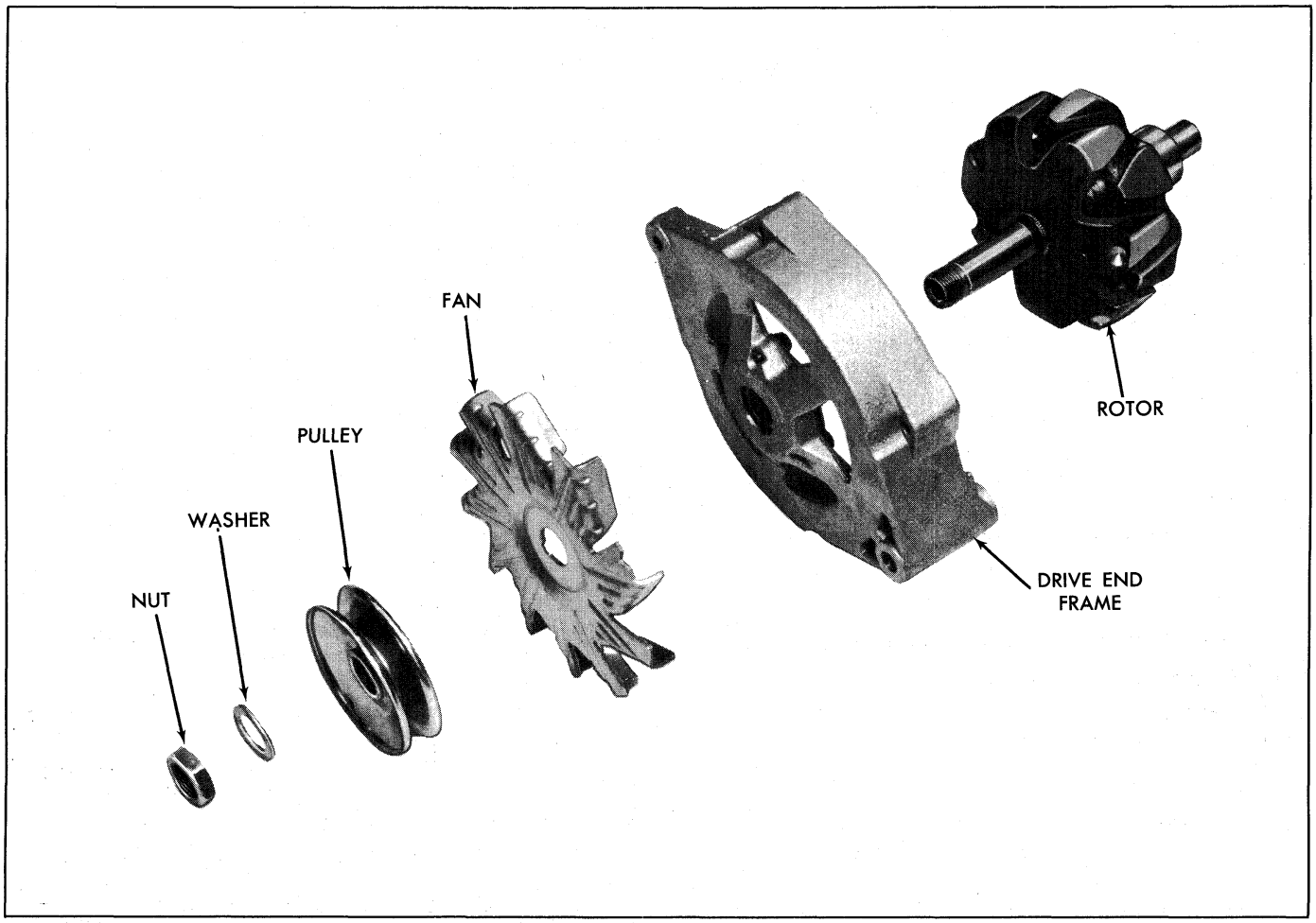


Fig. 6D-18 Rotor and Drive End Frame

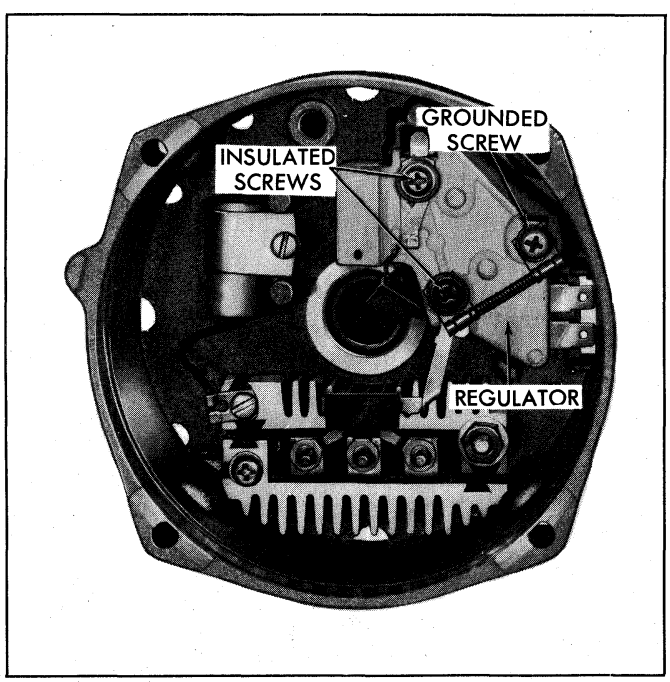


Fig. 6D-19 Regulator Attaching Screw Location

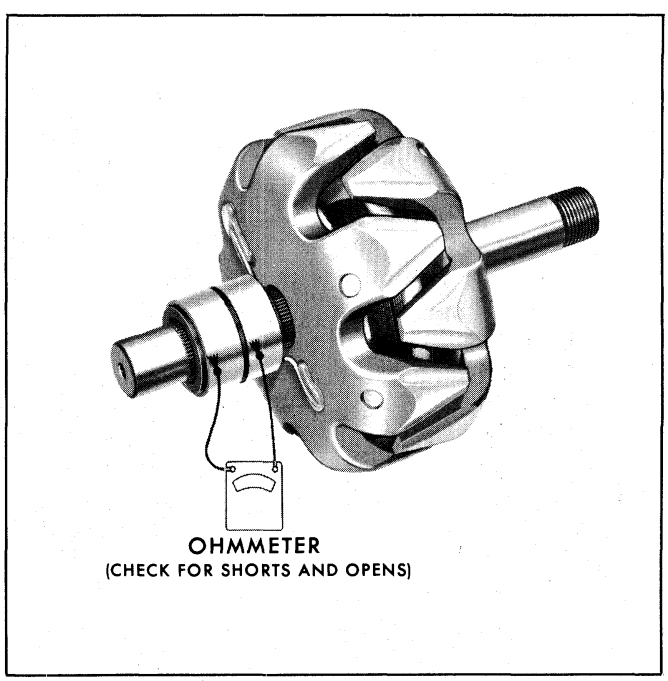


Fig. 6D-20 Checking Rotor Windings

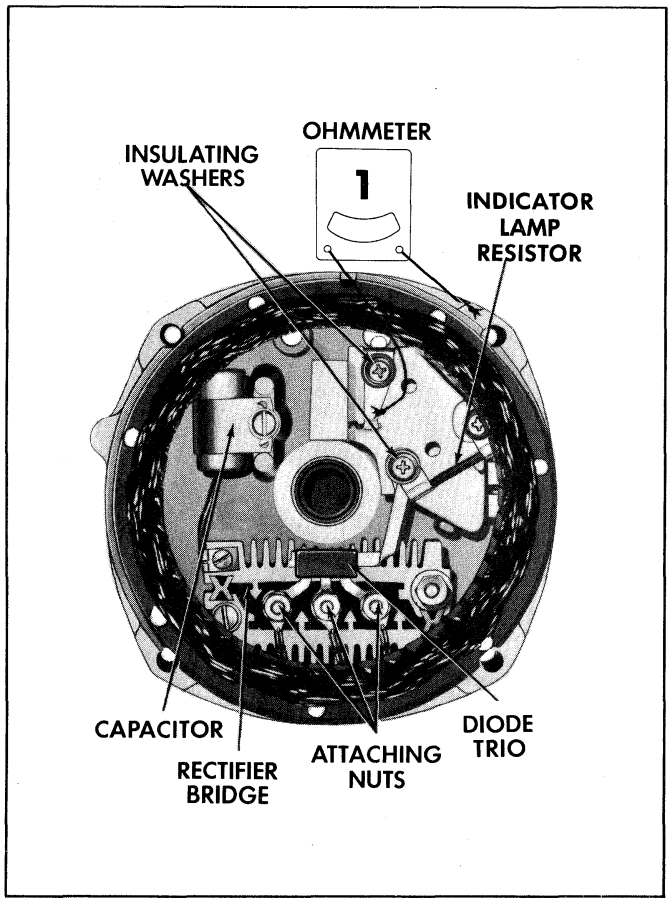


Fig. 6D-21 Slip Ring End Frame Assembly

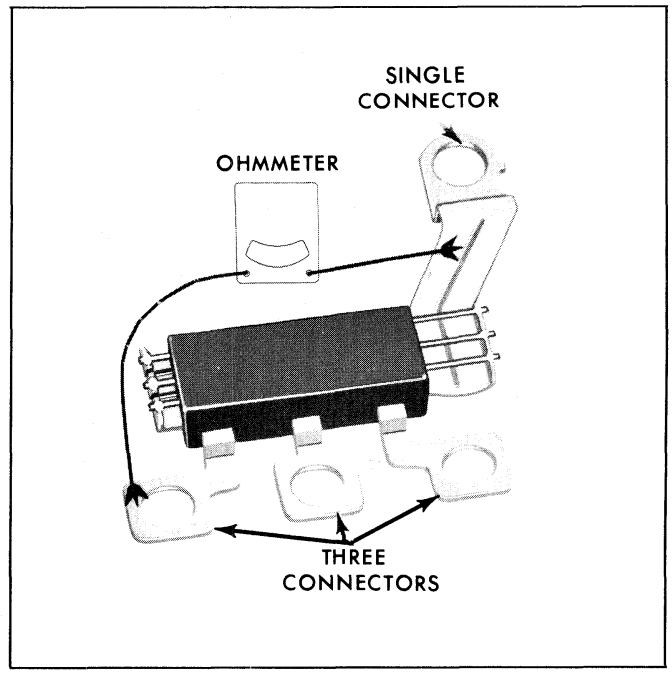


Fig. 6D-22 Checking Diode Trio

reading above the specified value indicates shorted windings; a reading below the specified value indicates excessive resistance. If the resistance reading is below the specified value, the winding is shorted; if above the specified value the winding has excessive resistance.

Remember that the winding resistance and ammeter readings will vary slightly with winding temperature changes. If the rotor is not malfunctioning, but the generator fails to supply rated output, the trouble is in the diode trio, rectifier bridge, stator, or regulator.

b. Diode Trio Check

The diode trio is identified in Figure 6D-21. To check the diode trio, remove it from the end frame assembly by detaching the three nuts, the attaching screw, and removing the stator assembly.

NOTE: that the insulating washer on the screw is assembled over the top of the diode trio connector.

Connect an ohmmeter having a 1 1/2 volt cell, and using the lowest range scale, to the single connector and to one of the three connectors Fig. 6D-22. Observe the reading. Then reverse the ohmmeter leads to the same two connectors. If both readings are the same. replace the diode trio. A good diode trio will give one high and one low reading. Repeat this same test between the single connector and each of the other two connectors. Also, connect the ohmmeter to each pair of the three connectors. If any reading is zero, replace the diode trio.

NOTE: Figures 6D-21 and 6D-22 illustrate two diode trios differing in appearance. Either one of these diode trios may be used in these generators, and the two are completely interchangeable.

c. Rectifier Bridge Check

NOTE: that the rectifier bridge has a grounded heat sink and an insulated heat sink connected to the output terminal. Also, note the insulating washer located between the insulated heat sink and end frame Fig. 6D-23.

To check the rectifier bridge, connect one lead of ohmmeter to the grounded heat sink and press down very firmly onto one of the flat metal connectors and not on threaded stud with other lead. Then reverse the lead connections to the grounded heat sink and press down very firmly onto the same flat metal connector, and not on threaded stud Fig. 6D-23. If both readings are the same, replace the rectifier bridge. A good rectifier bridge will give one high and one low reading. Repeat this same test between the grounded heat sink and the other two flat metal connectors and between the insulated heat sink and each of the three metal connectors. This makes a total of six checks, with two readings taken for each check.

The ohmmeter check of the rectifier bridge, and of the diode trio as previously covered, is a valid and accurate check. Do not replace either unit unless at least one pair of readings is the same.

CAUTION: *Do not use high voltage to check these units. Use only ohmmeter or 12 volt test lamp.*

To replace the rectifier bridge, remove the attaching screw and the "BAT" terminal screw, and disconnect the capacitor lead. Note the insulator between the insulated heat sink and end frame Fig. 6D-23.

d. Stator Checks (Fig. 6D-24)

The stator windings may be checked with a 110-volt test lamp or an ohmmeter. If the lamp lights, or if the meter reading is low when connected from any stator lead to the frame, the windings are grounded. If the lamp fails to light,

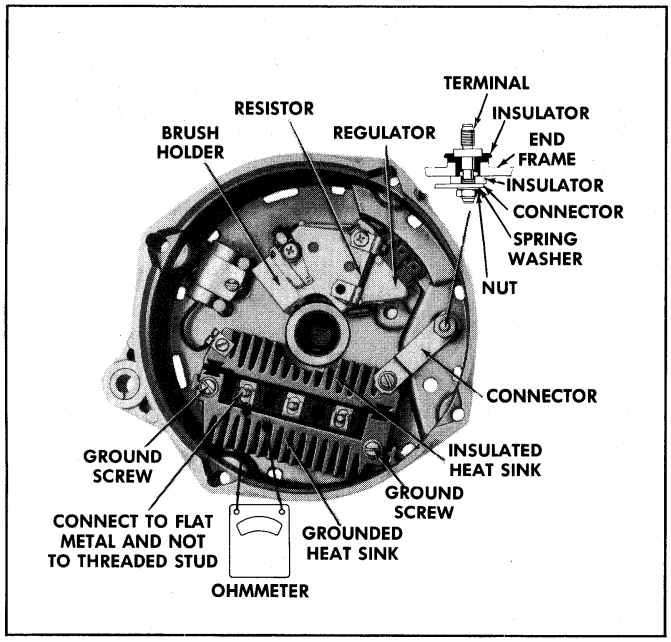


Fig. 6D-23 Checking Rectifier Bridge

or if the meter reading is high when successively connected between each pair of stator leads, the windings are open.

NOTE: Delta windings on 27-SI series cannot be checked for opens.

To test stator windings for shorts, check the readings of each of the three winding phases, using an ohmmeter "Hook-up" as shown in Fig. 6D-25. Ohmmeter used should indicate readings in tenths (.1) of an ohm. Ohmmeter readings for these phases should be equal. If not a short exists and stator must be replaced.

NOTE: A black or dark brown appearance of the stator windings is normal and should not, by itself, be reason for replacement until the stator windings are checked with an ohmmeter as explained above.

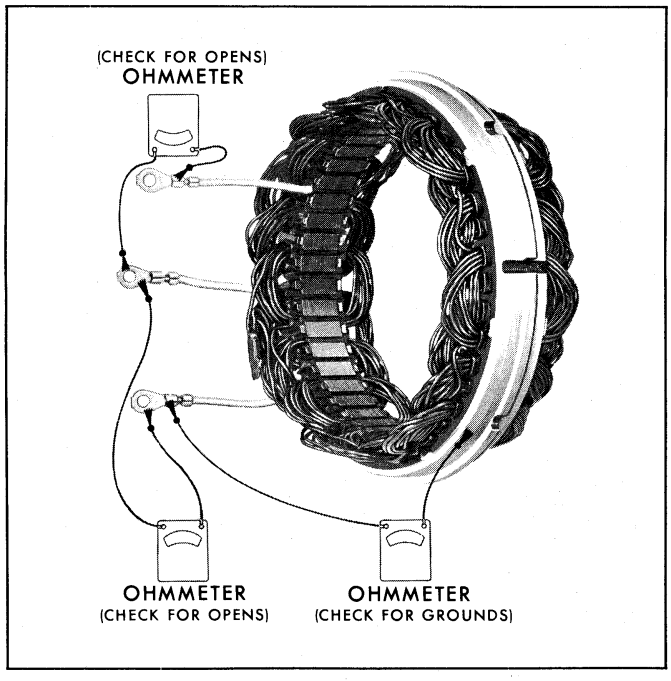


Fig. 6D-24 Checking Stator Windings

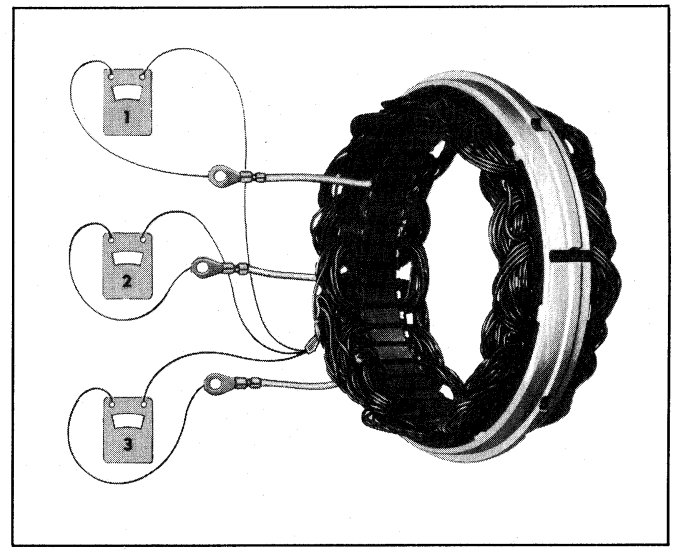


Fig. 6D-25 Checking Stator Windings For Shorts

GENERATOR TESTING - ON CAR

Tester, J-26290, is designed to determine whether a problem is in the generator or somewhere in the car's wiring harness. While the instrument panel tell-tale light will indicate most common generator failures, it cannot differentiate between a generator failure and a harness failure. By eliminating the car wiring and testing the generator with Tester J-26290, the problem can be isolated to either the car or the generator, and in some cases can indicate which generator components might be defective.

To diagnose a suspected charging system, connect Tester J-26290 into charging system as shown in Fig. 6D-26, and proceed as follows:

1. With engine off (including lights and accessories), observe indicator light on tester:
2. If indicator light is flashing, proceed to Fast Idle Test (Step 7 below).
3. If indicator light is on, tester is defective and should be replaced.
4. If indicator light is off, remove tester connector from generator and again observe indicator light.
5. If indicator light flashes with connector disconnected, remove generator and replace the rectifier bridge. Repair and retest.
6. If indicator light is off with connector disconnected, check for 12 volts at the #2 terminal of the harness connector. If terminal has 12 volts, replace tester. If 12 volts is not available, repair wiring harness and retest.
7. Start engine and operate at fast idle (lights and accessories still off);
8. If indicator light goes out, generator is operating properly; do not remove generator. Any charging system problem is in the car's wiring harness. Repair and retest.
9. If indicator light remains on, remove generator and check stator, diode trio and rectifier bridge, as described in this section.
10. If indicator light flashes, remove the generator and check the rotor and diode trio as described in this section.

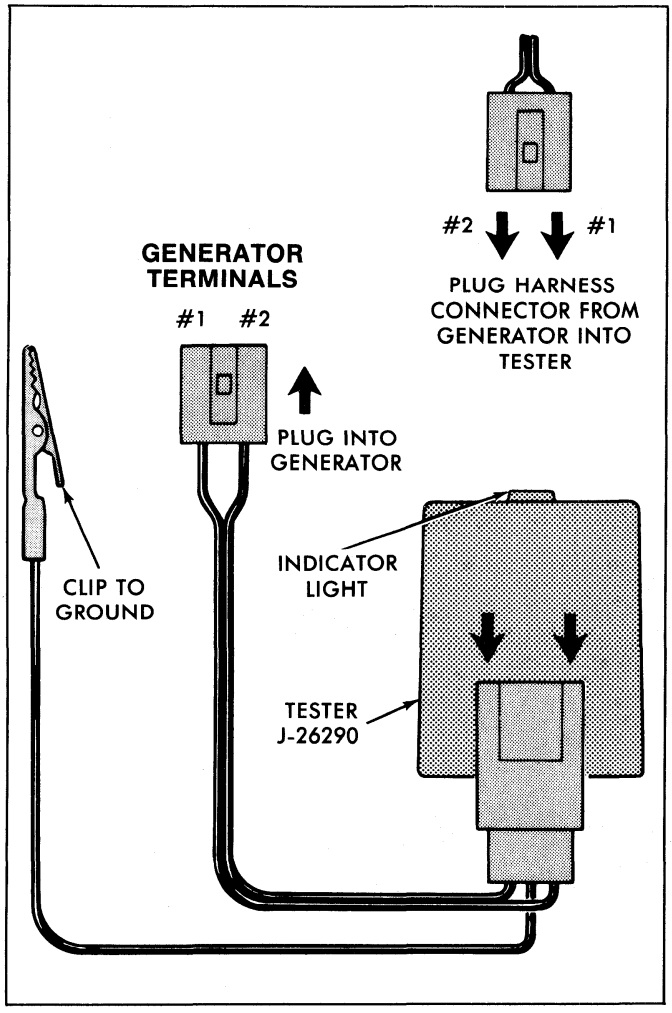


Fig. 6D-26 Generator Tester

Also inspect the brushes and slip rings. If the above checks do not show a defect, replace the regulator and retest.

SLIP RING SERVICING

If the slip rings are dirty, they may be cleaned and finished with 400 grain or finer polishing cloth. Spin the rotor, and holding the polishing cloth against the slip rings until they are clean.

CAUTION: *The rotor must be rotated in order that the slip rings will be cleaned evenly. Cleaning the slip rings by hand without spinning the rotor may result in flat spots on the slip rings, causing brush noise.*

Slip rings which are rough or out of round should be trued in a lathe to .002 inch maximum indicator reading. Remove only enough material to make the rings smooth and round. Finish with 400 grain or finer polishing cloth and blow away all dust.

BEARING REPLACEMENT AND LUBRICATION

The bearing in the drive end frame can be removed by detaching the retainer plate screws, and then pressing the bearing from the end frame. If the bearing is in satisfactory condition, it may be reused, and it should be filled one-quarter full with lubricant part no. 1948791 or before equivalent before reassembly.

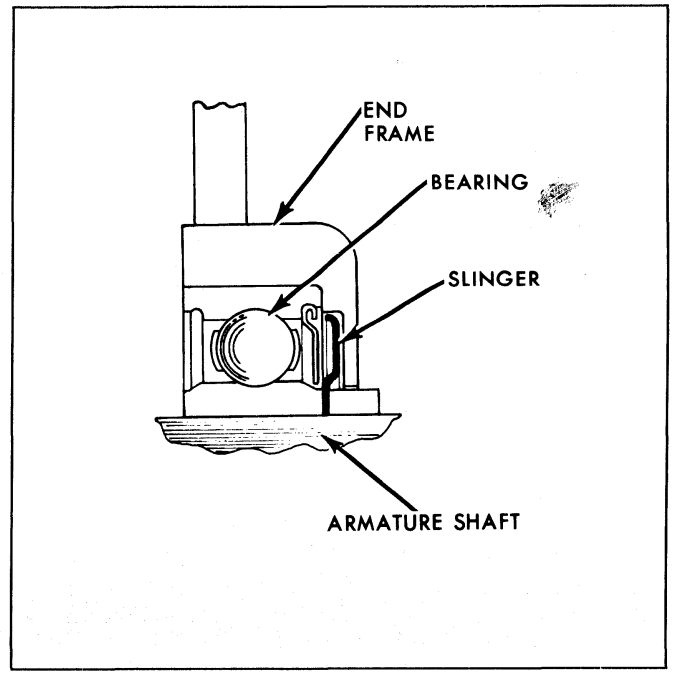


Fig. 6D-27 Drive End Bearing Assembly

CAUTION: *Do not overfill, as this may cause the bearing to overheat, and use only 194791 lubricant or equivalent.*

To install a new bearing, press in with a tube or collar that just fits over the outer race, with the bearing and slinger assembled into the end frame as shown in Fig. 6D-27. It is recommended that a new retainer plate be installed if the felt seal in the retainer plate is hardened or excessively worn. Fill the cavity between the retainer plate and bearing with 1948791 lubricant or equivalent.

The bearing in the slip ring end frame should be replaced if its grease supply is exhausted. No attempt should be made to re-lubricate and reuse the bearing. To remove the bearing from the slip ring end frame, press out with a tube or collar that just fits inside the end frame housing. Press from the outside of the housing towards the inside.

To install a new bearing, place a flat plate over the bearing and press in from the outside towards the inside of the frame until the bearing is flush with the outside of the end frame. Support the inside of the frame with a hollow cylinder to prevent breakage of the end frame. Use extreme care to avoid misalignment or otherwise placing undue stress on the bearing.

If the seal is separate from the bearing, it is recommended that a new seal be installed whenever the bearing is replaced. Press the seal in with the lip of the seal toward the rotor when assembled, that is, away from the bearing. Lightly coat the seal lip with oil to facilitate assembly of the shaft into the bearing.

Generator Removal and Installation - With H.D. Generator (Fig. 6D-28)

a. Removal

1. Disconnect negative battery cable from battery and position out of way.

2. Disconnect all wiring connections from generator and position out of way.

3. Loosen belt tensioning pulley bolts to relieve belt tension and remove belt.

4. Remove two nuts and lock washers from lower mounting bolts, at generator, leaving bolts in place.

5. Remove bolt and lock washer from upper mounting at generator and remove generator by sliding rearward off lower mounting bolts.

b. Installation

1. Position generator to lower mounting bracket and install lower mounting bolts.

2. Install bolt and lock washer securing generator to upper mounting bracket and tighten bolt to 60 ft. lbs. (81.4N·m).

3. Install lock washers and nuts on lower mounting bolts and tighten nuts to 60 ft. lbs. (81.4Nm).

4. Position belt around generator and belt tensioning pulley and adjust belt tension as described on Page 6B-12. Tighten tensioning pulley bolts to 19 foot-pounds (25.8 N·m).

5. Position wiring harness and connect to required generator terminals.

6. Position negative battery cable and connect to battery.

7. Polarize charging system by momentarily connecting a jumper wire between the generator "BAT" terminal and the generator "R" terminal.

8. Start engine and operate at 1500 RPM for 10 seconds. Generator lamp should go out.

Generator Disassembly and Assembly - With H.D. Generator

a. Disassembly

1. Remove cover plate from slip ring end frame.

2. Hold rotor shaft with allen wrench while removing shaft nut. Remove washer, pulley, fan and slinger.

3. Remove four through bolts securing drive end frame to slip ring end frame and separate slip ring end frame and stator from drive end frame and rotor.

CAUTION: *Brushes should be cleaned as soon as possible to prevent grease from soaking into brushes.*

4. Separate stator from slip ring end frame by removing the nuts and washers from the three stator lead studs, Fig. 6D-29.

5. Place tape over bearing and shaft to protect from dirt. Use pressure sensitive tape and not friction tape which would leave a gummy deposit.

6. Remove two remaining nuts and washers from each rectifier bridge.

7. Remove the following from the A.C. terminal studs: nut, lockwasher, flat washer insulating washer and insulating collar.

8. Remove screw with flat washer and insulator securing diode trio at brush holder and remove diode trio, A.C. leads and inner insulator.

9. Remove connector strap from each rectifier bridge.

10. Remove two nuts with internal tooth lockwashers and flat washers securing bottom rectifier bridge and remove two terminal studs.

11. Remove one screw with lock and flat washers securing bottom rectifier bridge to end frame and remove rectifier bridge.

12. To remove bridge nearest voltage adjuster, remove two screws with lock and flat washers.

13. To remove remaining rectifier bridge it is necessary to **loosen** the nut at the "BAT" terminal. Remove one screw with external tooth lockwasher securing "BAT" terminal lead to bridge.

14. Remove one additional screw securing bridge to end frame and remove bridge.

15. Remove two remaining screws securing brush holder and remove brush holder.

16. Remove voltage adjuster cap making note of cap position for assembly.

17. Remove one screw securing voltage regulator bracket to end frame and remove bracket and regulator.

18. Capacitor and "R" terminal lead may now be removed if desired.

19. To remove rotor from drive end frame, remove four screws from around drive end bearing and tap rotor out of housing with a soft faced hammer.

20. To remove bearings refer to Page 6D-23.

b. Assembly (Fig. 6D-30)

1. Install capacitor and "R" terminal lead if removed.

2. Position voltage regulator and adjuster to end frame. Position bracket over adjuster and secure with one screw and external tooth lockwasher.

3. Install voltage adjustment cap in same position as removed.

4. Of the three rectifier bridges, two are identical and one has an insulating sleeve at one end. Select one of the two identical ones and position under the "BAT" lead. Secure to end frame using one screw with lock and flat washers. Secure "BAT" lead to bridge using one screw with external tooth lockwasher.

5. Tighten "BAT" terminal nut.

6. Install bridge with insulator at opposite side of end frame. Secure using two screws with lock and flat washers.

7. Position remaining rectifier bridge in end frame. Install two terminal bolts with internal tooth lockwashers. Use a flat washer at end with insulated bridge and capacitor lead at opposite end. Install but do not tighten nuts.

8. Install one screw with lock and flat washers securing bridge to end frame and tighten screw. Tighten two nuts installed in Step 7.

9. Install connector strap to each bridge.

10. Install insulator at inside of end frame for A.C. terminal studs and position diode trio and A.C. terminal leads.

11. Install insulating sleeve, insulating washer, flat washer, lockwasher and nut to each A.C. terminal. Tighten nuts.

12. Position diode trio and A.C. leads at each bridge. Secure each lead with nut and flat washer.

13. Install brush holder over voltage regulator and secure with three screws. Two screws nearest bearing have insulating washers. All screws have flat washers.

14. Install brush springs and brushes. Hold brushes in position with paper clip through holder and end frame.

15. Position stator to end frame with notches in stator aligned with holes for through bolts.

16. Install stator leads to bridges at remaining open terminals. Secure with nuts and flat washers.

17. If removed, install drive end frame to rotor. Align weld nut plate and secure with four screws.

18. Remove tape from slip ring end bearing and rotor shaft. Make sure the shaft is perfectly clean after removing the tape.

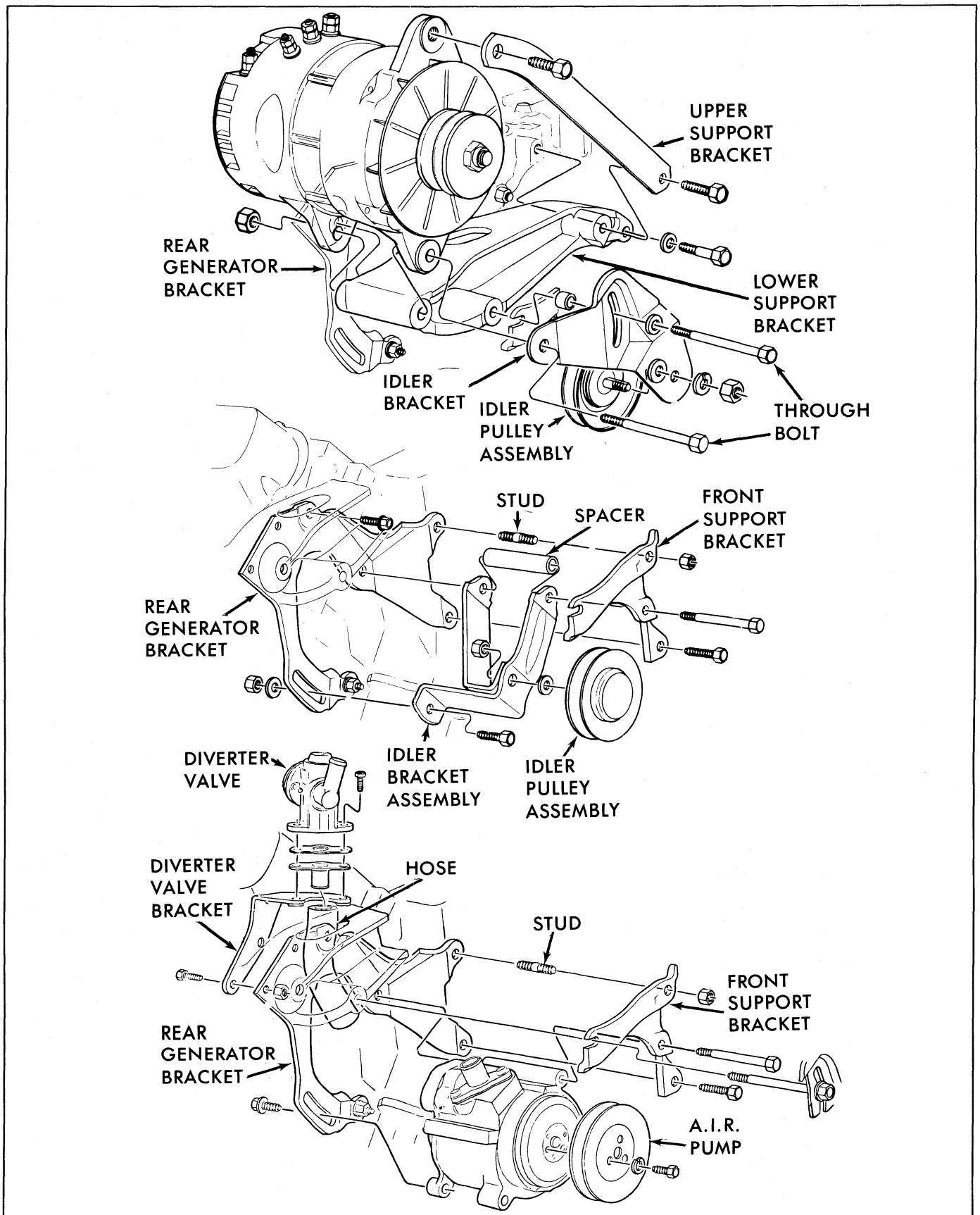


Fig. 6D-28 Generator Mounting - Heavy Duty Generator

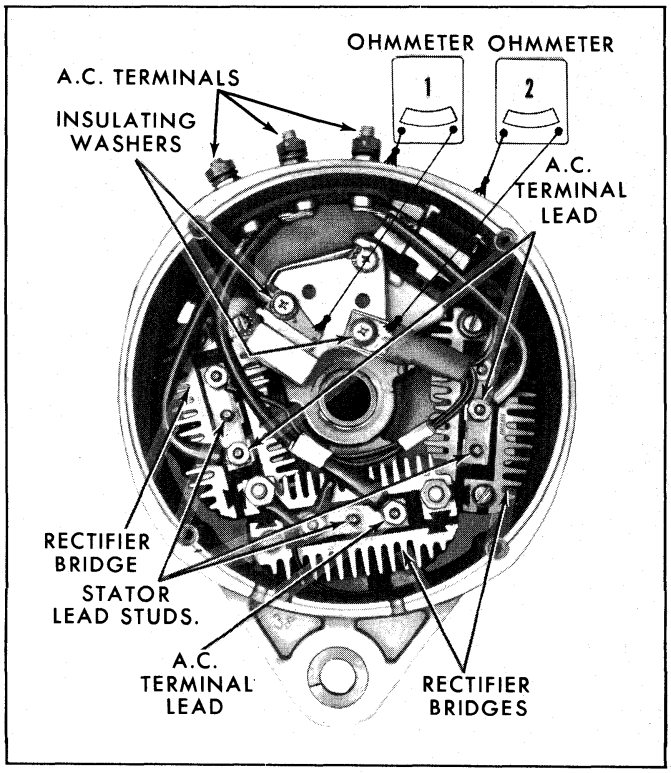


Fig. 6D-29 Slip Ring End Frame - With Heavy Duty Generator

19. Install rotor and drive end frame to stator and slip ring end frame after aligning mounting lugs and through bolt holes. Secure with four through bolts.

20. Remove brush holding pin and install cover plate to slip ring end frame. Secure with four screws.

21. Assemble slinger, fan, pulley, washer and nut on rotor shaft. Hold rotor shaft with an allen wrench and tighten nut to 75 foot-pounds (101.5N·m).

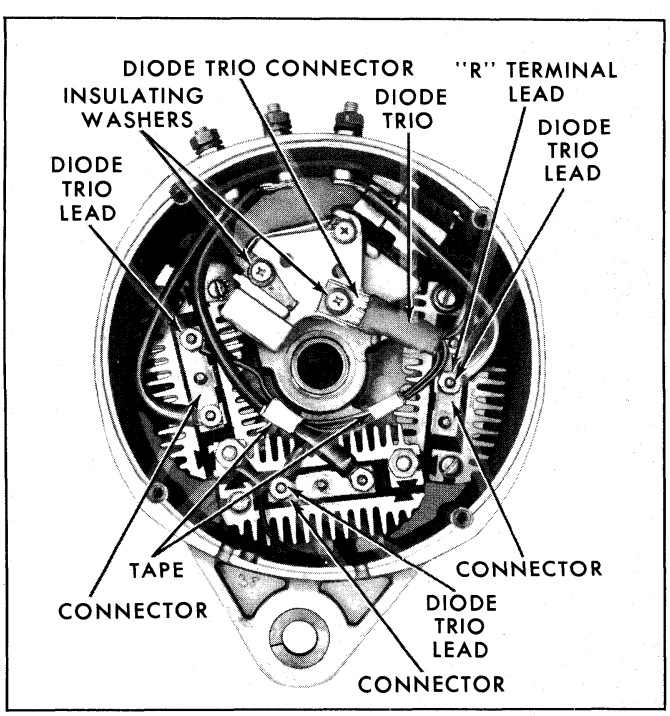


Fig. 6D-30 Slip Ring End Frame Components - Heavy Duty Generator

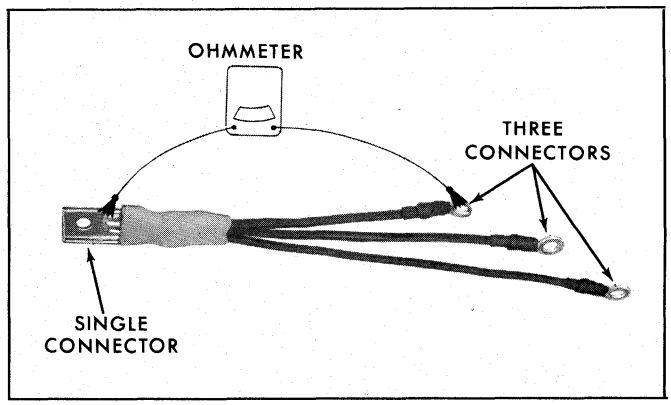


Fig. 6D-31 Checking Diode Trio - Heavy Duty Generator

Generator Inspection and Test - H.D. Generator

a. Ohmmeter Checks

1. Connect ohmmeter number 1 (having a 1-1/2 volt cell and using lowest range scale) from brush lead clip to end frame as shown in Fig. 6D-29. Then reverse lead connections.

2. If both readings are zero, either the brush lead clip is grounded or regulator is malfunctioning.

3. A grounded brush lead clip can result from omission of insulating washer, Fig. 6D-29, omission of insulating sleeve over screw, or damaged insulating sleeve. Remove screw to inspect sleeve. If satisfactory, replace regulator as described in Part g.

4. Repeat Steps 1, 2 and 3 above except connect number 1 ohmmeter as shown Fig. 6D-29.

b. Diode Trio Check

The diode trio is identified in Fig. 6D-30. To check the diode trio, remove it from the end frame assembly by detaching the nuts and attaching screw. Note that the insulating washer on the screw is assembled over the top of the diode trio connector. Connect an ohmmeter having a 1-1/2 volt cell, and using the lowest range scale, to the single connector and to one of the three connectors in Fig. 6D-31. Observe the reading. Then reverse the ohmmeter leads to the same two connectors. If both readings are the same, replace the diode trio. A good diode trio will give one high and one low reading. Repeat this same test between the single connector and each of the other two connectors.

NOTE: Diode trios differing in appearance may be specified for use in the same integral Charging System, and the two are completely interchangeable.

c. Rectifier Bridge Check

NOTE: that each rectifier bridge has a grounded heat sink and an insulated heat sink. The insulated heat sinks are connected together, and electrically are connected to the output or "BAT" terminal. Also, note the stack-up of parts in Fig. 6D-32.

To check the rectifier bridge, connect one lead of ohmmeter to a heat sink and press down very firmly onto one of the flat metal connectors and not on threaded stud with other lead. Then reverse the lead connections to the same heat sink and press down very firmly onto the same flat metal connector, and not on threaded stud Fig. 6D-32. If both readings are the same, replace the rectifier bridge. A good rectifier bridge will give one high and one low reading. Repeat this same test between the grounded heat sink and the other

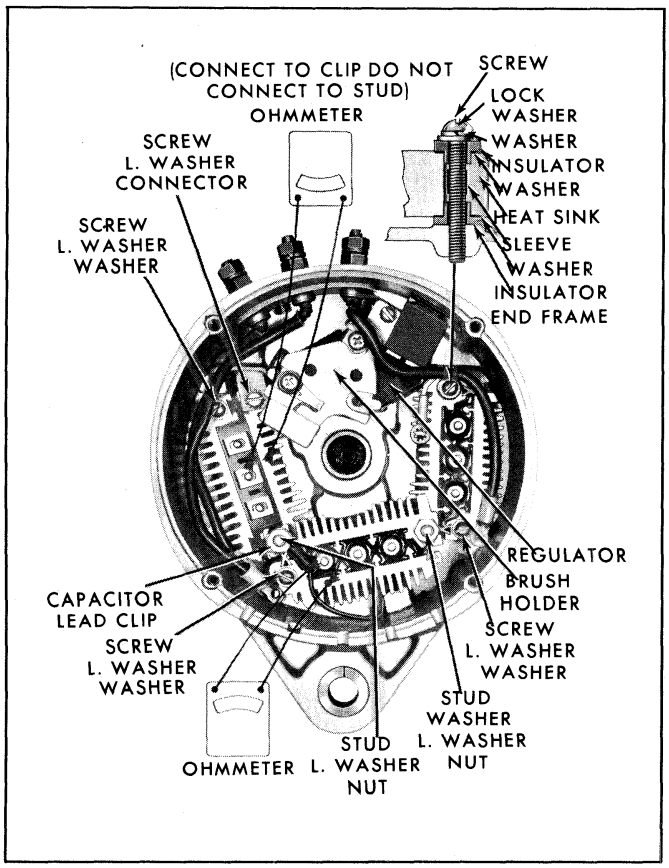


Fig. 6D-32 Slip Ring End Frame Parts Position - Heavy Duty Generator

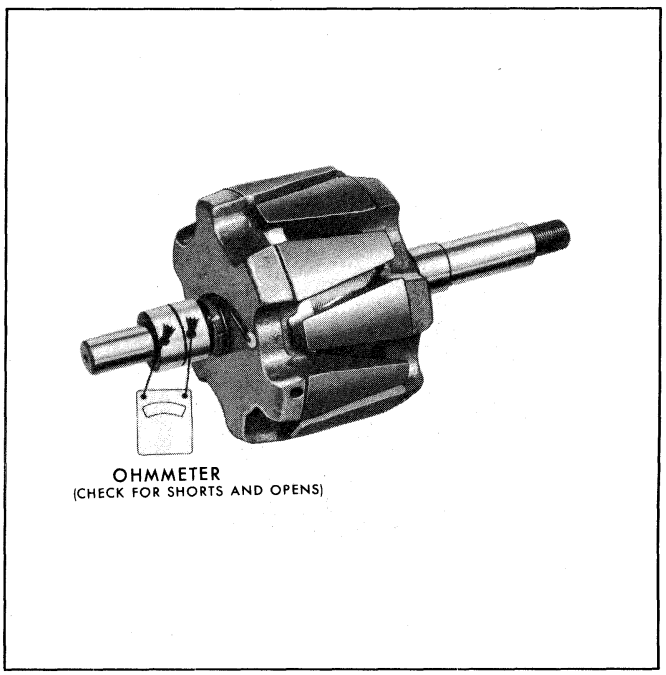


Fig. 6D-33 Checking Rotor - Heavy Duty Generator

two flat metal connectors and not on the threaded studs. This makes a total of six checks, with two readings taken for each check. Check the other two rectifier bridges in the same manner.

The ohmmeter check of the rectifier bridge, and of the diode trio as previously covered, is a valid and accurate check. Do not replace either unit unless at least one pair of readings is the same.

CAUTION: *Do not use high voltage to check these units. Use only ohmmeter or 12 volt test lamp.*

d. Rotor Field Winding Checks (Fig. 6D-33)

To check for opens, connect the test lamp or ohmmeter to each slip ring. If the lamp fails to light, or if the ohmmeter reading is high (infinite), the winding is open.

The winding is checked for short circuits or excessive resistance by connecting a battery and ammeter in series with the edges of the two slip rings. The current flowing through the rotor winding should be 4.0 to 4.5 amperes at 80°F (26.6°C.). A reading above 4.5 amperes indicates a short.

If the winding is shorted, replace the rotor, and the regulator as described in part g of this note.

NOTE: Regulator replacement may have been indicated in Part a of this note.

An alternate method is to check the resistance of the field by connecting an ohmmeter to the two slip rings. Ohmmeter should read 2.75 to 3.0 ohms. A reading below 2.75 ohms indicates a shorted rotor.

Remember that the winding resistance and ohmmeter reading will vary slightly with winding temperature changes.

e. Stator Checks (Fig. 6D-34)

The stator windings may be checked for grounds with a 110-volt test lamp or an ohmmeter. If the lamp lights, or if the meter reading is low when connected from any stator lead to a clean metal part of the frame, the windings are grounded. The delta windings cannot be checked for opens or for short circuits without laboratory test equipment. However, if all other electrical checks are normal and the generator fails to supply rated output, but will supply at least 10 amperes output, shorted stator windings are indicated.

f. Regulator Check (Fig. 6D-35)

Since the regulator is completely enclosed, there is no practical way to check this unit with a test instrument. If none of the previous checks show any defects, and an overcharged condition was present, remove the connector body from the regulator and check with an ohmmeter using the middle range scale. Connect the ohmmeter to each adjacent pair of terminals, making four checks in all. If any one check is infinite, replace the connector body. The connector body need not be checked for an undercharged condition.

If all of the previous checks are satisfactory, replace the regulator provided that in the previous performance checks:

1. The maximum ampere output was less than 10 amperes, or
2. The system voltage was over 15 volts.

g. Brush Holder and Regulator Replacement

After removing the stator and diode trio, the brush holder and regulator may be replaced by removing the two remaining screws.

NOTE: The two insulators located over the top of the brush clips in Fig. 6D-30, and that these two screws have special insulating sleeves over the screw body above the threads.

NOTE: The third mounting screw may or may not have an insulating sleeve. If not this screw must not be

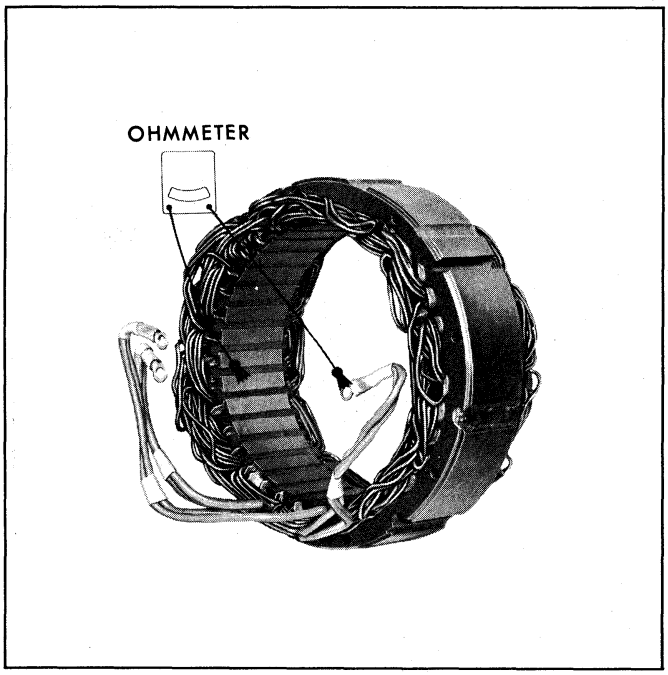


Fig. 6D-34 Checking Stator - Heavy Duty Generator

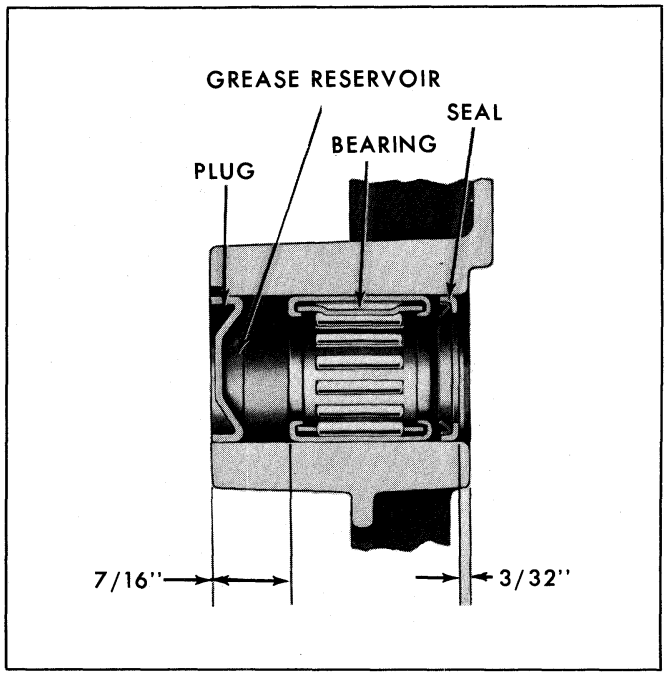


Fig. 6D-36 Slip Ring End Bearing Assembly - Heavy Duty Generator

interchanged with either one of the other two screws, as a ground may result, causing no output or uncontrolled output.

h. Slip Ring Servicing

If the slip rings are dirty, they may be cleaned and finished with 400 grain or finer polishing cloth. Spin the rotor, and hold the polishing cloth against the slip rings until they are clean.

CAUTION: *The rotor must be rotated in order that the slip rings will be cleaned evenly.*

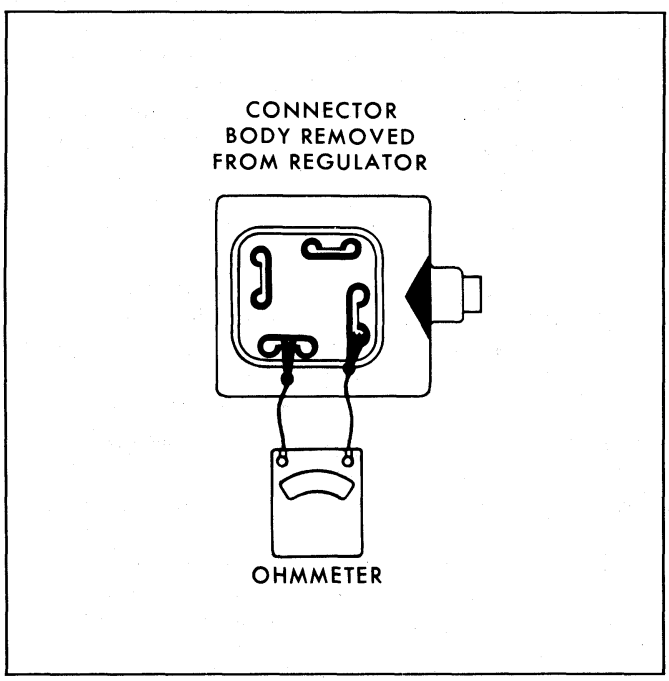


Fig. 6D-35 Checking Connector Body - Heavy Duty Generator

Cleaning the slip rings by hand without spinning the rotor may result in flat spots on the slip rings, causing brush noise.

Slip rings which are rough or out of round should be trued in a lathe to .002 inch maximum indicator reading. Remove only enough material to make the rings smooth and round. Finish with 400 grain or finer polishing cloth and blow away all dust.

i. Bearing Replacement and Lubrication

The drive end frame bearing is sealed on both sides, and cannot be lubricated. To replace the bearing, pull off of rotor shaft using Puller J-8433. Use a tube or collar that just fits over the inner race to press the new bearing into the end frame.

The bearing in the slip ring end frame should be replaced if its grease supply is exhausted. No attempt should be made to relubricate and reuse the bearing. To remove the bearing from the slip ring end frame, press out with a tube or collar that just fits inside the end frame housing.

To install a new bearing, use the tube or collar to press the bearing in from the outside of the housing towards the inside to the dimension shown in Fig. 6D-36. Fill the plug with No. 1948791 lubricant or equivalent so that when pressed in flush with the end frame the grease reservoir will be half filled. Insure that some of the lubricant will be contacting the bearing when the plug is assembled. Use a new seal, and press in to the dimension shown in Fig. 6D-36. Coat the seal lip with the lubricant to facilitate assembly of the rotor shaft into the bearing. Note that the lip of the seal is toward the bearing.

j. Magnetizing the Rotor

The rotor normally retains magnetism to provide voltage build-up when the engine is started. AFTER DISASSEMBLY OR SERVICING, HOWEVER, IT may be necessary to reestablish the magnetism. To magnetize the rotor connect the Integral Charging System to the battery in

a normal manner, then mementarily connect a jumper lead from the battery positive post to the Integral Charging System relay terminal, identified in Fig. 6D-8. This procedure will restore the normal residual magnetism in the rotor.

IGNITION SYSTEM

TABLE OF CONTENTS

General Description 6D-23
H.E.I. Distributor 6D-23
Ignition Timing 6D-25
Secondary Wiring 6D-25
Spark Plugs 6D-25
Ignition Switch 6D-25
Vacuum Advance Systems 6D-24
Diagnosis 6D-28
H.E.I. Distributor 6D-28
Spark Plugs 6D-30
On-Car Service 6D-31
H.E.I. Distributor 6D-31
Remove and Replace 6D-31
Distributor 6D-31
Module 6D-31
Pick-up Coil 6D-31
Rotor 6D-31
Vacuum Advance Unit 6D-31
Integral Ignition Coil 6D-31
Capacitor 6D-32
Distributor Spark Switches 6D-32
Ignition Timing 6D-32
Spark Plug Wires 6D-35

GENERAL DESCRIPTION HIGH ENERGY IGNITION SYSTEM

Distributor

An aluminum alloy ignition distributor (H.E.I.) Fig. 6D-37, is mounted on the top left front of the engine except Seville and on top center rear on Seville. It is fully automatic in operation, and driven by an alloy iron gear that meshes with a gear that is integral with the camshaft. All cars except Seville the distributor cam rotates in a clockwise direction when viewed from above. The firing order is 1-5-6-3-4-2-7-8. On Seville the distributor cam rotates in a counterclockwise direction when viewed from above. The firing order is 1-8-4-3-6-5-7-2.

The High Energy Ignition System, Fig. 6D-37 features a built-in ignition coil, an electronic module and a magnetic pick-up assembly. The module and pick-up assembly take the place of the conventional contact points and condenser.

The HEI system is designed to provide high output secondary voltages. The system is energized by one wire from the ignition switch. The eight spark plug wires complete the entire external wiring circuit.

A terminal is provided in the cap to which a tachometer can be connected. A connector plugs into the cap to connect the pick-up assembly and electronic module to the ignition coil.

On cars equipped with electronic fuel injection the distributor has a speed sensor and rotating magnets. The operation of the speed sensor is explained on Page 6C-51.

Ignition Coil

In the HEI SYSTEM, Fig. 6D-38 the ignition coil is built into the distributor cap. The coil is somewhat smaller physically than a conventional coil, but has more primary and secondary windings. It is built more like a true transformer with the windings surrounded by the laminated iron core. A conventional coil has the iron core inside the windings. Although the HEI coil operates in basically the same way as a conventional coil, it is more effective in generating higher secondary voltage when the primary circuit is broken.

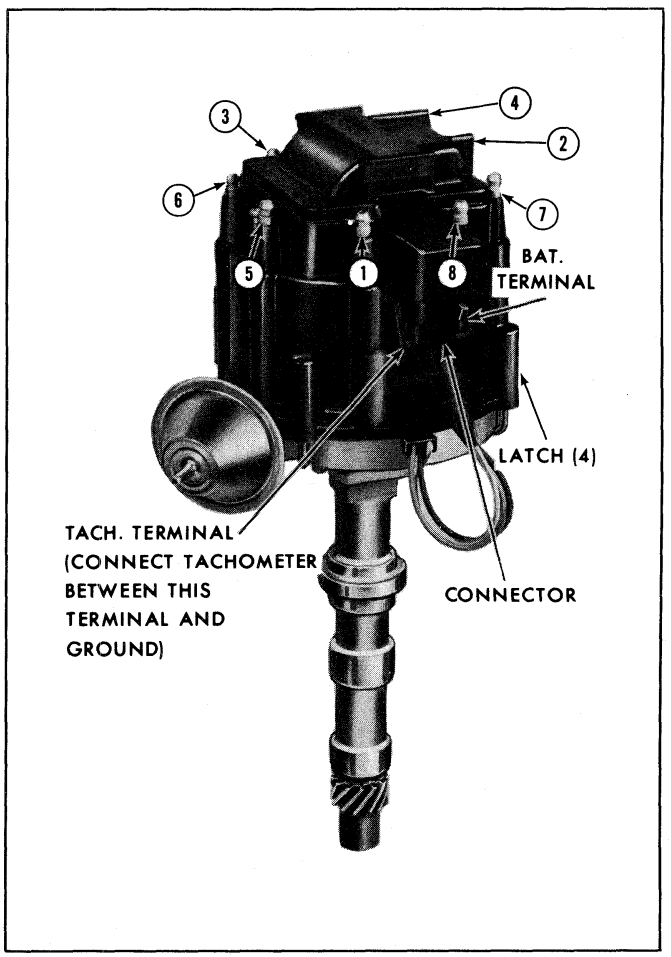


Fig. 6D-37 High Energy Ignition System

Engine	Usage			Distributor Number
	Exc. Calif.	Alt.	Calif.	
350	X	X		110 3221
			X	110 3222
425 (EFI)	X	X		110 3219
			X	110 3297
425 (Carb)	X			110 3217
			X	110 3277 (Except Eldorado Limousine and Commercial Chassis)
			X	110 3300 (Eldorado)
			X	110 3298 (Limousine and Commercial Chassis)

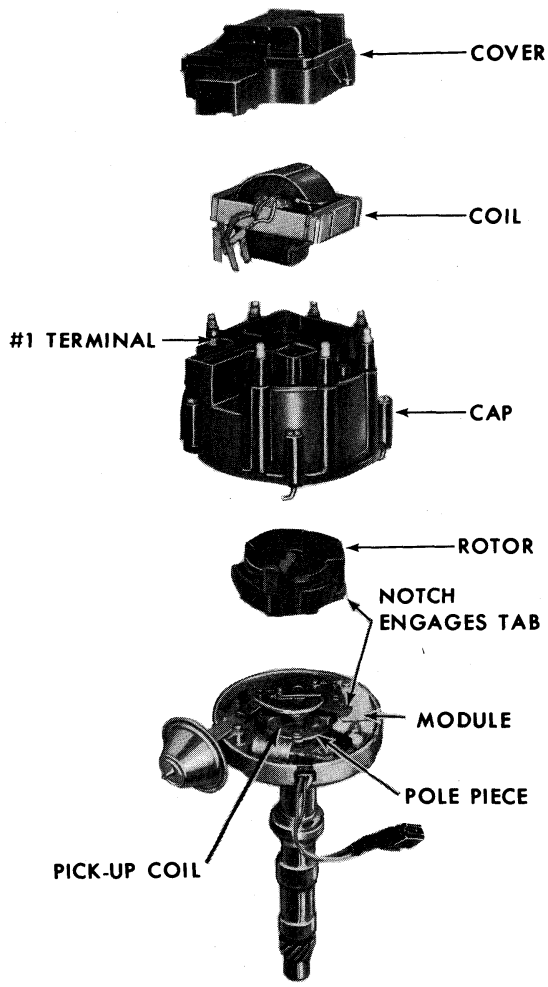


Fig. 6D-38 High Energy Ignition - Disassembled

Centrifugal Advance

At idle, the spark is timed to occur just before the piston reaches top dead center on the compression stroke. As engine speed increases, it is necessary to fire the spark plug somewhat earlier, to provide sufficient time for the mixture to burn and deliver its power to the piston. To provide this advance, a centrifugal advance mechanism is used. The mechanism consists of two weights that move out against spring tension as engine speed increases. This movement is transmitted to a rotating pole piece causing the rotating pole piece to advance relative to the magnetic ring. Therefore, the timing of the cylinders varies from no advance at low engine speeds to full advance at high speeds as the weights reach the limits of their travel. The weights and springs are calibrated to provide the best possible performance at wide open throttle with 91 (research) octane fuel.

Vacuum Advance

During part throttle conditions a partial vacuum is developed in the intake manifold. Since less air and fuel are admitted, the mixture is less highly compressed. Under these conditions, the mixture will burn slower and, in order to achieve full power, the spark must be advanced. The vacuum sensitive advance mechanism consists of a spring loaded diaphragm connected by a linkage to the magnetic ring. The spring loaded side of the diaphragm is connected directly to the intake manifold vacuum on all cars except California. On California cars the diaphragm is connected to intake manifold vacuum thru the carburetor through a thermo vacuum switch.

Electronic Module

The electronic module is a solid state unit containing five complete circuits which control spark triggering, switching, current limiting, dwell control and distributor pick-up. Dwell angle is controlled by a transistor circuit within the module and is **varied** in direct relation to engine speed.

Pick-Up Coil Assembly

The pick-up coil assembly consists of the following:

1. A rotating pole piece timer core with eight external teeth which is turned by the distributor shaft.
2. A stationary magnetic ring with eight internal teeth.
3. A pick-up coil and magnet which are located between the pole piece and a bottom plate.

VACUUM ADVANCE SYSTEMS

All 1977 Cadillac engines are equipped with distributor vacuum spark advance. Vacuum advance provides smooth part throttle operation and good fuel economy. There are two types of vacuum advance: 1) ported vacuum and 2) full manifold vacuum.

Ported vacuum advance systems have a timed port in the carburetor throttle body above the throttle plates. The timed port provides vacuum during open throttle operation only.

Full manifold vacuum advance systems use manifold vacuum from either a manifold vacuum port on the carburetor or a fitting in the intake manifold. Vacuum is provided whenever the engine is running.

Operation

The pick-up coil is connected to transistors in the electronic module. The electronic module is connected to the primary windings in the coil. As the distributor shaft turns the timer core teeth out of alignment with the teeth of the pole piece a voltage is created in the magnetic field of the

pick-up coil.

The pick-up coil sends this voltage signal to the electronic module, which determines from RPM when to start current building in the primary windings of the ignition coil.

Each time the timer core teeth align with the pole piece teeth the pick-up coil sends this different voltage signal to the electronic module which electronically shuts off the ignition coil primary circuit. This in turn collapses the coil magnetic field, induces high secondary voltage and fires one spark plug.

The electronic module delivers full battery voltage to the ignition coil which is limited to five to six amperes. There is no primary resistance wire in the HEI SYSTEM. The electronic module triggers the closing and opening of the primary circuit instantaneously with no energy lost due to breaker point arcing or capacitor charging time lag. The capacitor in the HEI unit functions only as a radio noise suppressor.

This instantaneous and efficient circuit triggering enables the HEI system to deliver up to approximately 35,000 volts through the secondary wiring to the spark plugs.

Because of this higher voltage the HEI system has 8MM diameter spark plug wires with silicone insulation. The silicone wire is gray in color and more heat resistant than standard black wire and less vulnerable to deterioration. Silicone insulation is soft, however, and must not be mishandled.

IGNITION TIMING

Timing specifications for each engine are listed in Section 6E. When using a timing light, connect an adapter between the No. 1 spark plug and the No. 1 spark plug wire, or use an inductive type pick-up. **Do not pierce the plug lead.** Once the insulation of the spark plug cable has been broken, voltage will jump to the nearest ground, and the spark plug will not fire properly.

SPARK PLUGS

R45NSX resistor type, plugs with long reach are used in all cars except Seville.

R47SX plugs used in the Seville engines are also a resistor type plug with long reach.

Normal or average service is assumed to be a mixture of idling, slow speed, and high speed operation with some of each making up the daily total driving. Occasional or intermittent high-speed driving is essential to good spark plug performance as it provides increased and sustained combustion heat that burns away any excess deposits of carbon or oxide that may have accumulated from frequent idling or continual stop-an-go or slow-speed driving. Spark plugs are protected by an insulating boot made of special heat-resistant material which covers the spark plug terminal and extends downward over a portion of the plug insulator. These boots prevent plugs from grounding out causing missfire, even though a film is allowed to accumulate on exposed portion of plug porcelains.

NOTE: Do not mistake corona discharge for flash-over or a shorted insulator. Corona is a steady blue light appearing around insulator, just above the shell crimp. It is the visible evidence of high-tension field, and has no effect on ignition performance. Usually it can be detected only in darkness. This discharge may repel dust particles, leaving a clear ring on the insulator just above the shell. This ring is sometimes mistakenly regarded as evidence that combustion gases have blown out between shell and insulator.

All spark plugs have a type number on the insulator which designates thread size as well as relative position of the plug in the Heat Range. Type numbers starting with 4 are 14 mm. thread size.

The last digit of the type number indicates the Heat Range position of the plug in the Heat Range System. Read these numbers as you would a thermometer; the higher the last digit, the hotter the plug will operate in engine; the lower the last digit the cooler the plug.

IGNITION SWITCH

The switch is located in the steering column on the right hand side just below the steering wheel. The electrical switching portion of the assembly is separate from the key and lock cylinder. However, both are synchronized and work in conjunction with each other through the action of the actuator rod assembly.

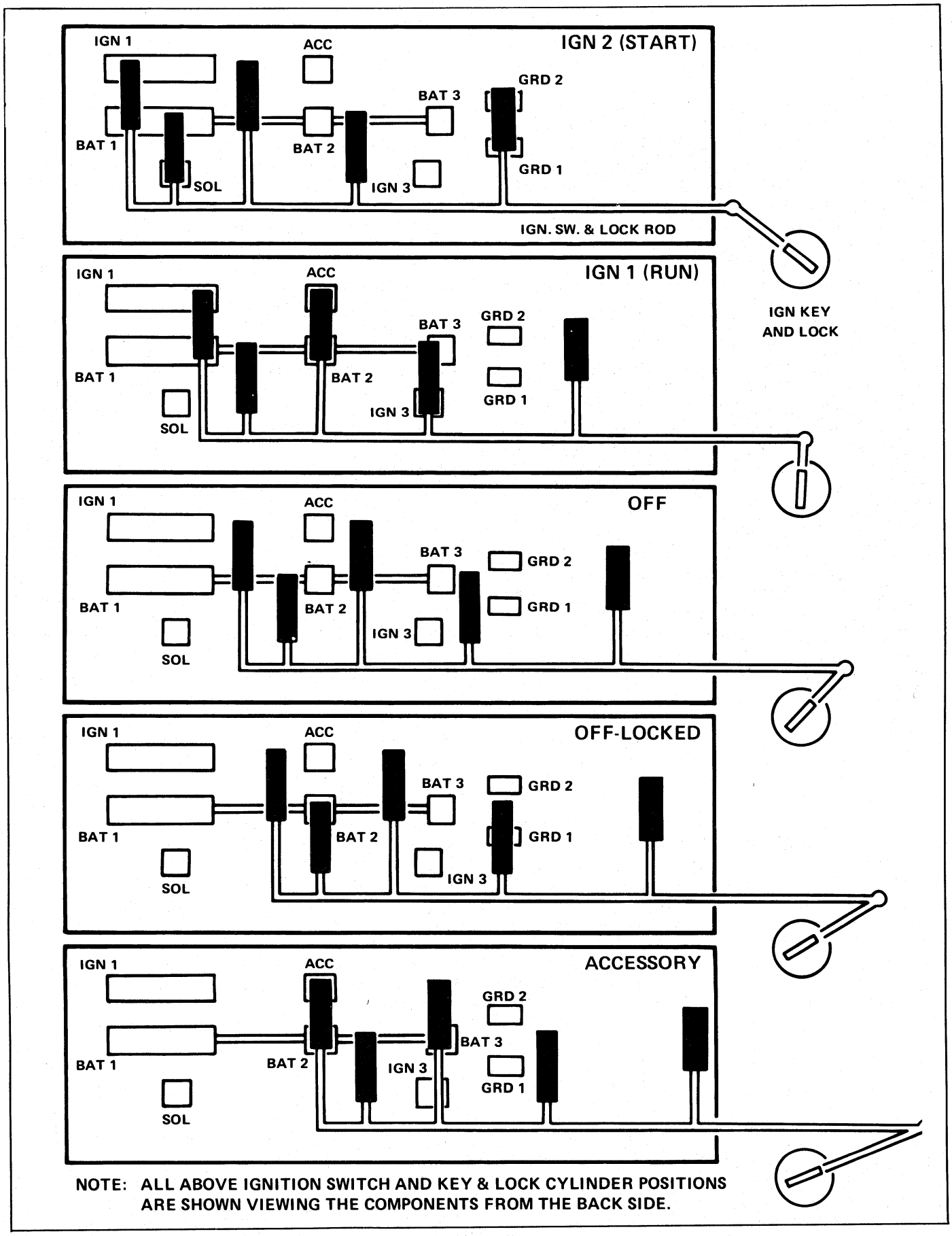
For a complete explanation of the key and lock cylinder, and the actuator rod assembly, see STEERING, Section 3B.

The ignition and starting switch is key operated through the actuator rod assembly to close the ignition primary circuit and to energize the starting motor solenoid for cranking.

The ignition switch used on all cars has five positions: Two "OFF" positions ("OFF" and "OFF-LOCKED"), "ACCESSORY", "RUN" and "START". "OFF" is the center position of the key-lock cylinder, and "OFF-LOCKED" is the next position to the left.

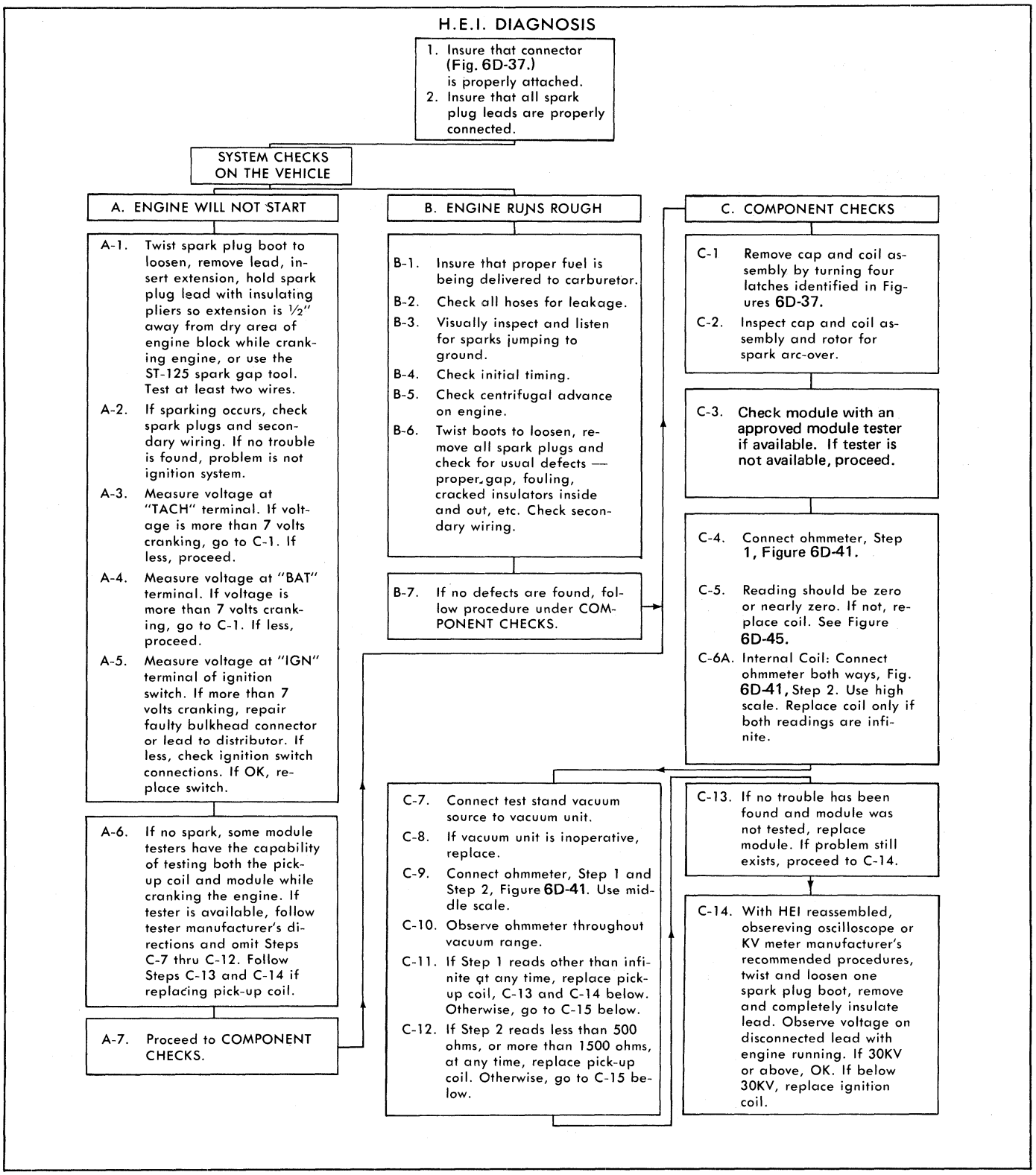
"ACCESSORY" is located one more detent to the left of "OFF-LOCKED". Turning the key to the right of the "OFF" position until spring pressure is felt will put the ignition switch in the "RUN" position, and when turned fully to the right against spring pressure, the switch will be in the "START" position.

The connections to the ignition switch are shown in the Chassis Electrical Wiring Diagrams at the end of the manual. The charts included on the diagrams show how the switches are internally connected in each switch position. Fig. 6D-39 also shows how the switch is internally connected.



NOTE: ALL ABOVE IGNITION SWITCH AND KEY & LOCK CYLINDER POSITIONS ARE SHOWN VIEWING THE COMPONENTS FROM THE BACK SIDE.

Fig. 6D-39 Ignition Switch and Key Chart


H.E.I. DIAGNOSIS
1. Insure that connector (Fig. 6D-37.) is properly attached.
2. Insure that all spark plug leads are properly connected.
SYSTEM CHECKS ON THE VEHICLE
A. ENGINE WILL NOT START
A-1. Twist spark plug boot to loosen, remove lead, insert extension, hold spark plug lead with insulating pliers so extension is ½" away from dry area of engine block while cranking engine, or use the ST-125 spark gap tool. Test at least two wires.
A-2. If sparking occurs, check spark plugs and secondary wiring. If no trouble is found, problem is not ignition system.
A-3. Measure voltage at "TACH" terminal. If voltage is more than 7 volts cranking, go to C-1. If less, proceed.
A-4. Measure voltage at "BAT" terminal. If voltage is more than 7 volts cranking, go to C-1. If less, proceed.
A-5. Measure voltage at "IGN" terminal of ignition switch. If more than 7 volts cranking, repair faulty bulkhead connector or lead to distributor. If less, check ignition switch connections. If OK, replace switch.
A-6. If no spark, some module testers have the capability of testing both the pick-up coil and module while cranking the engine. If tester is available, follow tester manufacturer's directions and omit Steps C-7 thru C-12. Follow Steps C-13 and C-14 if replacing pick-up coil.
A-7. Proceed to COMPONENT CHECKS.
B. ENGINE RUNS ROUGH
B-1. Insure that proper fuel is being delivered to carburetor.
B-2. Check all hoses for leakage.
B-3. Visually inspect and listen for sparks jumping to ground.
B-4. Check initial timing.
B-5. Check centrifugal advance on engine.
B-6. Twist boots to loosen, remove all spark plugs and check for usual defects — proper gap, fouling, cracked insulators inside and out, etc. Check secondary wiring.
B-7. If no defects are found, follow procedure under COMPONENT CHECKS.
C. COMPONENT CHECKS
C-1 Remove cap and coil assembly by turning four latches identified in Figures 6D-37.
C-2. Inspect cap and coil assembly and rotor for spark arc-over.
C-3. Check module with an approved module tester if available. If tester is not available, proceed.
C-4. Connect ohmmeter, Step 1, Figure 6D-41.
C-5. Reading should be zero or nearly zero. If not, replace coil. See Figure 6D-45.
C-6A. Internal Coil: Connect ohmmeter both ways, Fig. 6D-41, Step 2. Use high scale. Replace coil only if both readings are infinite.
C-7. Connect test stand vacuum source to vacuum unit.
C-8. If vacuum unit is inoperative, replace.
C-9. Connect ohmmeter, Step 1 and Step 2, Figure 6D-41. Use middle scale.
C-10. Observe ohmmeter throughout vacuum range.
C-11. If Step 1 reads other than infinite at any time, replace pick-up coil, C-13 and C-14 below. Otherwise, go to C-15 below.
C-12. If Step 2 reads less than 500 ohms, or more than 1500 ohms, at any time, replace pick-up coil. Otherwise, go to C-15 below.
C-13. If no trouble has been found and module was not tested, replace module. If problem still exists, proceed to C-14.
C-14. With HEI reassembled, obsereving oscilloscope or KV meter manufacturer's recommended procedures, twist and loosen one spark plug boot, remove and completely insulate lead. Observe voltage on disconnected lead with engine running. If 30KV or above, OK. If below 30KV, replace ignition coil.

IGNITION SYSTEM DIAGNOSIS

DISTRIBUTOR TESTING

For service departments equipped with distributor testing equipment, the following information on performance characteristics is provided.

EXCEPT SEVILLE

CENTRIFUGAL ADVANCE		VACUUM ADVANCE	
Distributor RPM	Distributor Advance	Inches of Mercury	Distributor Advance
200	0°	4″	0°
300	0° to -¼°		
400	-½° to 2½°	5½″	0° to 1½°
550	2½° to 6°		
600	3½° to 6°	14¾″	11½° to 14½°
2000	7½° to 9½°		
3000	6½° to 9½°	16″	13½° to 14½°

Except California.

Centrifugal Advance		Vacuum Advance	
Distributor RPM	Distributor Advance	Inches of Mercury	Distributor Advance
200	0°	7½″	0°
300	0° to ¼°	8½″	0° to 1½°
400	-½° to 2¼°	11½″	3¾° to 5½°
575	2½° to 6°	12″	4½° to 5½°
625	4° to 6⅛°		
2000	7½° to 9½°		
3000	6½° to 9½°		

California — Eldorado Only

Centrifugal Advance		Vacuum Advance	
Distributor RPM	Distributor Advance	Inches of Mercury	Distributor Advance
200	0°	3½″	0°
300	0° to -¼°	4½″	0° to 1½°
400	-½° to 1½°	10″	6½° to 8°
600	1° to 3°	12″	8½° to 10¼°
2500	6° to 8°	13″	9½° to 10½°
3000	5½° to 8°		

California Except EFI, Eldorado, Limousine and Commercial Chassis

Centrifugal Advance		Vacuum Advance	
Distributor RPM	Distributor Advance	Inches of Mercury	Distributor Advance
200	0°		
300	0° to -¼°	4¼″	0°
475	-½° to 1¾°	5⅓″	0° to 1¼°
575	½° to 3°	9½″	4¼° to 5½°
600	1° to 3°	9¾″	4½° to 5½°
2500	5⅞° to 8°		
2525	6° to 8°		
3000	5½° to 8°		

California — Limousine and Commercial Chassis Only

Centrifugal Advance		Vacuum Advance	
Distributor RPM	Distributor Advance	Inches of Mercury	Distributor Advance
200	0°	3½″	0°
300	0° to -¼°	4¾″	0° to 1¾°
475	-½° to 1¾°	12¼″	8½° to 10½°
600	¾° to 3°	13	9½° to 10½°
625	1° to 3⅛°		
2425	5⅞° to 8°		
2525	6° to 8°		
3000	5½° to 8°		

California — EFI Only

SEVILLE

Centrifugal Advance		Vacuum Advance	
Distributor RPM	Distributor Advance	Inches of Mercury	Distributor Advance
200	0°	7″	0°
400	0° to -⅜°		
500	-½° to 2⅝°	8″	0° to 1½°
725	5° to 8°		
775	6¼° to 8¼°	16½″	10° to 12½°
2475	18½° to 22°		
2500	20° to 22°	18″	11½° to 12½°
3000	19° to 22°		

Except California

Centrifugal Advance		Vacuum Retard		Vacuum Advance	
Distributor RPM	Distributor Advance	Inches of Mercury	Distributor Advance	Inches of Mercury	Distributor Advance
200	0°	1½″	0°	9″	0°
350	0° to -½°				
500	-½° to 2½°	4½″	0° to 2½°	11″	0° to 2½°
725	5° to 8°				
775	6½° to 8½°	7½″	1½° to 4¾°	17½″	6½° to 9¾°
2475	19½° to 22°				
2500	20° to 22°	11″	3¼° to 4¾°	19″	8¼° to 9¾°
3000	19½° to 22°				

California Only

Analyzing H.E.I. System Conditions

Careful adherence to the following procedures will lead to the location and correction of High Energy Ignition system problems. Normally only a portion of the procedures need be performed. Before starting the detailed procedure:

1. Make sure that wiring connector is properly attached to connector at side of distributor cap.

2. Make sure that all spark plug leads are properly connected at plugs and at distributor terminals.

Trouble in the ignition system will show up as one of the following conditions:

a. Engine will not start.

b. Engine starts but runs roughly.

a. Engine will not Start

1. Connect voltmeter between "BAT" terminal lead on distributor connector and ground.

2. Turn ignition switch ON.

3. If voltage is zero, there is an open circuit in the 18 pink wire between the distributor and the bulkhead connector; or in the 12 pink wire between the bulkhead connector and the ignition switch; or in the 10 red wire between the ignition switch and the starter solenoid. Repair as required.

4. If reading is battery voltage, hold one spark plug lead with insulated pliers approximately 1/4 inch away from a dry area of engine block while cranking engine.

5. If sparking occurs, trouble is not in distributor. Check spark plugs.

6. If sparking does not occur, proceed to part c.

b. Engine Starts But Runs Roughly Except EFI

1. Check fuel system as described on Page 6C-6.

2. Check all vacuum hoses for leakage. Vacuum hose routing is shown on Page 6E-24.

3. Visually inspect and listen for sparks jumping to ground or to other plug wires.

4. Check ignition timing.

5. Check centrifugal advance mechanism for proper operation.

6. Remove all spark plugs and check for malfunctions such as improper gap, fouling, cracked insulators (inside and out), etc.

7. If no malfunctions are found, proceed to part c.

c. Component Checks

1. Disconnect 3-wire connector from distributor cap.

2. Connector analyzer J-24642 to 3-wire connector, Fig. 6D-40.

3. Connect analyzer leads to battery, Fig. 6D-40. Observe polarity.

4. Push analyzer button while cranking engine. If green light comes on, module and pickup coil are both good. The ignition coil is probably malfunctioning and should be checked with an ohmmeter as follows:

a. Remove cap and coil assembly by removing wiring harness connector and battery lead and turning four cap to housing latches.

b. Connect ohmmeter with one lead to the "BAT" terminal and the second lead to the "TACH" terminal as shown in position 1 of Fig. 6D-41.

c. Reading should be zero or nearly zero. If not, replace coil.

d. Connect ohmmeter both ways as shown in position 2 of Fig. 6D-41. Use high scale. Replace coil only if both readings are infinite or show an open circuit.

e. Connect ohmmeter with one lead to the "TACH" terminal and the second lead to the coil secondary output terminal as shown in position 2 of Fig. 6D-41. Use middle

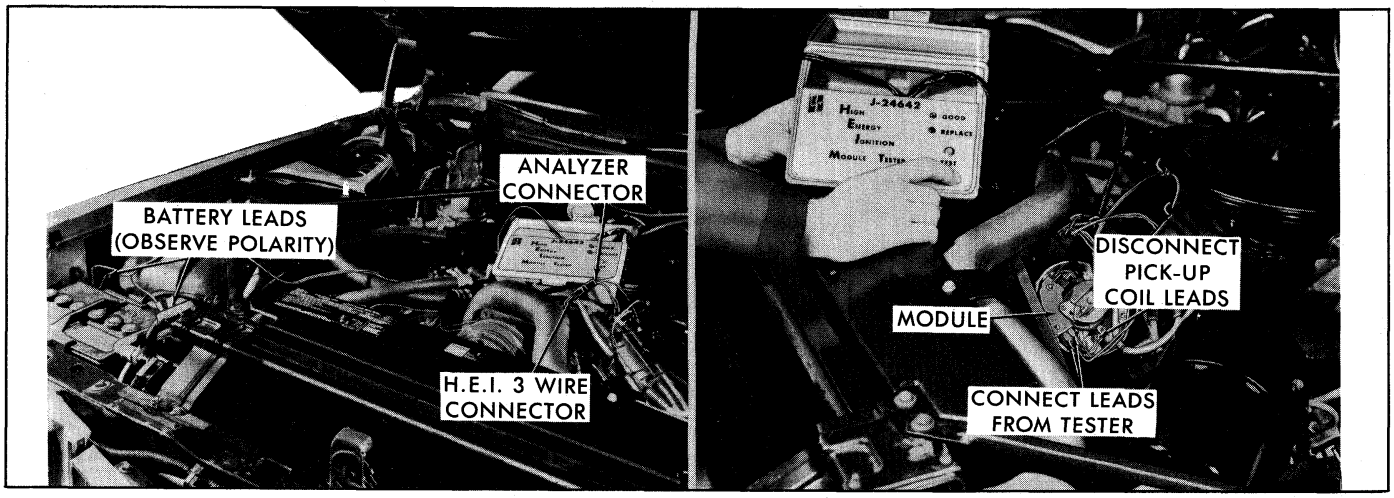


Fig. 6D-40 Testing HEI Module

or high scale. Reading should not be infinite. If reading is infinite, replace coil.

5. If red light comes on in step 3, either the module or the pickup coil is malfunctioning. Lift distributor cap and connect green and white analyzer wire clips to module. (These analyzer leads provide an alternating current pulse, just as good pickup coil does).

6. Push analyzer button. If green light now comes on, the pickup coil is malfunctioning. If red light still comes on, the module is probably malfunctioning.

7. Replace malfunctioning component and retest.

SPARK PLUGS

Worn or dirty plugs may give satisfactory operation at idling speed, but under operating conditions they frequently fail. Faulty plugs are indicated in a number of ways: poor fuel economy, power loss, loss of speed, hard starting and general poor engine performance.

Spark plug failure, in addition to normal wear, may be due to carbon fouled plugs, excessive gap or broken insulator.

Fouled plugs may be indicated by checking for black carbon deposits. The black deposits are usually the result of slow-speed driving and short runs where sufficient engine operating temperature is seldom reached. Worn pistons, rings, faulty ignition, over-rich carburetion and spark plugs which are too cold will also result in carbon deposits.

Excessive gap wear, on plugs of low mileage, usually indicates the engine is operating at high speeds or loads that are consistently greater than normal or that a plug which is too hot is being used. In addition, electrode wear may be the result of plug overheating, caused by combustion gases leaking past the threads, due to insufficient torquing of the spark plug. Excessively lean carburetion will also result in excessive electrode wear.

Broken insulators are usually the result of improper installation or carelessness when regapping the plug. Broken upper insulators usually result from a poor fitting wrench or an outside blow. The cracked insulator may not make itself evident immediately, but will as soon as oil or moisture penetrates the fracture. The fracture is usually just below the crimped part of shell and may not be visible.

Broken lower insulators usually result from carelessness when regapping and generally are visible. In fairly rare instances, this type of break may result from the plug operating too "hot" such as encountered in sustained periods of high-speed operation or under extremely heavy loads. When regapping a spark plug, to avoid lower insulator breakage, always make the gap adjustment by bending the ground (side) electrode. Spark plugs with broken insulators should always be replaced.

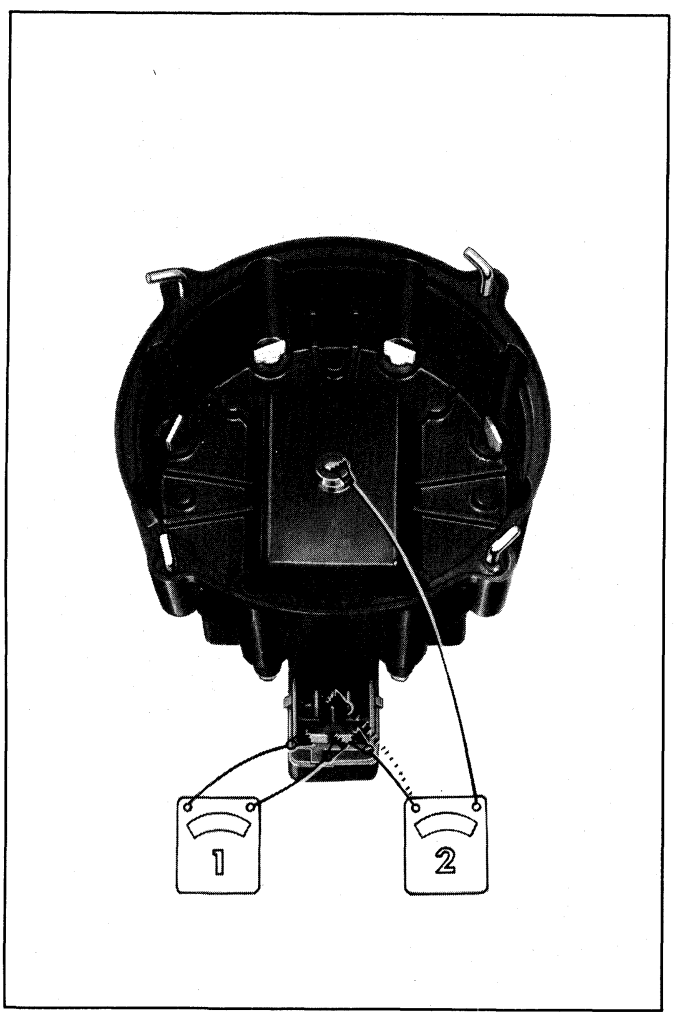


Fig. 6D-41 Checking HEI Ignition Coil

ON CAR SERVICE

The HEI system is designed to be free from routine maintenance. If component part replacement should become necessary, nowever, several items specific to the HEI system should be noted.

Electronic Module

The electronic module is serviced by complete replacement only. When replacing the module a liberal coating of special silicone grease must be applied to the metal mounting surface on which the module will be installed. If this grease is not applied the module will not cool properly which can cause the module to malfunction. A tube of this special silicone grease is supplied with each replacement module.

Tachometer Connections

In the distributor cap connector is a "tach" terminal. Connect the tachometer to this terminal and to ground. Some tachometers must connect from the "tach" terminal to the battery positive (+) terminal. Follow tachometer manufacturer's instructions.

CAUTION: *Grounding "tach" terminal could damage the H.E.I. electronic module.*

Other Test Equipment

Oscilliscopes require special adaptors. Distributor machines require a special amplifier. The equipment manufacturers have instructions and details necessary to modify test equipment for HEI DIAGNOSIS.

H.E.I. DISTRIBUTOR

Service Precautions

1. When making compression checks, disconnect the ignition switch feed wire at the distributor. When disconnecting this connector **do not** use a screwdriver or tool to release the locking tab as it may break.

2. No periodic lubrication is required. Engine oil lubricates the lower bushing and an oil-filled reservoir provides lubrication for the upper bushing.

3. The tachometer terminal is next to the ignition switch connector on the distributor cap.

CAUTION: *The tachometer terminal must NEVER be connected to ground, as damage to the module can result.*

NOTE: Some service tachometers and electronic diagnostic equipment currently in use may NOT be compatible with the High Energy Ignition System. It is recommended that you consult your representative of such equipment as to the necessary updating of your equipment for compatibility with the HEI system.

4. There is no dwell adjustment as this is controlled by the module.

5. The centrifugal advance, and vacuum advance are similar to the conventional ignition.

6. The material used to construct the spark plug cables is very pliable and soft. This cable will withstand more heat and carry a higher voltage. Due to the more pliable cable, scuffing and cutting become easier. It is therefore extremely important that the spark plug cables be routed correctly to prevent chaffing or cutting.

Distributor Removal and Installation

a. Removal

1. Disconnect wiring harness connectors at side of distributor cap.

2. On EFI cars disconnect speed sensor connector at distributor trigger.

3. Remove distributor cap and position out of way.

4. Disconnect vacuum advance hose from vacuum advance mechanism.

5. Scribe a mark on the engine in line with rotor. Note approximate position of distributor housing in relation to engine.

6. Remove distributor hold-down nut and clamp.

7. Lift distributor from engine.

b. Installation

1. Install distributor.

NOTE: To insure correct timing of the distributor, the distributor must be INSTALLED with the rotor correctly positioned as noted in Step 5a.

If the engine was accidentally cranked after the distributor was removed, the following procedure can be used for installing:

a. Remove No. 1 spark plug.

b. Place finger over No. 1 spark plug hole and crank engine slowly until compression is felt.

c. Align timing mark on pulley to "0" on engine timing indicator.

d. Turn rotor to point between No. 1 and No. 8 spark plug towers on distributor cap, Fig. 6D-37.

e. Install distributor.

2. Install distributor hold-down clamp and snugly install nut.

3. Move distributor housing to approximate position relative to engine noted during removal.

4. Position distributor cap to housing with tab in base of cap aligned with notch in housing and secure with four latches.

5. Connect wiring harness connector to terminals on side of distributor cap. Connector will fit only one way.

6. Adjust ignition timing using the procedure described on Page 6D-32.

Distributor Disassembly and Assembly

a. Disassembly

1. Remove distributor as described on Page 6D-31.

2. Remove rotor from distributor shaft by removing two screws.

3. Remove two advance springs and advane weights.

4. Remove two screws holding module to housing and move module to a position where connector may be removed from "B" and "C" terminals.

5. Remove wires from "W" and "G" terminals of module.

6. Remove roll pin from drive gear.

CAUTION: *Distributor gear should be supported in such a way that no damage will occur to distributor shaft while removing pin.*

7. Remove gear, shim and tanged washer from distributor shaft. Remove any burrs that may have been caused by removal of pin.

NOTE: Seville does not have a shim or tanged washer.

8. On E.F.I. cars perform the following:

a. Remove four screws securing speed sensor to distributor housing and remove sensor and gasket.

b. Remove plug from opposite side of sensor housing on distributor.

c. Remove roll pin from magnet assembly.

9. Remove distributor shaft and magnet assembly from housing.

10. Remove three screws securing pole piece to housing and remove pole piece, magnet and pick-up coil.

11. Remove lock ring at top of housing and remove pick-up coil retainer and felt washer.

NOTE: No attempt should be made to service the shaft bushings in the housing.

12. Remove vacuum advance mechanism by removing two screws.

13. Disconnect capacitor lead and remove capacitor by removing one screw.

14. Remove wiring harness from distributor housing.

b. Assembly

1. Position vacuum advance unit to housing and secure with two screws.

2. Position felt washer over lubricant reservoir at top of housing.

3. Position pick-up coil retainer to housing with vacuum advance arm over actuating pin of vacuum advance mechanism. Secure with lock ring.

4. Install pick-up coil magnet and pole piece. Loosely install three screws holding pole piece. See Fig. 6D-42 for correct identification.

5. Install distributor shaft and rotate to check for even clearance all around between pole piece and shaft projections.

6. Move pole piece to provide even clearance and secure with three screws.

7. On E.F.I. cars perform the following:

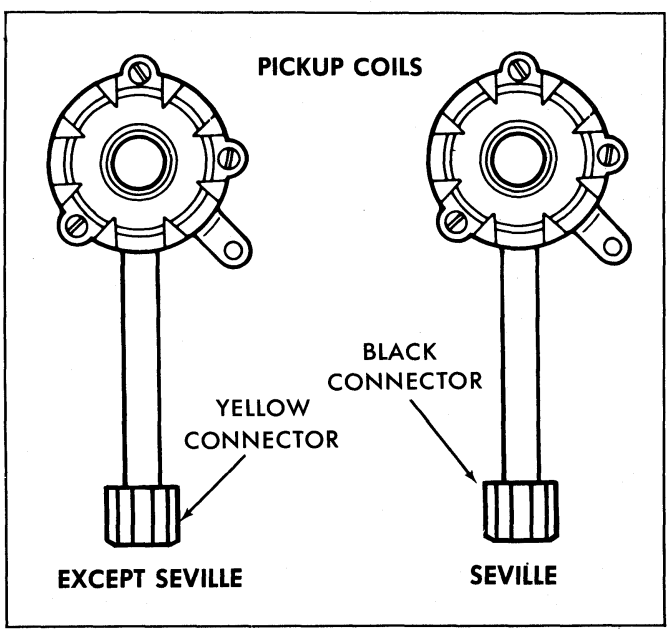


Fig. 6D-42 Pickup Coil Identification

a. Remove distributor shaft to a position where speed sensor rotating magnet may be installed in position in distributor housing.

b. Engage speed sensor rotating magnet on distributor shaft and install shaft in position. Do not install roll pin.

NOTE: Sevilles do not have a shim or tanged washer.

8. Install tanged washer, shim and drive gear (teeth up) to bottom of shaft.

9. Note that the distributor drive gear has a dimple on one side next to the drive pin hole. Align the drive gear so that the dimple is on the same side of the shaft as the rotor pointer. Temporarily install the rotor to insure that alignment is correct.

10. Install drive gear using new roll pin.

11. On E.F.I. cars perform the following:

a. Align speed sensor rotating magnet, and install new roll pin.

b. Install plug in distributor housing behind speed sensor.

c. Using a new gasket, position speed sensor to distributor housing with wiring harness coming out of top of sensor (directly below distributor housing) and secure with four screws.

12. Position capacitor to housing and loosely install one mounting screw.

13. Install connector to "B" and "C" terminals on module with tab on top.

14. Apply special silicone lubricant liberally to bottom of module and secure with two screws.

15. Position wiring harness with grommet in housing notch.

16. Connect pink wire to capacitor stud, and black wire to capacitor mounting screw. Tighten screw.

17. Connect white wire from pick-up coil to terminal "W" of module.

18. Connect green wire from pick-up coil to terminal "G" of module.

19. Install centrifugal advance weights and springs.

20. Install rotor and secure with two screws.

CAUTION: *Notch on side of rotor must engage tab on cam weight base.*

21. Install distributor as described on Page 6D-32.

IGNITION TIMING ADJUSTMENT - Except Seville

Ignition timing may be adjusted by either of two methods:

1) with conventional strobe light timing equipment or,
2) with a probe type timing advance meter. Both methods are described.

a. Strobe Light Timing

1. Adjust distributor clamp nut to allow distributor to be turned by hand, but without excessive looseness.

2. Disconnect vacuum advance unit hose and plug the end. This is important, as a manifold leak will affect timing adjustments.

3. Insert a timing light adapter between the number 1 spark plug and its lead wire. Avoid puncturing the boots or cable covers.

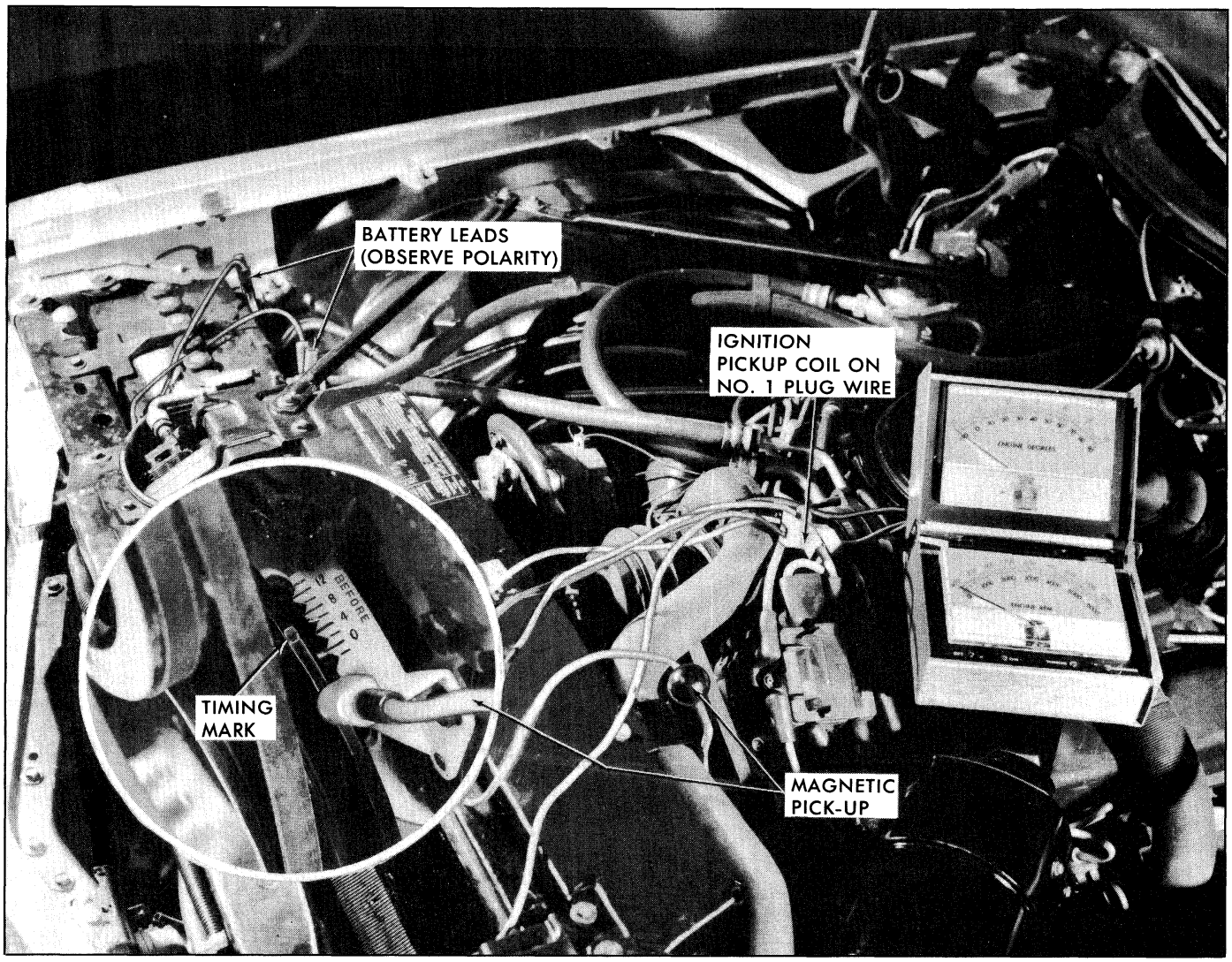


Fig. 6D-43 Ignition Timing Adjustment

CAUTION: *Do not time engine on seven cylinders as this could cause damage to the catalytic converter.*

4. Connect a suitable timing light to the adapter.

NOTE: Make sure that timing marks and scribe marks are clean.

5. Disconnect and plug the EGR vacuum hose.

6. Connect tachometer to engine and set parking brake securely, place transmission lever in park position.

7. Start engine.

8. With the engine warm, place the fast idle cam follower on the second step of the fast idle cam. On E.F.I. cars, adjust throttle linkage manually to obtain 1400 rpm.

9. With the engine speed at 1400 rpm, observe the timing light flashes on pulley in relation to the notches on the front cover. Set the timing to 18 degrees before top dead center, Fig. 6D-43.

NOTE: The fast idle speed and then timing may have to be reset at this point.

10. Tighten clamp nut to 18 foot-pounds and recheck timing to make sure it did not change.

11. Disconnect the tachometer and timing light. Remove adapter from engine. Replace distributor and EGR vacuum hoses. Position hose clamps properly.

b. Timing Advance Meter

1. Adjust distributor clamp nut to allow distributor to be turned by hand, but without excessive looseness.

2. Disconnect vacuum advance unit hose and plug the end. This is important, as a manifold leak will affect timing adjustments.

3. Disconnect and plug EGR vacuum hose.

4. Connect power supply for timing meter to battery. Observe correct polarity, see Fig. 6D-43.

5. Install ignition pickup clip over number 1 spark plug wire, see Fig. 6D-43. Be sure jaws are clean and locking button is pressed forward to close jaws firmly.

6. Install magnetic pickup in receptacle of timing tab and press down firmly. See Fig. 6D-43.

NOTE: Pickup should be as close to pulley surface as possible without making contact.

7. Make sure that all leads to advance meter are out of way of moving parts and exhaust manifold. Place transmission selector lever in the park position.

8. Turn power switch ON and timing-advance switch to TIMING position.

9. Start the engine.

10. With the engine warm, place the fast idle cam

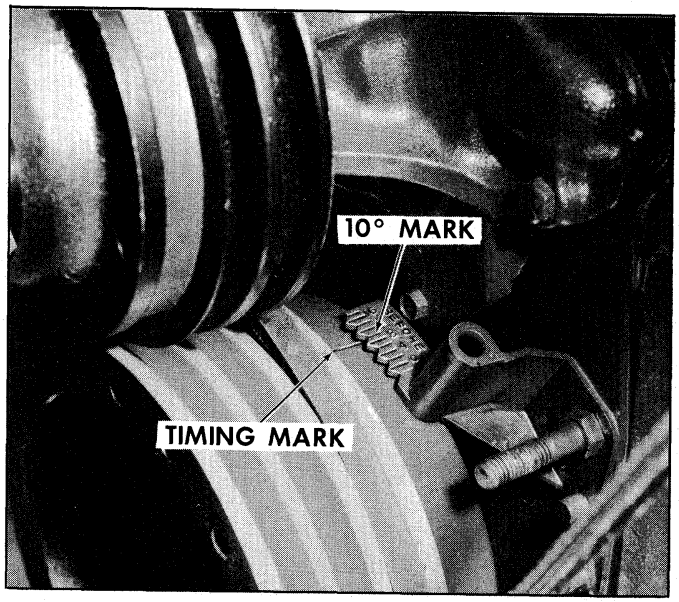


Fig. 6D-44 Ignition Timing Adjustment - Seville

follower on the second step of the fast idle cam. On E.F.I. cars adjust throttle linkage manually to obtain 1400 rpm.

11. With the engine speed at 1400 rpm, observe the ENGINE DEGREES meter and set timing to 18 degrees before top dead center (+18 degrees on the meter).

NOTE: The engine speed, then timing may have to be reset at this point.

12. Tighten clamp nut to 18 foot-pounds, and recheck timing to be sure that it did not change.

13. Replace distributor and EGR vacuum hoses. Position hose clamps properly.

14. Disconnect timing advance meter connections from engine.

Ignition Timing Adjustment - Seville

Ignition timing may be adjusted by either of two methods; 1. with conventional strobe light timing equipment or, 2. with a probe type timing advance meter. Both methods are described.

a. Strobe Light Timing

1. Adjust distributor clamp nut to allow distributor to be turned by hand, but without excessive looseness.

2. Disconnect vacuum advance unit hose and vacuum retard unit hose when used at distributor and place a piece of tape over end of hose. This is important, as a manifold leak will affect timing adjustments.

3. Insert a timing light adapter between the number 1 spark plug and its lead wire.

NOTE: If spark plug adapters are not available disconnect number 1 spark plug wire and connect timing light to plug lead. Time engine on seven cylinders. Do not force pins or wires thru spark plug wire nipple.

4. Connect a suitable timing light to adapter.

NOTE: Make sure that timing marks and scribe marks are clean.

5. Disconnect and plug A.L.C.

6. Connect tachometer to engine and set parking brake securely. Place transmission selector lever in neutral or park position.

7. Start engine.

8. With idle speed at 650 rpm or less, observe timing light flashes on pulley in relation to notches on front cover. Set timing to 10 degrees before top dead center, 8 degrees on California cars, Fig. 6D-44.

9. Recheck idle speed with vacuum advance hose connected and reset to 650 RPM if required.

10. Tighten clamp nut to 18 foot-pounds, and recheck timing to make sure that it did not change.

11. Disconnect tachometer and timing light, and remove adapter from engine.

b. Timing Advance Meter

1. Adjust distributor clamp nut to allow distributor to be turned by hand, but without excessive looseness.

2. Disconnect vacuum advance unit hose at distributor and place a piece of tape over end of hose. This is important, as a manifold leak will affect timing adjustments.

3. Disconnect and plug A.L.C.

4. Connect power supply for timing meter to battery. Observe correct polarity, Fig. 6D-44.

5. Install ignition pickup clip over No. 1 spark plug wire, Fig. 6D-43. Be sure jaws are clean and locking button is pressed forward to close jaws firmly.

6. Install magnetic pickup in receptacle of timing tab and press down firmly to contact the pulley surface, Fig. 6D-43.

7. Make sure that all leads to advance meter are out of way of moving parts and exhaust manifold.

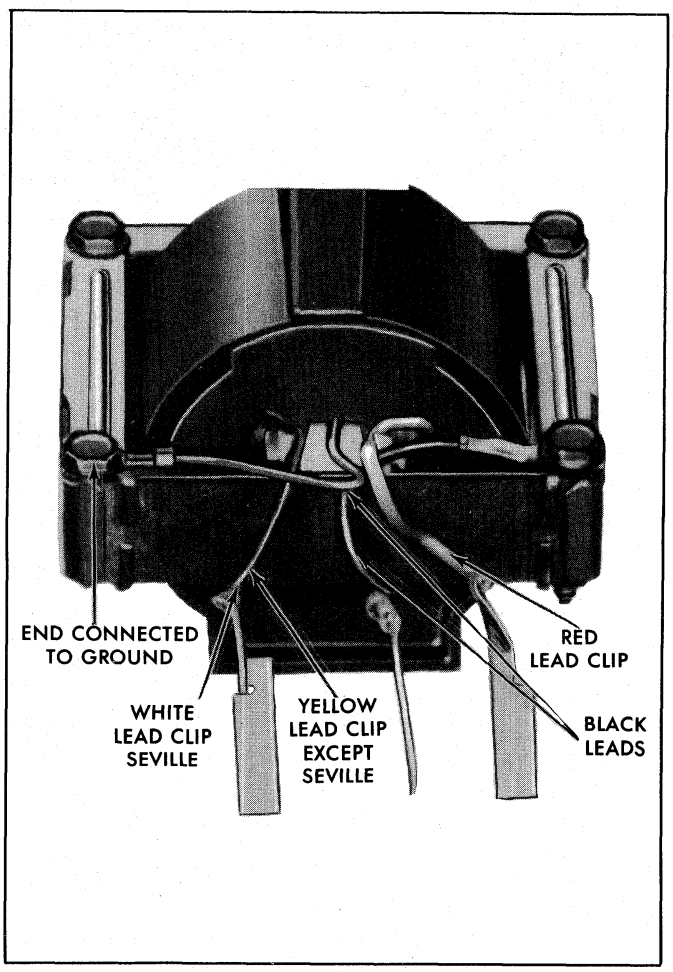


Fig. 6D-45 Ignition Coil Identification

8. Turn power switch ON and timing-advance switch to TIMING position.

9. Start engine.

10. With idle speed to 650 RPM or less, observe ENGINE DEGREES meter and set timing to 10° before top dead center (+10 degrees on meter), 8° on California cars.

11. Tighten clamp nut to 18 foot-pounds, and recheck timing to make sure that it did not change.

12. Remove tape from vacuum advance hose and connect hose to vacuum advance unit.

13. Recheck idle speed with vacuum advance hose connected and reset as required.

14. Disconnect timing advance meter connection from engine.

Ignition Coil

a. Removal

1. Disconnect battery wire and harness connector from distributor cap.

2. Remove three screws securing coil cover to distributor cap.

3. Remove four screws securing ignition coil to distributor cap.

4. Remove ground wires from coil.

5. Push coil leads from under side of connectors and remove coil from distributor cap.

b. Installation

1. Position coil into distributor cap with terminals over connector at side of cap. See Fig. 6D-45 for correct identification.

2. Push coil lead wires into connector on side of cap as follows: black (ground) in center; brown next to vacuum advance unit; pink opposite vacuum advance unit.

3. Secure ignition coil with four screws. Place ground wires under coil mounting screw.

4. Install coil cover onto distributor cap and secure with three screws.

IGNITION SWITCH

For removal and replacement procedures, refer to Steering Section 3B.

SPARK PLUG WIRES

Use care when removing spark plug wire boots from spark plugs. Twist the boot 1/2 turn before removing, and pull on the **boot only** to remove the wire.

It is extremely important when replacing plug wires to route the wires correctly and through the proper retainers. Failure to route the wires properly can lead to radio ignition

Refer to Fig. 6D-46 for proper spark plug wire routing.

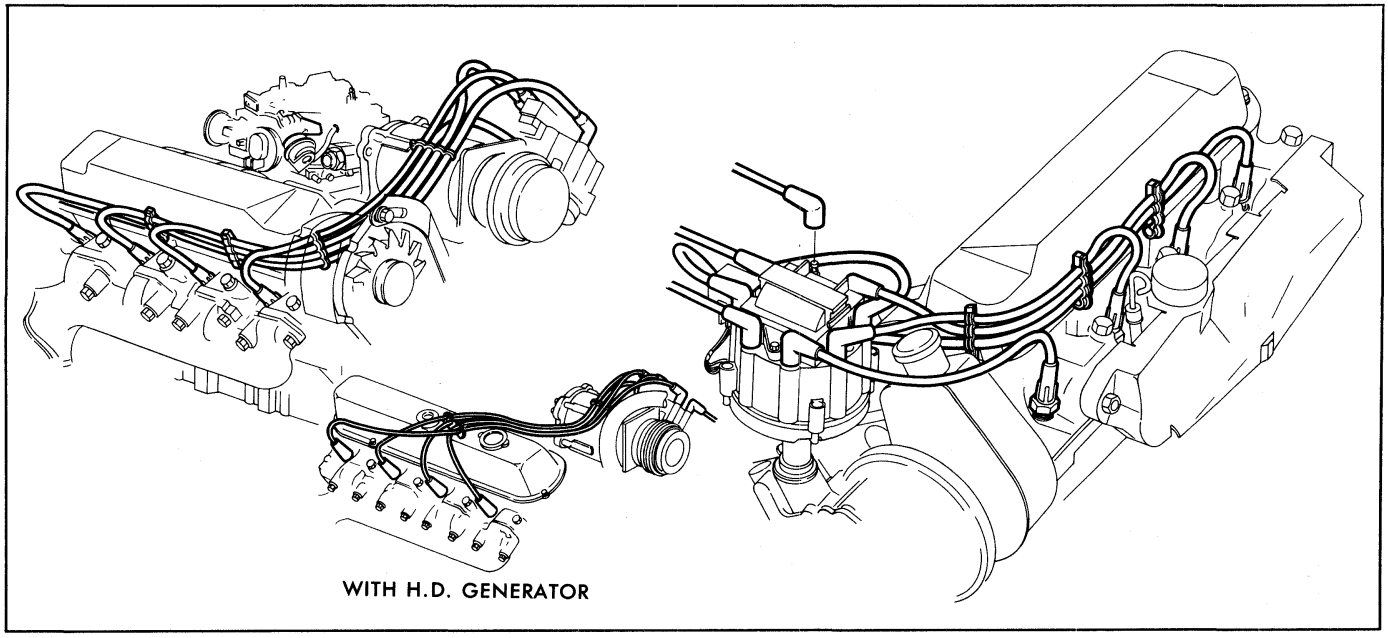


Fig. 6D-46 Spark plug wire routing.

CRANKING SYSTEM
TABLE OF CONTENTS

General Discription
- Cranking Circuit 6D-36
- Starter Motor 6D-36

Diagnosis 6D-37
- Cranking Voltage Test 6D-37
- Diagnosis Chart 6D-38
- Starter Motor Resistance Test 6D-39
- Checkling Starter Motor Pinion Clearance 6D-40

On Car Service 6D-40
- Starter Motor Removal and Installation 6D-40

Unit Repair 6D-42
- Disassembly 6D-42
- Visual Inspection 6D-43
- Checking Procedures 6D-44
- Assembly 6D-44
- Fusible Links 6D-45

Specifications 6D-46

Special Tools 6D-47

GENERAL DESCRIPTION

CRANKING CIRCUIT

The cranking circuit consists of the battery, starting motor, ignition switch, and related electrical wiring. These components are connected electrically as shown in Fig. 6D-47. Only the starting motor will be covered in this portion.

THEORY OF OPERATION STARTER

Starter

The starter Motor Fig. 6D-48 is mounted on the right rear side of the engine except Seville which is mounted on the left rear side of the engine. The starter motor has four pole shoes with two series fields. The drive end housing encloses the entire shift lever mechanism. An over-running clutch drive is used to engage the cranking motor pinion with the engine ring gear.

When the control switch is closed, the solenoid is energized, shifting the cranking motor pinion into mesh with the ring gear. The main contacts of the solenoid are then closed so that battery current is delivered to the starter motor.

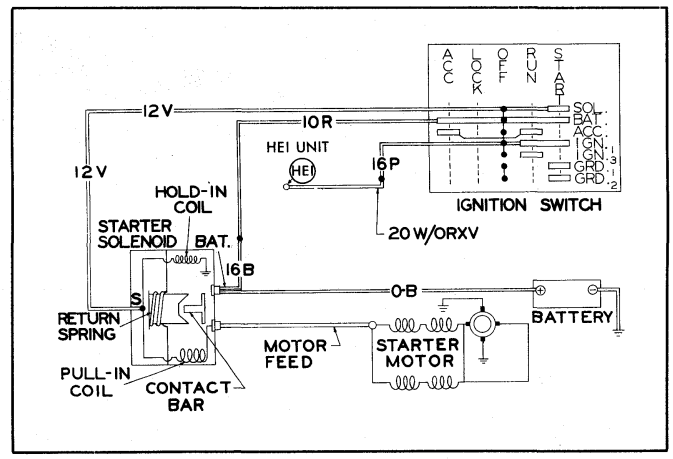


Fig. 6D-47 Starting System Circuit

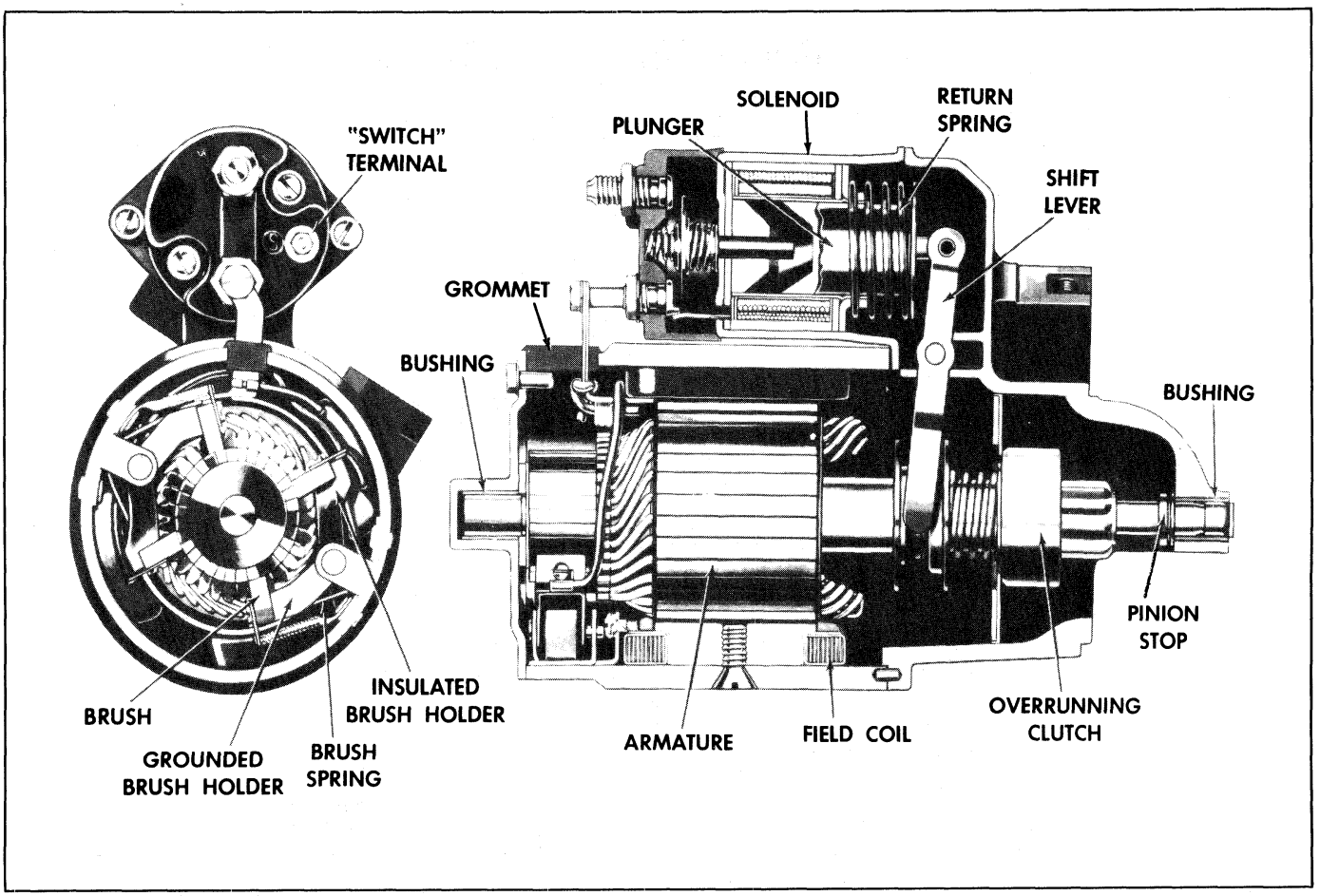


Fig. 6D-48 Starter Motor Cutaway View

DIAGNOSIS

Before removing any unit in a cranking circuit for repair, the following checks should be made:

Battery: To determine the condition of the battery, follow the testing procedure outlined in the Battery Section Page 6D-2. Insure that the battery is fully charged.

Wiring: Inspect the wiring for damage. Inspect all connections to the cranking motor, solenoid, ignition switch, and battery, including all ground connections. Clean and tighten all connections as required.

Solenoid and Ignition Switch: Inspect all switches to determine their condition. Connect a jumper lead around any switch suspected of being defective. If the system functions properly using this method, repair or replace the bypassed switch.

Motor: If the battery, wiring and switches are in satisfactory condition, and the engine is known to be functioning properly, remove the motor and follow the test procedures outlined below.

Never operate the cranking motor more than 30 seconds at a time without pausing to allow it to cool for at least two minutes. Overheating, caused by excessive cranking, will seriously damage the cranking motor.

Visual Inspection

With the cranking motor removed from the engine, the pinion should be checked for freedom of operation by turning it on the screw shaft. The armature should be checked for freedom of rotation by prying the pinion with a screwdriver. Tight bearings, a bent armature shaft, or a loose pole shoe screw will cause the armature to not turn freely. If the armature does not turn freely the motor should be disassembled. However, if the armature does rotate freely, the motor should be tested before disassembly.

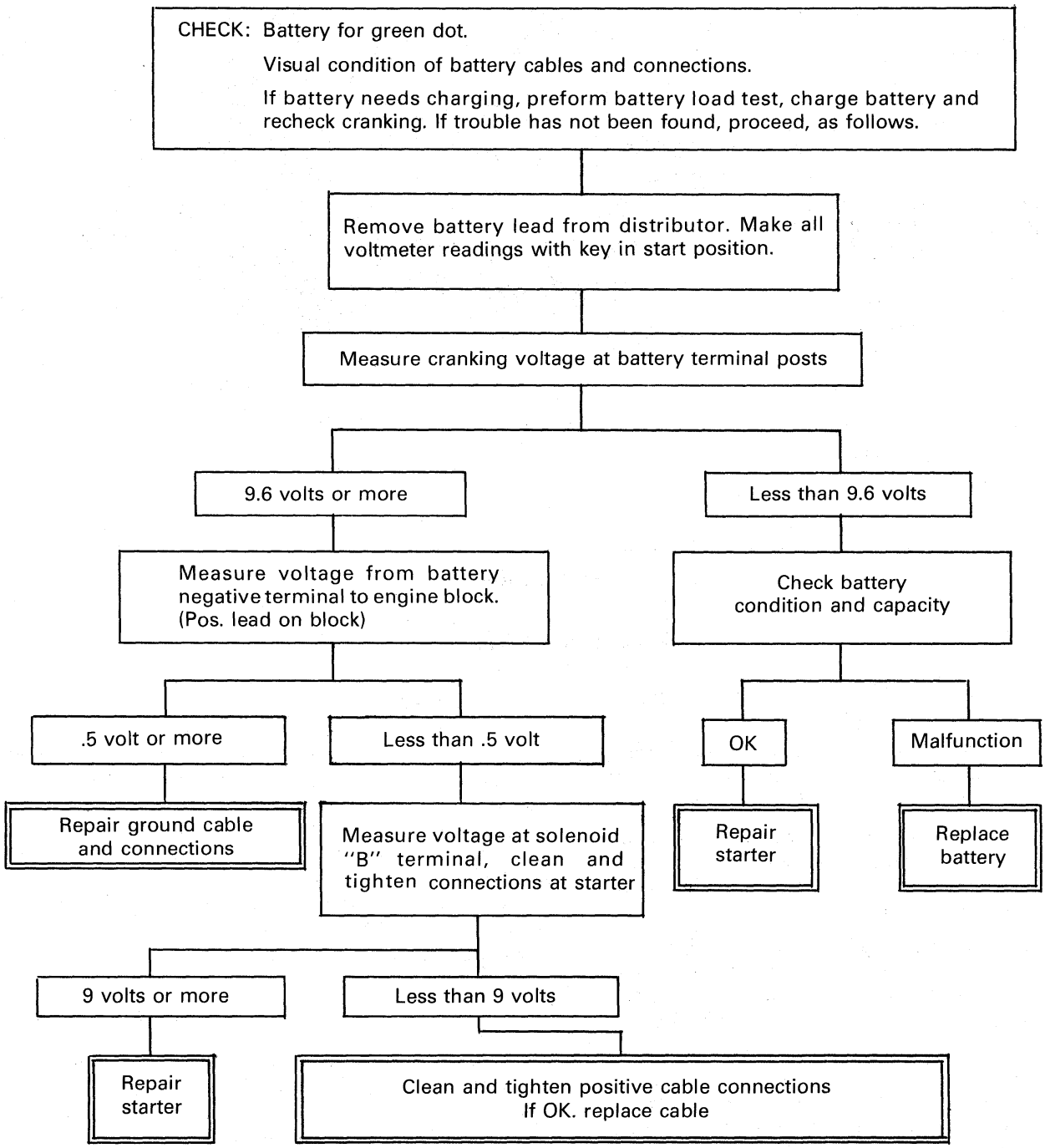
Cranking Voltage Test

1. To keep engine from starting, disconnect H.E.I. harness connector at distributor. Connect voltmeter across the battery terminals.
2. With volmeter on 16 volt scale, crank engine.
3. Observe cranking voltage and engine speed. Voltage should be greater than 9 volts. Cranking speed should be at least 200 RPM (at room temperature).
4. If cranking voltage and engine speed are correct, shut off ignition and re-connect H.E.I. harness connector at distributor.
5. If voltage and engine speed are not correct, further testing of the battery, on Page 6D-2 and starter circuit on

STARTING SYSTEM

DIAGNOSIS

SLOW CRANKING, SOLENOID CLICKS OR CHATTERS



NOTE: This procedure is designed for use on engines and batteries at room or normal operating temperatures. It also assumes there are no engine defects which would cause cranking problems. To use it under other conditions might result in misdiagnosis.

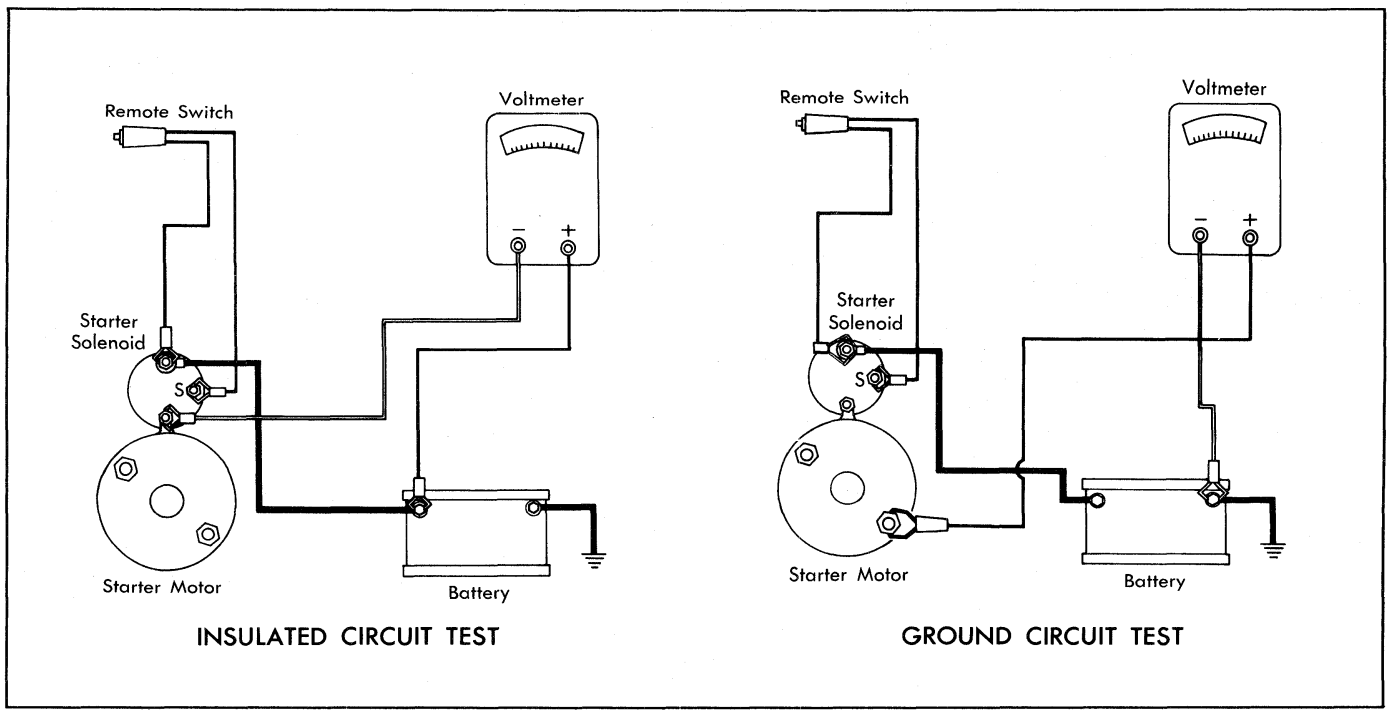


Fig. 6D-49 Starting Curcuit Tests

must be performed.

Starter Motor Circuit Resistance Test

a. Battery Cable and Starter Switch Test–Insulated Circuit Test

This test measures the resistance of the cables and switches that feed the starter motor. The heavy current used by the starter motor will produce a voltage drop in the wiring which can be measured as an indication of this resistance. The battery should be fully charged.

1. Disconnect H.E.I. harness connector at distributor so engine will not start.
2. Using Battery Starter Tester, turn voltmeter selector switch to 16-volt scale.
3. Connect starter solenoid remote switch and test leads as shown in Fig. 6D-49.
4. Connect positive voltmeter lead to positive battery terminal screw. Connect negative voltmeter lead to starter "motor" terminal, Fig. 6D-49.
5. Close starter solenoid remote switch, and turn voltmeter to 4 volt scale while cranking. Observe reading, and immediately turn meter back to 16 volt scale.
6. Voltmeter should show .6 of a volt or less while engine is being cranked. If voltage drop is more than .6 of a volt, it is an indication that the cables or connections are dirty or corroded, the solenoid switch is defective, the starter motor is drawing too much current, or that the engine torque requirement is high.
7. If voltage drop across the entire insulated side of the battery starter circuit exceeds the specified .6 volt, test the individual parts of the insulated circuit for excessive resistance. Maximum voltage drop for each should not exceed the following specifications:
   a. Battery to Solenoid Switch .4 volt.
   b. Across Solenoid Battery Terminal .2 volt.
   c. Solenoid Switch to Starter Terminal Zero.

b. Ground Circuit Test

1. Turn voltmeter selector switch of Battery Starter Tester to 4 volt position.
2. Connect test leads as shown in Fig. 6D-49.
3. Connect starter solenoid remote switch as shown in Fig. 6D-49.
4. Connect negative voltmeter lead to negative battery terminal screw.
5. Connect positive voltmeter lead to the starting motor through bolt.
6. With starter motor cranking engine, voltage drop should not exceed .3 volt. A reading of more than .3 volt is usually an indication of resistance due to loose, dirty, or corroded connections.
7. Reconnect H.E.I. harness connector at distributor.

Checking Inoperative Starter Motor

If starter motor cranks engine slowly or not at all, check battery, battery terminals and connections, ground cable, and battery-to-starter motor cable. Corroded, frayed, or broken cables should be replaced, and loose or dirty connections corrected.

The overrunning clutch should withstand 80 to 85 foot-pounds torque without slipping. The pinion should turn freely and smoothly in the overrunning direction. The solenoid switch contacts should be checked for burned conditions, and the contact disc and terminal studs should be replaced if necessary.

Inspect brushes and commutator. Brushes should form a good contact with commutator and have the correct spring tension. If there are burned bars in the commutator, it may indicate open circuited armature coils that may prevent proper cranking. Inspect soldered connections at commutator rise bars, and resolder any damaged connections.

Tight or dirty bearings will reduce armature speed or

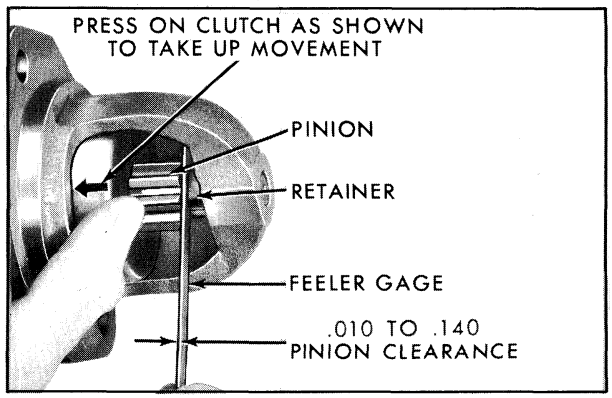


Fig. 6D-50 Checking Pinion Clearance

prevent the armature from turning. A worn bearing, bent shaft, or loose pole shoe will allow armature to drag, causing slow speed or failure of the armature to rotate. Check for these conditions.

Checking Starter Motor Pinion Clearance

a. Preferred Method (Fig. 6D-50)

1. Remove starter motor from car as described on Page 6D-40.

2. Energize solenoid by applying 6 volts between solenoid "S" terminal and ground.

CAUTION: *Do not use more than 6 volts or motor will operate. As a further precaution, connect a heavy jumper wire from the solenoid motor terminal to ground.*

3. After energizing solenoid, press on clutch, Fig. 6D-50, to take up movement.

4. Push pinion away from stop retainer as far as possible and use feeler gage to check clearance between starter motor pinion and pinion stop retainer, Fig. 6D-50. Clearance should be .010 inch to .140 inch when pinion is in cranking position.

b. Alternate Method (Fig. 6D-50)

If a six volt battery is not available, pinion clearance may be checked with a 12-volt battery in the following manner:

1. Remove starter motor from car as described on Page 6D-40.

2. Disconnect the motor field coil connector from the solenoid motor terminal and insulate it carefully.

3. Connect a 12 volt battery from the solenoid switch terminal to the solenoid frame.

Momentarily connect a jumper lead from the solenoid motor terminal to the solenoid frame. This will shift the pinion into cranking position and hold it there until the battery is disconnected.

4. After energizing solenoid, press on clutch, Fig. 6D-50 to take up movement.

5. Push pinion away from stop retainer as far as possible and use feeler gage to check clearance between starter motor pinion and pinion stop retainer, Fig. 6D-50. Clearance should be .010 inch to .140 inch when pinion is in cranking position.

NOTE: Pinion clearance cannot be adjusted. If clearance is incorrect, disassemble starter motor and check for excessive wear of solenoid linkage, shift lever mechanism or improper assembly of these parts. All worn parts must be replaced.

ON-CAR SERVICE

No periodic lubrication of the starting motor or solenoid is required. The motor and brushes cannot be inspected without disassembling the unit, so no service is required on the motor or solenoid between overhaul periods.

Starter Motor-Removal and Installation (Fig. 6D-51 and 6D-52) Except Seville

a. Removal

1. Disconnect negative battery cable at battery.

2. On Eldorados, disconnect starter harness multiple connector at right rear of engine.

3. Raise front end of car.

4. Disconnect battery lead at starter solenoid terminal (except Eldorado).

5. Remove spring clip securing wire to solenoid housing (Eldorado only).

6. Remove screw and nut securing support bracket to starter and crankcase (except Eldorado).

7. Remove two screws that hold starter motor.

8. Remove starter motor by pulling it forward; then toward right front wheel.

b. Installation

1. Position starter motor in proper location in flywheel housing.

2. Install two screws holding starter motor. Tighten screws to 46 foot-pounds, Fig. 6D-51 and 6D-52.

NOTE: Ground strap is placed under out board bolt. (except Eldorado).

3. Install starter motor support bracket and secure with screw and nut. Tighten screw to 12 ft. lbs. and nut to 6 ft. lbs. (except Eldorado).

4. On all except Eldorados, install starter motor harness to terminals on solenoid.

5. Install spring clip securing solenoid wires to solenoid housing and connect starter harness to underhood harness at right rear of engine (Eldorado only).

6. Lower car.

7. Connect negative battery cable to battery.

Starter Motor–Removal and Installation (Fig. 6D-53) Seville

a. Removal

1. Disconnect negative battery cable at battery.

2. Raise front end of car.

3. Disconnect battery lead at starter solenoid terminal.

4. Remove two screws each side securing crossover pipe and remove pipe.

5. Remove two screws securing support bracket to starter and crankcase.

6. Remove two screws that hold starter motor and shim (if used) between starter and crankcase, remove starter.

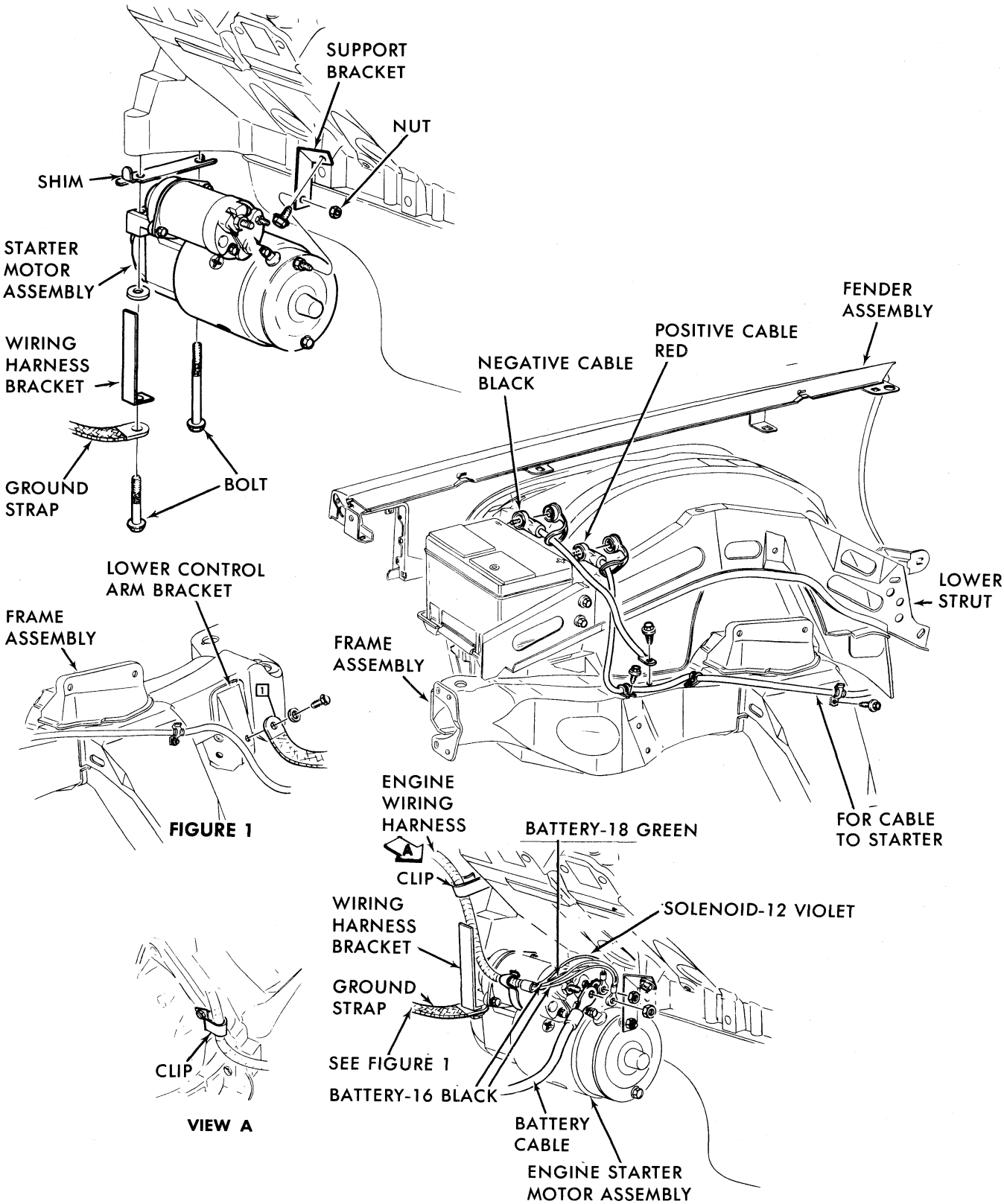


FIGURE 1

Fig. 6D-51 Starter Motor Installation - Except Eldorado and Seville

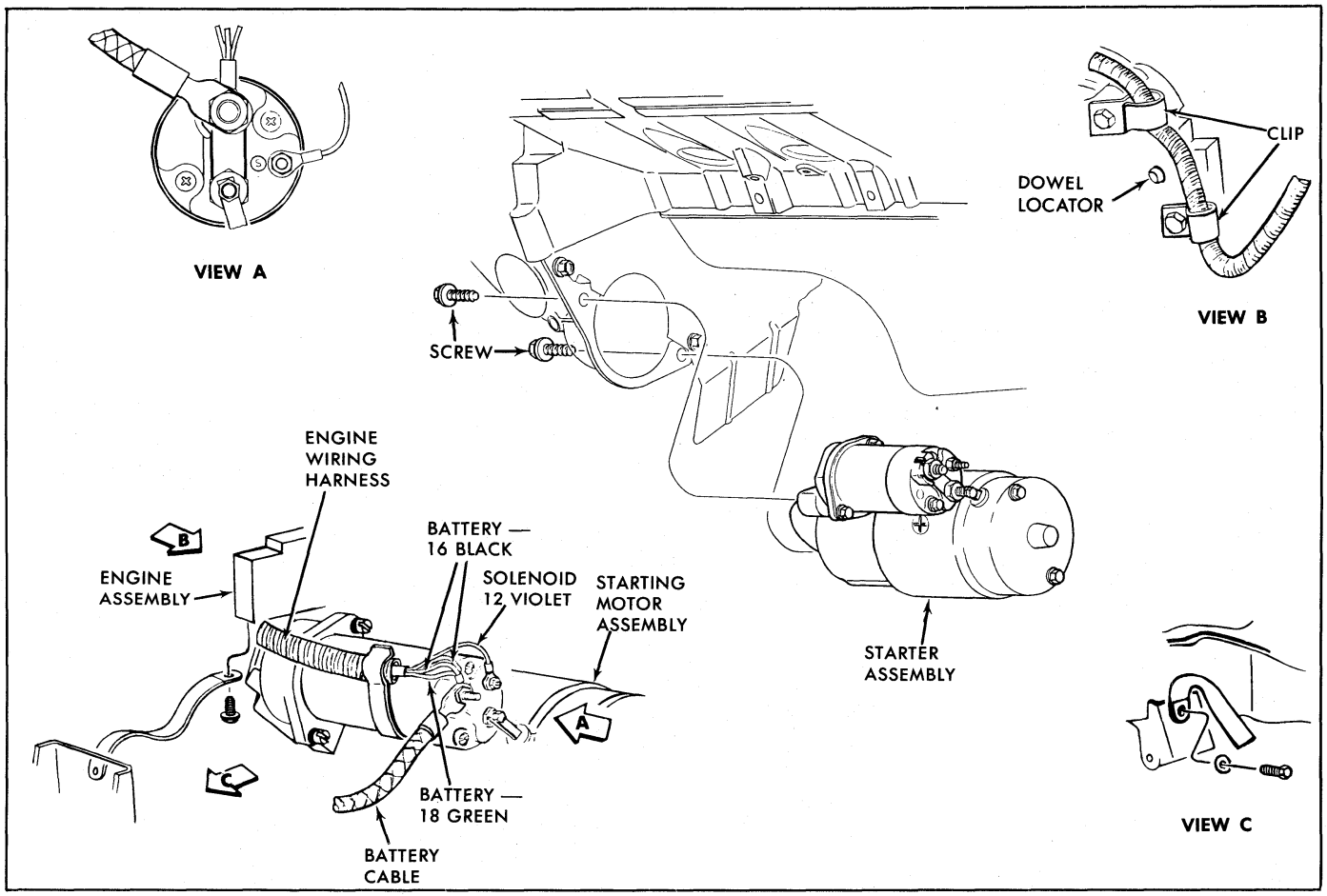


Fig. 6D-52 Starter Motor Attaching Parts - Eldorado

b. Installation

1. Position starter in proper location in flywheel housing.

2. Install two screws and shim (if used) holding starter motor. Tighten screws to 46 foot-pounds (66.4N·m) Fig. 6D-53.

3. Install starter motor support bracket and secure with two screws. Tighten screw to 12 ft. lbs. (16.3 N·m).

4. Install starter motor harness to terminals on solenoid.

5. Lower car.

6. Connect negative battery cable to battery.

UNIT REPAIR

Starter Motor-Disassembly, Testing and Assembly

CAUTION: *When the starter motor is disassembled for cleaning and inspection of parts, the overrunning clutch, armature, and fields should not be cleaned in a degreasing tank, or with grease dissolving solvents, since these would dissolve the lubricant in the clutch mechanism and would damage the insulation in the armature and field coils. Worn parts should be replaced, and the commutator should be turned down in a lathe if necessary.*

a. Disassembly (Fig. 6D-48)

a. Disconnect field coil connector from solenoid motor terminal.

2. Remove two screws and lockwashers that hold solenoid switch assembly to starter drive housing and remove solenoid and solenoid return spring by rotating solenoid assembly counterclockwise to release solenoid flange from center frame.

3. Remove two through bolts.

4. Remove commutator end frame and leather brake washer.

5. Remove center frame assembly.

6. Remove snap ring that holds shift lever pivot pin, using snap ring pliers, J-4880, and remove pivot pin from drive housing.

7. Remove plunger and shift lever assembly and armature assembly with overrunning clutch from drive end housing.

8. Remove overrunning clutch from armature shaft as follows:

a. Slide thrust collar off end of armature shaft, Fig. 6D-54.

b. Slide a standard 3/8″ pipe coupling or 5/8″ deep socket onto shaft so end of coupling or socket butts against edge of retainer, Fig. 6D-55. Tap end of coupling or socket

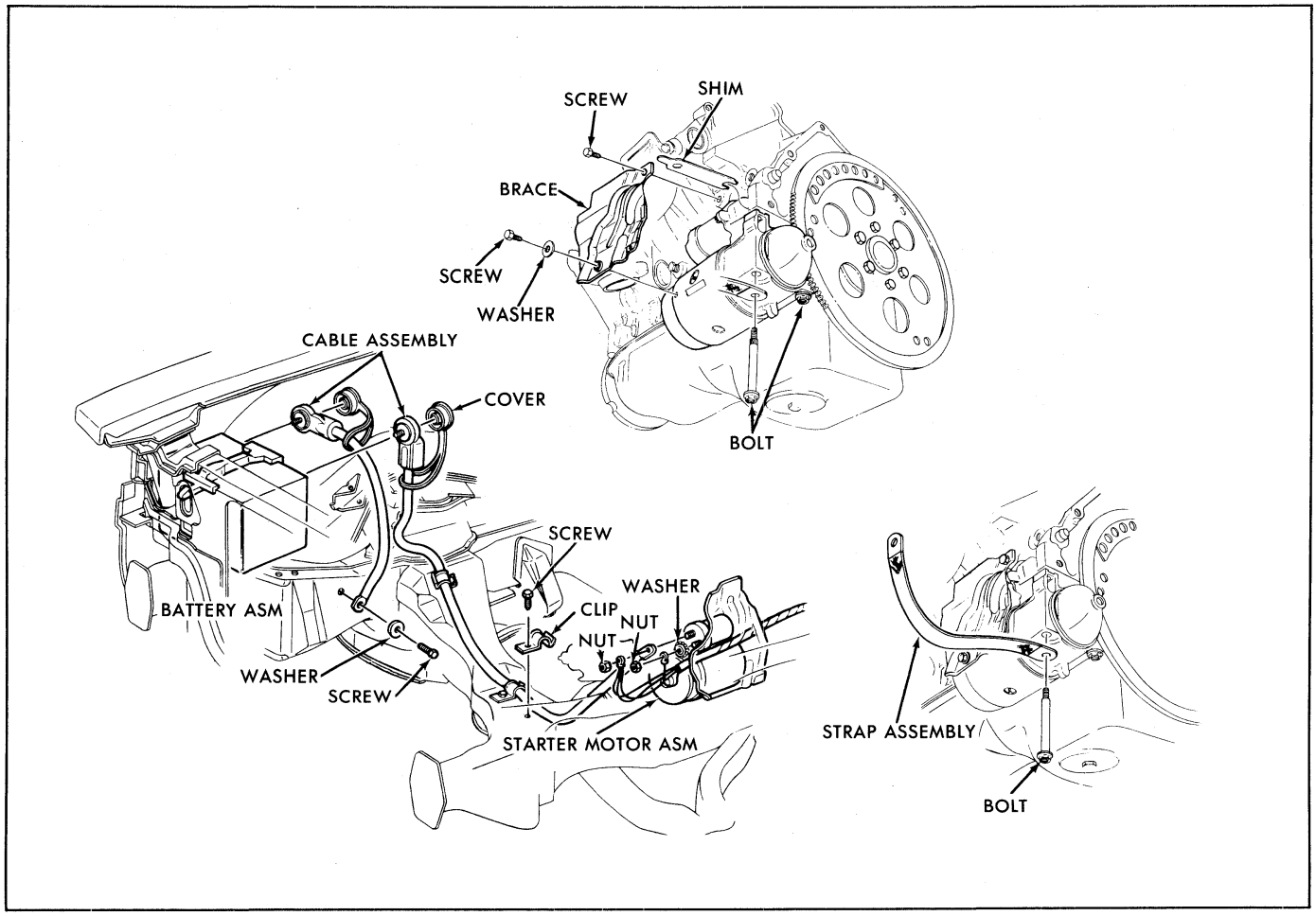


Fig. 6D-53 Starter Motor Attaching Parts - Seville

with hammer, driving retainer toward armature and off snap ring.

c. Remove snap ring from groove in shaft using pliers or other suitable tool. If snap ring is badly distorted during removal, it will be necessary to use a new one when assembling shaft.

d. Slide retainer and clutch assembly from armature shaft.

9. To disassemble solenoid, proceed as follows:

a. Remove two screws with neoprene washers and nut with neoprene washer from switch terminal.

b. Remove contact cover.

c. Remove push rod assembly.

d. Inspect push rod assembly and contact studs for damage or wear. Contact assembly cannot be broken down further and must be replaced as a unit if found defective.

e. To replace contact studs, hold stud while removing nut to be sure stud does not turn.

b. Visual Inspection

CAUTION: *The overrunning clutch, armature, and fields should not be cleaned in a degreasing tank, or with grease dissolving solvents, since solvents would dissolve lubricant in clutch mechanism and damage the insulation in armature and field coils.*

1. Test overrunning clutch action. Pinion should turn freely in the overrunning direction. Check pinion teeth to see that they have not been chipped, cracked or excessively worn. Replace clutch assembly if necessary.

2. Check bearings for signs of tightness, dirt or wear. Check for a bent armature shaft or a loose pole shoe screw.

3. Check brush holders to see that they are not deformed or bent so that brushes bind in their holders. Brush holders should be clean.

4. Check brushes for wear or damage in normal service. If worn down to one-half original length, brushes should be replaced.

5. See if full brush surface rides on the commutator when assembled, and if there is proper spring tension to give good firm contact. Replace weak brush springs.

6. Check brush leads and screws to be certain they are tight and clean. Clean leads, if necessary, and check tightness of screws.

7. Brush holding parts are replaced only if necessary, in the following manner:

a. Remove brush holder pivot pin.

b. Remove brush spring.

c. Replace brushes by removing attaching screw, installing a new brush and securing with attaching screw. (Trade name will be visible when brushes are correctly installed).

d. Install brush spring by inserting it in slot in center frame.

e. Install insulated brush and grounded brush, and secure with pivot-pin.

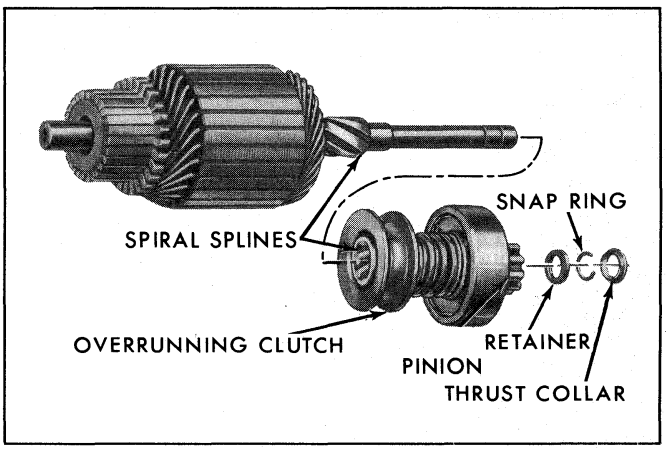


Fig. 6D-54 Starter Armature Assembly

8. Check fit of armature shaft in drive housing and in commutator end frame. Shaft should fit snugly in both bushings. If bushing in drive housing is worn, it will be necessary to replace the bushing. If bushing in commutator end frame is worn, replace commutator end frame bushing.

9. Inspect leather brake washer for damage, and replace, if necessary.

c. Checking Armature for Shorts

1. Place armature in growler. Lock armature in position by securing clamp on the commutator. Turn ON-OFF switch on.

2. Rotate armature while holding steel strip that comes with the tester near the armature. Steel strip will vibrate in the area of a short circuit. Turn off switch.

d. Checking Armature for Opens

1. Inspect the points where conductors are joined to the commutator for loose connections. Poor connections can cause arcing and burning of the commutator.

2. If bars are not badly burned, resolder leads in riser bars. Have commutator turned down in a lathe.

e. Checking Armature for Grounds

Check for grounds with aid of a 110-volt test lamp.

1. Remove armature from armature tester and place on bench.

2. Place one test lamp lead on the commutator.

3. Touch other test lamp lead to armature core and then armature shaft. If lamp lights, the armature is grounded.

If the commutator is worn, dirty or out of round, a ground condition may result. If a ground is indicated, have commutator turned down in a lathe.

f. Checking Field Coils for Grounds

Check field coils for grounds and opens, using 110-volt test lamp.

a. Connect one lead of test lamp to motor feed terminal and other to any clean surface of field frame. Lamp should not light.

If lamp lights, field coils are grounded and must be replaced.

g. Checking Field Coils and Insulated Brush Holder Leads

1. With center frame assembly positioned so that brush holders are on top, push upper motor feed terminal from center frame assembly.

2. Touch one test lamp lead to each of motor feed terminals. Lamp should light. If it does not light, there is an open in field coils and field coil assembly must be replaced.

3. If the lamp lights, perform Step 4 to check insulated brush holder leads.

4. Hold one test lamp lead to either motor feed terminal. Touch other lead in turn to two pigtail leads of insulated brushes. Lamp should light.

If lamp does not light in either instance, leads should be repaired by soldering. Be sure to install upper motor lead in grommet.

h. Assembly

1. To assemble solenoid, proceed as follows:

a. Install contact studs, holding studs while tightening nut to be sure stud does not turn.

b. Install push rod assembly and spring.

c. Install contact cover with switch terminal stud through square hole. Secure with two screws with plastic washers and lock nut with plastic washer on switch terminal stud.

2. Assemble overrunning clutch to armature shaft as follows:

a. Lubricate drive end of armature shaft with a few drops of SAE 30W oil.

b. Slide clutch assembly onto armature shaft with pinion outward, Fig. 6D-55.

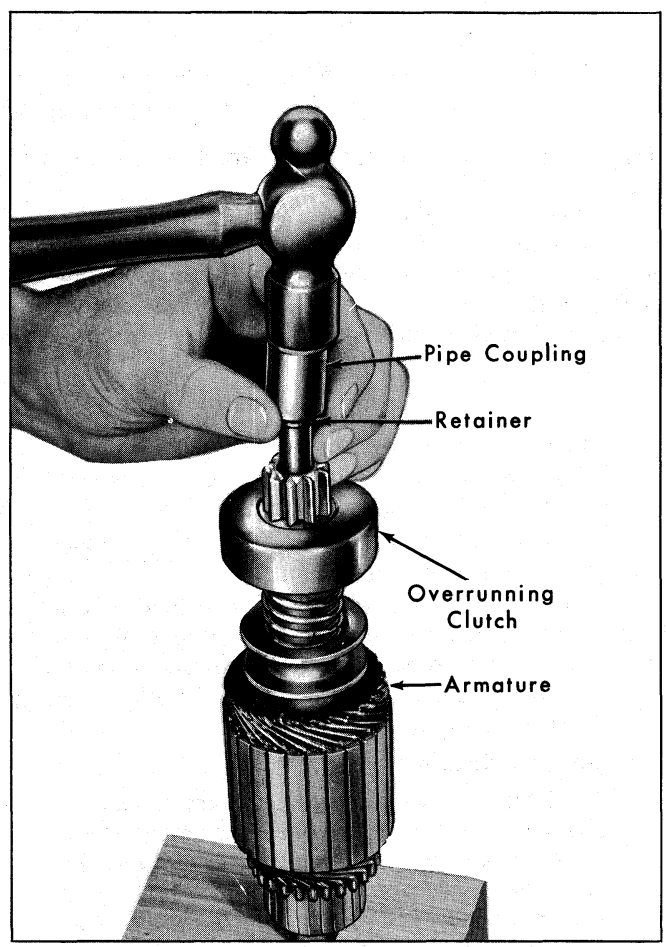


Fig. 6D-55 Removing Overrunning Clutch

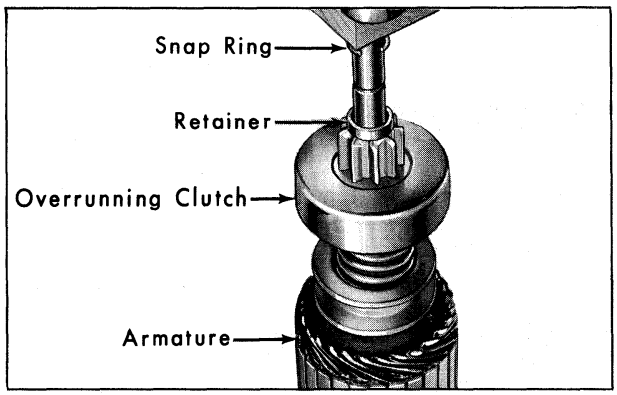


Fig. 6D-56 Installing Snap Ring on Shaft

c. Slide retainer onto shaft with cupped surface facing end of shaft, Fig. 6D-55.

d. Stand armature on end of a wood surface with commutator down. Position snap ring on upper end of shaft and hold in place with either a piece of wood or a 7/16" socket. Tap socket or block with hammer to force snap ring on end of shaft, Fig. 6D-56. Slide snap ring down to the second groove.

e. Assemble thrust collar on shaft with shoulder next to snap ring, Fig. 6D-57.

f. Position retainer and thrust collar next to snap ring. Using two pairs of pliers, grip retainer and thrust collar and squeeze until snap ring is forced onto retainer, Fig. 6D-57.

3. Place a small quantity of high melting point grease in drive end housing grease retainer.

4. Position legs of shift lever assembly in grooves of overrunning clutch. Install armature and overrunning clutch assembly into drive end housing, making certain that thrust washer is in place on end of shaft.

5. Install shift lever pivot pin into recess in housing and secure with snap ring, using Snap Ring Pliers, J-4880.

6. Mount starter in a vise and install solenoid return spring and solenoid switch assembly. Secure with two attaching screws and lock washers.

7. Apply a non-hardening sealing compound to area where center frame will contact solenoid case flange.

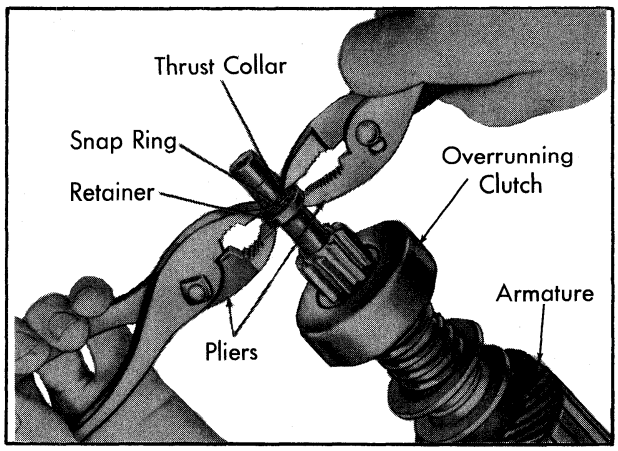


Fig. 6D-57 Installing Snap Ring on Retainer

8. Install center frame assembly on drive end housing by starting assembly over armature, spreading brush holders apart to engage commutator and mating dowel pin on frame with dowel pin hole in drive end housing.

9. Place a small quantity of high melting point grease on bushing in commutator end frame.

10. Place leather brake washer on armature shaft.

11. Slide commutator end frame on shaft and secure with two through bolts.

12. Install field coil terminal connector on solenoid motor terminal, securing with self-tapping screw and star washer.

Fusible Links

Fusible links are used to protect the engine primary harness at the starter motor. Fusible link wire is usually 4-6 wire gage sizes smaller than the circuit it protects. Should the fusible link wire break as the result of a short circuit, first find the source of the short circuit and repair. Because of the smaller diameter wire, a small change in the length of the fusible link would result in a large change in the "fuse rating" of the wire. For this reason it is important to replice damaged fusible links with a new piece of fusible link wire, cut to the correct length, which is available from various sources.

Complete information on fusible links is contained in section 12 of this manual.

SPECIFICATIONS

BATTERY

Replace with	87-5
Voltage	12 volts
Cables	2 Gage
Terminal Grounded	Negative
Cranking Power at 0°F.	3500 Watts

STARTER MOTOR

Brush Springs Tension	35 OZ
No Load Specifications	
Voltage	9 Volts
Amperage	65-95 AMPS
Speed	7,000-10,500 RPM

SOLENOID

Amperage Draw at 10 Volts	
Hold-In Winding	14.5-16.5 AMPS
Both Windings	41-47 AMPS

GENERATOR

Rated Output (At 14 Volts):	
All Except Seville, Limousine and Commercial Chassis	63 AMPS
Seville, Limousine and Commercial Chassis*	80 AMPS
Commercial Chassis with H.D. Generator	145 AMPS
Field Current Draw (At 12 Volts and 80°F.)	4.0 to 4.5 AMPS

*Also includes with Trailer Towing Package and AIR option.

GENERATOR PULLEY RATIO:

63 AMP Without A.I.R.	3.09 to 1
63 AMP With A.I.R.	3.36 to 1
80 AMP Without A.I.R.-Exc. Seville	2.86 to 1
80 AMP With A.I.R.-Exc. Seville	3.12 to 1
80 AMP-Seville Only	2.967 to 1
145 AMP	2.28 to 1

DISTRIBUTOR-Vacuum Disconnected To Time

Initial Timing-Exc. Seville @ 1400 RPM	18° BTDC
Seville Except California @ 600 RPM	10° BTDC
California @ 600 RPM	8° BTDC
Rotation Exc. Seville	Clockwise
Seville	Counterclockwise
Firing Order Exc. Seville	1,5,6,3,4,2,7,8
Seville	1,8,4,3,6,5,7,2
Centrifugal Advance	See Page 6D-5
Vacuum Advance	See Page 6D-5

IGNITION COIL

Primary Resistance	.4 to .5 OHMS
Secondary Resistance	8000-9500

SPARK PLUGS

Type (AC Number) Except Seville	R-45NSX
Seville Only	R-47SX
Gap Except Seville	.060 In.
Seville Only	.060 In.
Thread Diameter	14 MM
Torque	25 Foot-Pounds

TORQUE SPECIFICATIONS

Material No.	Application	Size	Torque
260M	Battery Cable To Battery Screw-Exc. Seville	3/8-16	70 in. lbs.
	Seville	3/8-16	55 in. lbs.
260M	Battery Hold Down Screw-Exc. Seville	5/16-24	6 ft. lbs.
275M	Seville	5/16-18	19 ft. lbs.
260M	Battery Ground Strap To Frame Screw-Exc. Seville	Self Tapping	22 ft. lbs.
	Seville	3/8-16	20 ft. lbs.
286M	Distributor Clamp Nut-Exc. Seville	5/16-24	18 ft. lbs.
280M	Distributor Clamp Screw-Seville	5/16-18	22 ft. lbs.
260M	Generator Adjusting Link To Generator Screw-Exc. Seville	5/16-18	10 ft. lbs.
280M	Seville	5/16-18	19 ft. lbs.
300	Generator Support Bracket Screw-Exc. Seville	3/8-16	17 ft. lbs.
280M	Seville	3/8-16	27 ft. lbs.
280	Generator Support Bracket Nut-Exc. Seville	3/8-24	17 ft. lbs.
286M	Seville	5/16-18	19 ft. lbs.
286M	Generator Terminal Nut-Exc. Seville	1/4-20	26 in. lbs.
284M	Seville	12-24	25 in. lbs.
Special	Spark Plugs - All	14 mm	25 ft. lbs.
280M	Starter Motor Mounting Screws-Exc. Eld. & Seville	3/8-16	46 ft. lbs.
	Seville	3/8-16	30 ft. lbs.
	Eldorado	7/16-14	46 ft. lbs.
Special	Starter Motor Brace to Mounting Screw - All	5/16-18	12 ft. lbs.
Special	Starter Motor Brace Mounting Screw - Exc. Seville	1/4-20	6 ft. lbs.
	Seville	3/8-16	20 ft. lbs.

NOTE: Refer to Back of Manual for bolt and nut markings and steel classification.

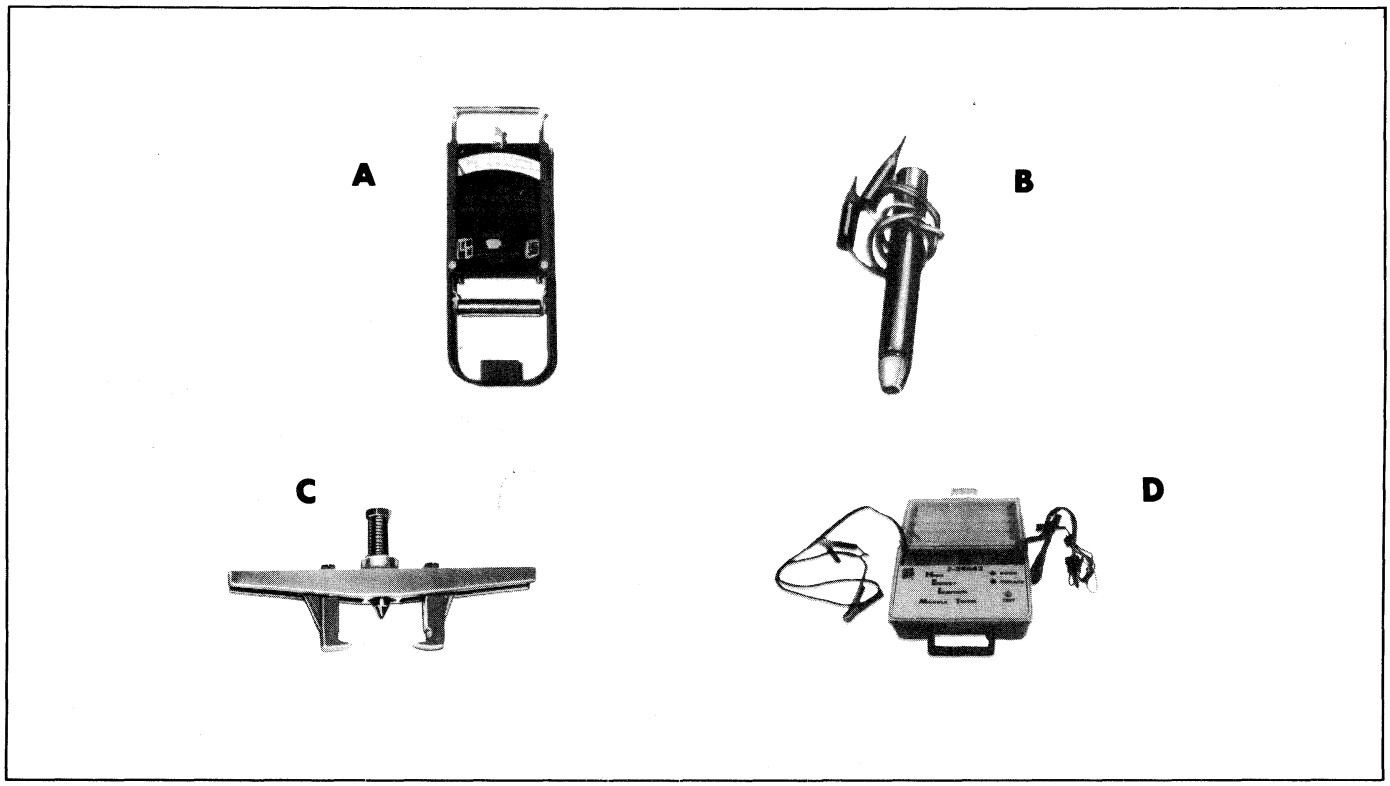


Fig. 6D-58 Special Tools

Key	Tool No.	Name
A	J-23600	Belt Tension Gage
B	J-21008	Diode Tester
C	J-8433	Puller
D	J-24642	HEI Tester

from 1976 Cad. S/M Pg. 6-52 Key, Tool No., Name

EMISSION CONTROLS

TABLE OF CONTENTS

General Description 6E-1
Early Fuel Evaporation Valve (EFE) Except Seville 6E-1
Diagnosis 6E-2
On Car Service
EFE Valve - Except Eldorado 6E-3
EFE Valve - Eldorado 6E-4
Positive Crankcase Ventilation System (PCV)
General Description 6E-4
Eiagnosis 6E-6
On Car Service 6E-6
Air Injection Reactor System (AIR)
General Description 6E-6
Diagnosis 6E-11
On Car Service 6E-11
Thermostatic Air Cleaner (TAC)
General Description 6E-12
Diagnosis 6E-15
On Car Service 6E-15
Exhaust Gas Recirculation (EGR)
General Description 6E-16
Diagnosis 6E-20
On Car Service 6E-22
Vacuum Controls
General Description 6E-23

GENERAL DESCRIPTION

Normal operation of automobile engines results in the release of several compounds to the atmosphere. Federal Government and State of California legislation has placed limitations on the quantities of three compounds which can be emitted. The three controlled compounds are:

Unburned Hydrocarbons (HC) - Carbon Monoxide (CO) - Oxides of Nitrogen

The Federal regulations have been revised for 1977 requiring that vehicles sold for initial licensing, registration, or titling at altitudes greater than 1219 meters (4000 feet) be capable of meeting emission standards at such altitudes. In most cases, the revised Federal and California regulations make it necessary to have specific engines and emission control systems for vehicles sold in areas above 1219 meters, areas below 1219 meters, and California.

The emission control section will consist of a general description, diagnosis and service procedure for emission control components and subsystems, followed by vacuum hose schematics.

GENERAL DESCRIPTION OF EMISSION CONTROL COMPONENTS

Carburetor Calibration

While the carburetor's main function is to provide the engine with a combustible air/fuel mixture, the carburetor calibration is critical to maintaining proper emission levels. The carburetor's idle, off-idle, main metering, power enrichment, and accelerating pump systems are calibrated to provide the best possible combination of engine performance and exhaust emission control. Carburetor adjustments and service must be performed using the recommended procedures to ensure engine exhaust emission levels remain within legislated limits. See Section 6C for carburetor adjustment specifications and recommended service procedures.

Distributor Calibration

The distributor is an integral part of the engine ignition system and the distributor calibration is an important part of exhaust emission control. Centrifugal advance and vacuum advance are calibrated to provide the best engine performance at varying speeds and loads while remaining within exhaust emission limits. Distributor diagnostics and service procedures are in Section 6D, Engine Electrical.

Catalytic Converter

The catalytic converter is an emission control device added to the exhaust system to reduce hydrocarbon and carbon monoxide pollutants from the exhaust gas stream. The converter contains pellets coated with platinum and palladium.

THE CATALYTIC CONVERTER REQUIRES THE USE OF UNLEADED FUEL ONLY

Periodic maintenance of the exhaust system is not required; however, if the car is raised for other service, it is advisable to check the general condition of the catalytic converter, pipes and mufflers.

Refer to Section 6F, Exhaust System, for catalytic converter service procedures and diagnostics.

EFE Valve - Except Seville

The Early Fuel Evaporation (E.F.E.) valve, Fig. 6E-1, is installed at the junction of the right hand exhaust manifold and exhaust pipe on all Cadillac cars except E.F.I. cars, which have a spacer. The EFE valve is a vacuum operated "heat valve" which directs exhaust gases through the exhaust cross-over passage in the intake manifold during cold engine operation. This heating of the intake manifold provides improved fuel vaporization during warm-up. The EFE valve is controlled by a thermostatic vacuum switch (T.V.S.).

The TVS, located in the upper left front of the cylinder block, allows manifold vacuum to the EFE valve below approximately 120°F. (49°C.) coolant temperature. Intake manifold vacuum closes the EFE valve, forcing the exhaust gases through the crossover passage to quickly warm the intake manifold for better fuel vaporization. At approximately 120°F. (49°C.) coolant temperature, the TVS changes position, blocks off manifold vacuum and allows the EFE valve to open resulting in the normal flow of gases through the exhaust system.

Lubricate shaft with Manifold Heat Valve Lubricant #1050422 or equivalent if valve sticks or binds.

DIAGNOSIS

EFE SYSTEM

Condition	Possible Cause	Correction
Poor Operation during warm-up such as—rough idle, stumble, etc.	1. No vacuum to EFE valve during warm-up period for cold start.	1. Check vacuum source for vacuum of 8″ hg. or above. Repair improper vacuum hose routing, leak in connecting system, diaphragm, or EFE, TVS. Failed EFE, TVS. Replace.
	2. EFE valve linkage bent or binding.	1. Repair EFE valve linkage.
	3. EFE valve linkage disconnected.	1. Reconnect linkage.
	4. EFE valve shaft siezed in bearing.	1. Replace EFE valve.
	5. EFE valve loose on shaft.	1. Replace EFE valve.
Poor Operation after warm-up rough idle -lack of high speed performance -surge, misses at all speeds	1. Failed EFE TVS -vacuum present at vacuum actuator.	1. Replace EFE, TVS.
	2. EFE valve asm. shaft siezed in bearing.	1. Replace EFE valve.
	3. EFE valve to housing interference.	1. Repair EFE valve.
	4. Vacuum actuator linkage bent or binding.	1. Repair EFE valve linkage.
	5. EFE valve separated from shaft.	1. Repair EFE valve linkage.
Noisy EFE valve asm.	1. Linkage stop failed.	1. Repair linkage stop tab.
	2. No vacuum actuator linkage over travel.	1. Replace vacuum actuator.
	3. Valve loose on shaft.	1. Replace EFE valve.
	4. Shaft loose in bushing, or bushing loose in housing.	1. Replace EFE valve.

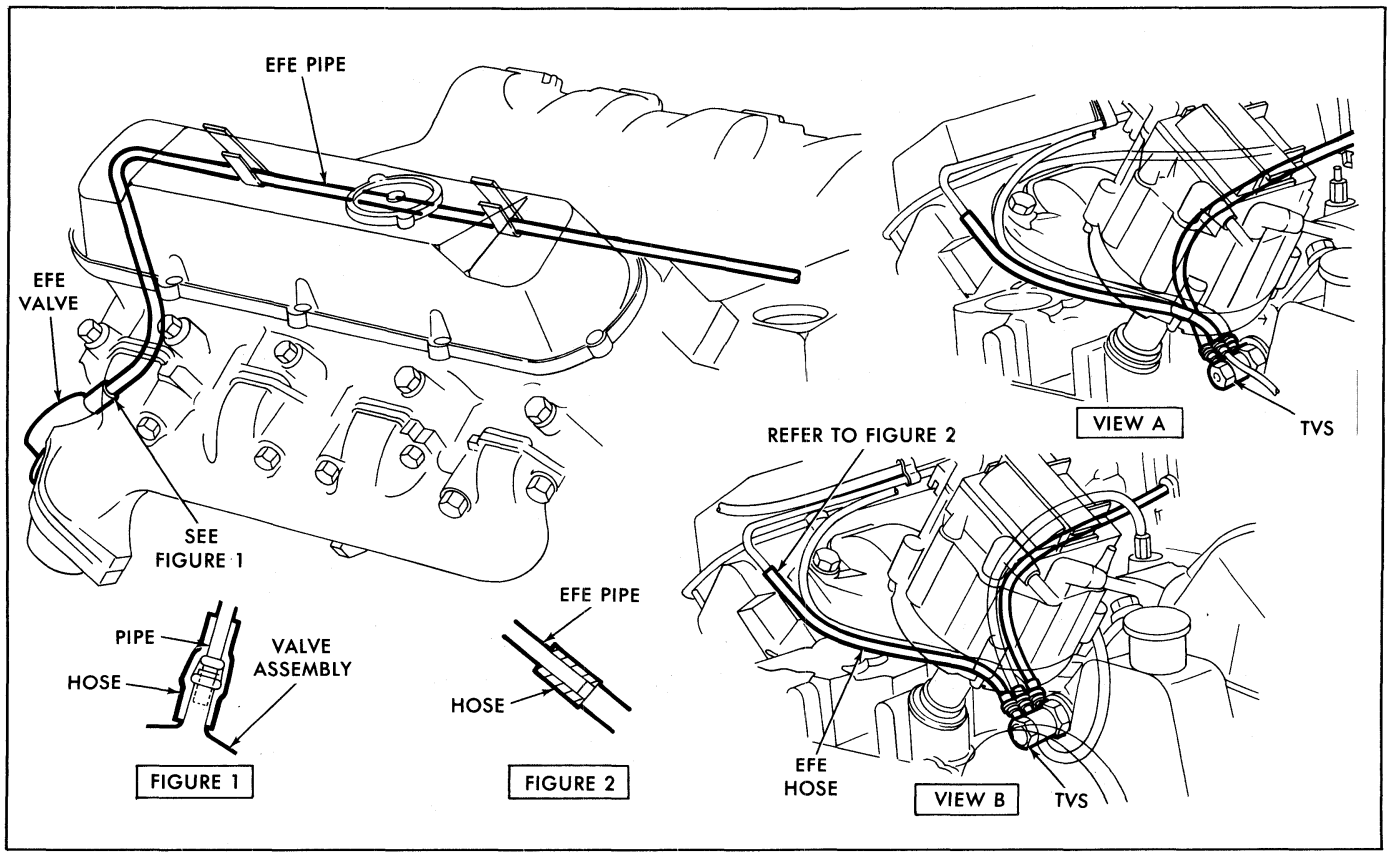


Fig. 6E-1 E.F.E. Valve

ON CAR SERVICE

EFE Valve (Except Eldorado)

a. Removal

1. Working under car, remove two bolts and clamp holding "Y" pipe to catalytic converter, Fig. 6E-2.
2. Remove two nuts (each side) holding "Y" pipe to exhaust manifolds and remove "Y" pipe from chassis.
3. Remove vacuum hose and vacuum actuator linkage from EFE valve.
4. Remove two studs holding EFE valve to right hand manifold and remove valve.

b. Installation

1. Position EFE valve to right hand exhaust manifold with actuator towards engine block. Secure with two studbolts, torque to 35 Ft. Lbs. (47.4 N·m).
2. Install vacuum hose and vacuum actuator linkage.
3. Secure "Y" pipe to manifolds with two nuts at each side, torque to 30 ft. lbs. (40.7 N·m).
4. Screw "Y" pipe to converter with clamp and two bolts, Fig. 6E-2. Torque to 35 ft. lbs. (47.4 N·m).

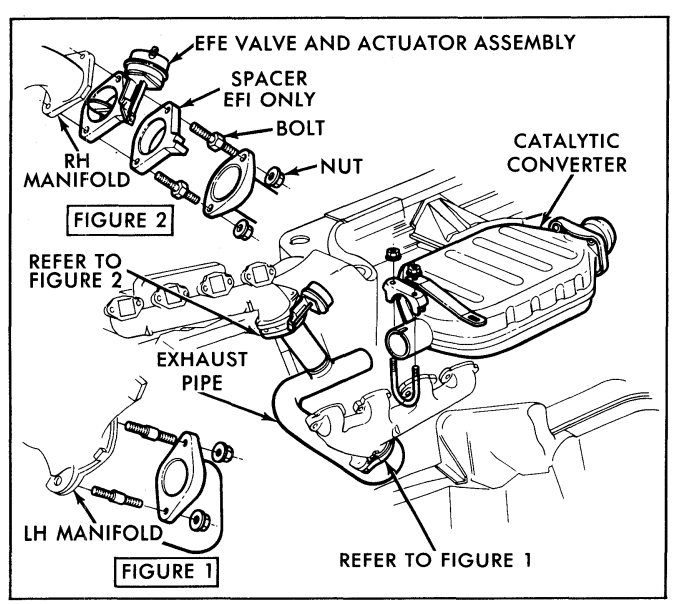


Fig. 6E-2 E.F.E. Valve Removal and Installation Except Eldorado

EFE Valve (Eldorado Only)

a. Removal

1. Working under car remove right hand exhaust pipe by removing two nuts at each end of pipe, Fig. 6E-3.

2. Remove vacuum hose and vacuum actuator linkage.

3. Remove two studs holding EFE valve to right hand exhaust manifold and remove valve.

b. Installation

1. Position EFE valve to right hand exhaust manifold with actuator towards engine block and secure with two studs, Fig. 6E-3. Torque to 35 ft. lbs.

2. Install vacuum hose and vacuum actuator linkage.

3. Secure exhaust pipe with two nuts at each end. Torque to 30 ft.lbs.

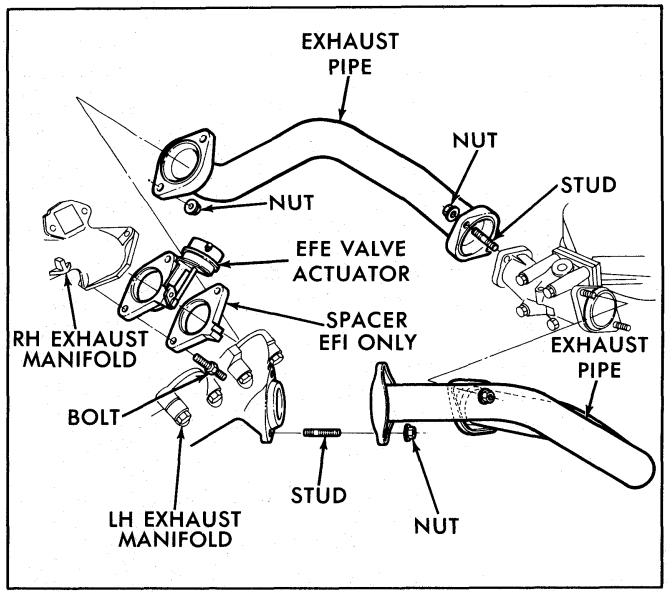


Fig. 6E-3 EFE Valve Removal and Installation Eldorado

POSITIVE CRANKCASE VENTILATION SYSTEM (P.C.V.)

GENERAL DESCRIPTION

The crankcase ventilation systems, Fig. 6E-4 and 6E-5, are designed to prevent contaminating hydrocarbons from escaping to the atmosphere. This is accomplished by routing the vapors from the crankcase through a vacuum controlled ventilating valve on the right rocker arm cover into the intake manifold, where they mix with the air-fuel mixture and are burned in the combustion process.

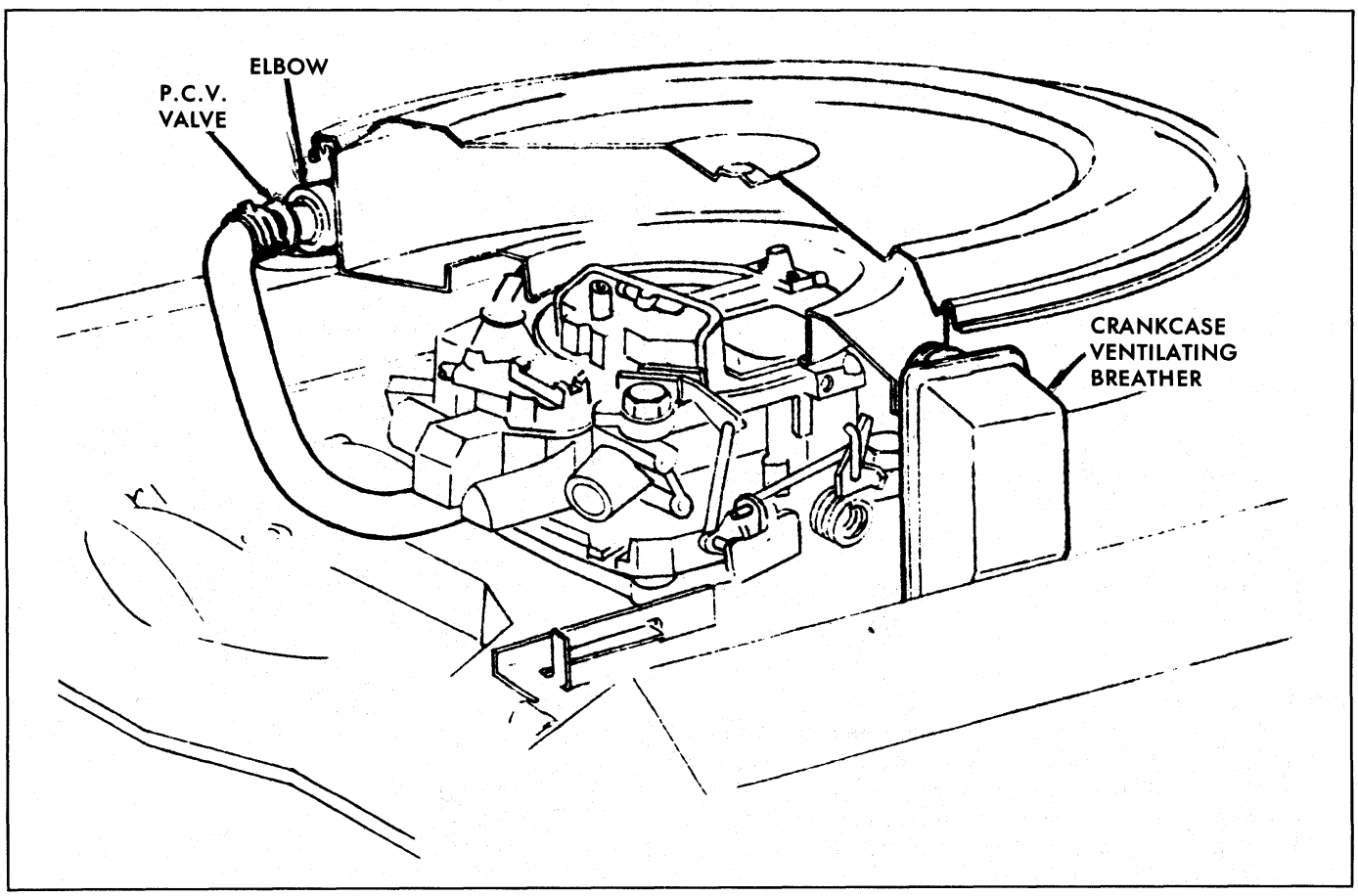


Fig. 6E-4 Positive Crankcase Ventilation Valve - Except Seville

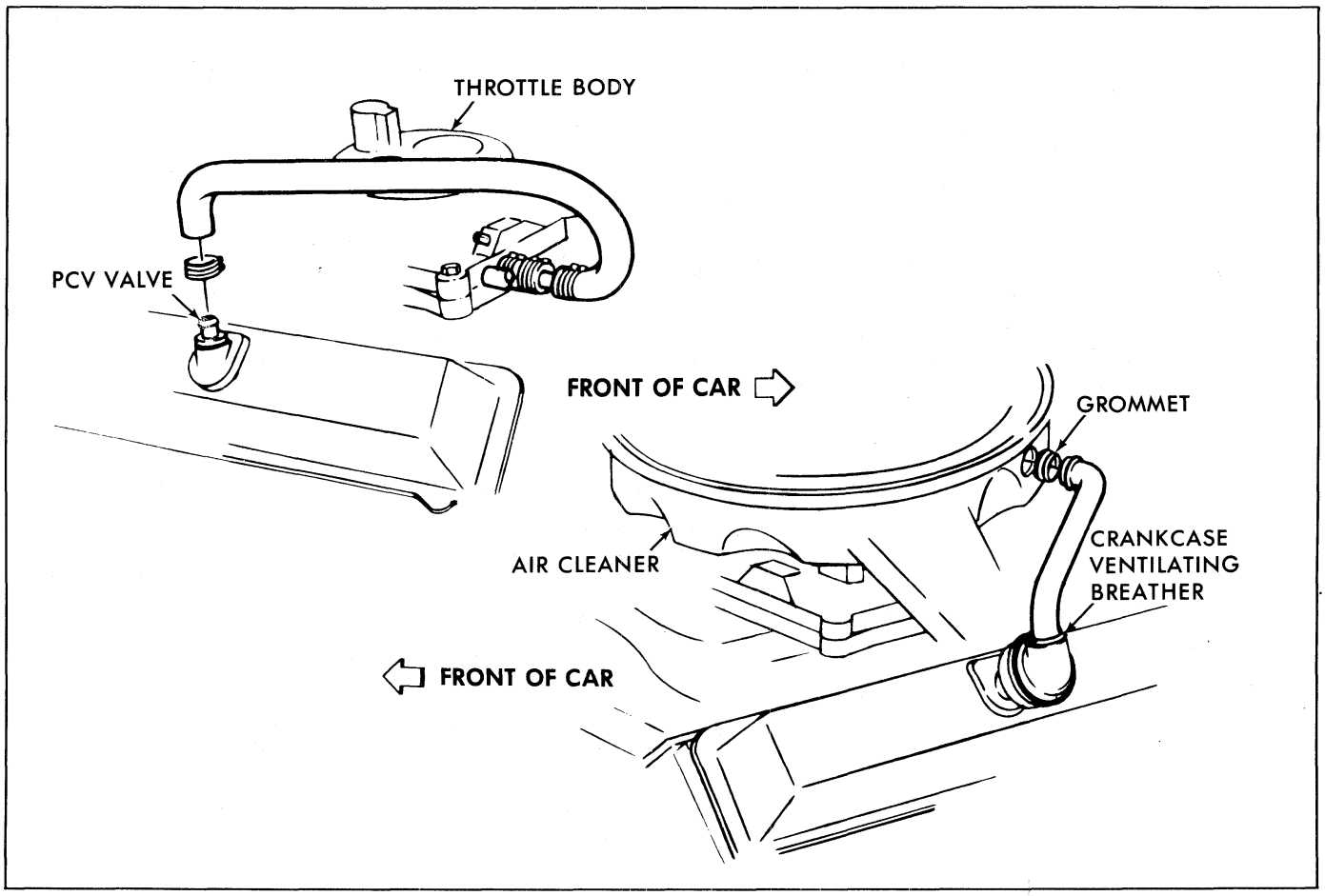


Fig. 6E-5 Positive Crankcase Ventilation System - Seville

Air is supplied to the crankcase ventilation system through a crankcase ventilating breather assembly located between the air cleaner and the left rocker arm cover.

Refer to Maintenance schedules I and II in Section 0 for Emission Control System Maintenance Recommendations.

When the engine is operating, air enters the positive crankcase ventilation system through the air cleaner and breather located on the left rocker arm cover. The breather contains the filtering element. The air then flows into the left rocker arm cover and into the valve lifter compartment, and combines with the blow-by gas, and unburned air-fuel mixture. These fumes are drawn through the right rocker arm cover and ventilation valve into the base of the carburetor or throttle body and intake manifold, where they are mixed with the air-fuel mixture and burned.

The Ventilator valve, Fig. 6E-6 is constructed so that it is held closed by spring pressure when the engine is not running. This prevents an accumulation of hydrocarbon laden fumes from collecting in the intake manifold, which could result in hard starting.

As the engine is started, manifold vacuum pulls the valve open against the spring pressure and as long as there is engine vacuum, the valve floats, permitting crankcase fumes to enter the intake manifold. A baffle in the right rocker arm prevents oil from being drawn into the intake manifold through the ventilator valve.

In the event of an engine backfire through the intake manifold the ventilator valve shuts, preventing any flow through it. This action prevents the ignition of fumes in the crankcase.

During certain engine operations where more blow-by is created than the ventilator valve can handle, the excess amount is returned to the air cleaner and to the carburetor by way of the left rocker arm cover and breather assembly and burned in the engine, instead of being released into the atmosphere. The breather assembly acts as a separator to keep oil from being drawn into the air cleaner during this operation.

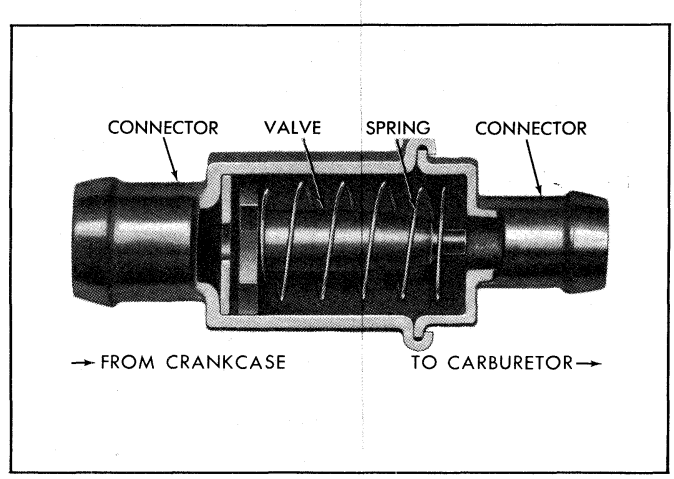


Fig. 6E-6 P.C.V. Valve.

CRANKCASE VENTILATOR VALVE DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE
Slow, unstable idle, rolling, frequent stalling, breather backflow.	Valve completely plugged, or stuck in backfire (engine off) position.
Engine operation OK, but breather backflow at heavy throttle.	Valve stuck in idle position
Rough, fast idle. Engine stalls. No backflow.	Valve stuck in intermediate position.

NOTE: If the valve is inoperative, it should be replaced.

ON CAR SERVICE

Positive Crankcase Ventilator Valve Replacement (Fig. 6E-4 and 6E-5)

a. Removal

1. Disconnect valve from rubber elbow on right rocker arm cover.
2. Release hose clamp and hose from ventilator valve grommet.

b. Installation

1. Place a small amount of silicone on both ends of new ventilator valve.
2. Install new valve with smaller end into hose.
3. Secure hose to valve with clamp
4. Install larger end of ventilator valve to right rocker arm cover grommet.

AIR INJECTOR REACTOR SYSTEM (A I R)
GENERAL DESCRIPTION

The AIR system of controlling hydrocarbons and carbon monoxide is used on E.F.I. cars and on all vehicles built for sale in the State of California.

The AIR system, Fig. 6E-7, reduces the amount of hydrocarbons and carbon monoxide in the exhaust gas by injecting air directly into the exhaust port of each cylinder (except 4 and 5 on E.F.I. cars). The air added to the hot exhaust gases causes further oxidation of the gases before they enter the exhaust manifold.

The AIR system consists of a belt-driven pump located with the front accessory group, two formed rubber air hoses, a metal tubing manifold between the cylinder heads, specially designed cylinder heads that incorporate air passages to the rear of the exhaust valves. There is a diverter valve and silencer between the AIR pump and the air manifold to control pressures within the system, and a check valve to protect the hoses and pump from hot gases.

Do not attempt to operate vehicle with drive belt disconnected.

a. AIR Pump (Fig. 6E-8)

The belt-driven air pump is located at the lower right front of the engine. The pump front mounting bracket is attached to the front of the engine. The pump rear mounting bracket is attached to the cylinder block. Power take-off for the pump is at the crankshaft pulley. Pump speed is 1.20 times crankshaft speed. Intake air passes through a centrifugal fan at the front of the pump, where foreign materials are separated from the air by centrifugal force. Air is delivered to the air injection manifold by an elbow on the AIR pump, a formed hose from the elbow to the diverter valve and a second formed hose from the diverter. The hoses are three-quarter inch inside diameter and are secured by four clamps.

The only serviceable components of this pump is the centrifugal fan. Do not assume pump is defective if it squeaks when turned by hand. Do not lubricate the pump in any way.

NOTE: If the engine or underhood compartment is to be cleaned with steam or high-pressure detergent, the centifugal filter fan should be masked off to prevent liquids from entering the pump.

b. Air Injection Manifold

The air injection manifold is held in the cylinder heads by clamps. These clamps must be installed correctly to insure proper sealing. The right hand side clip, (generator side) should be installed with the flanges pointing away from the cylinder head. The left hand clip should be installed with the flange pointing towards the cylinder head. Each feeder tube of the manifold is sealed by an asbestos and graphite packing gland seal which fits on the tube below the flange.

c. Cylinder Heads

Each cylinder head contains an air passage inboard of the valves with connecting passages at each exhaust valve area (except cylinders 4 and 5 on E.F.I. cars). The passages

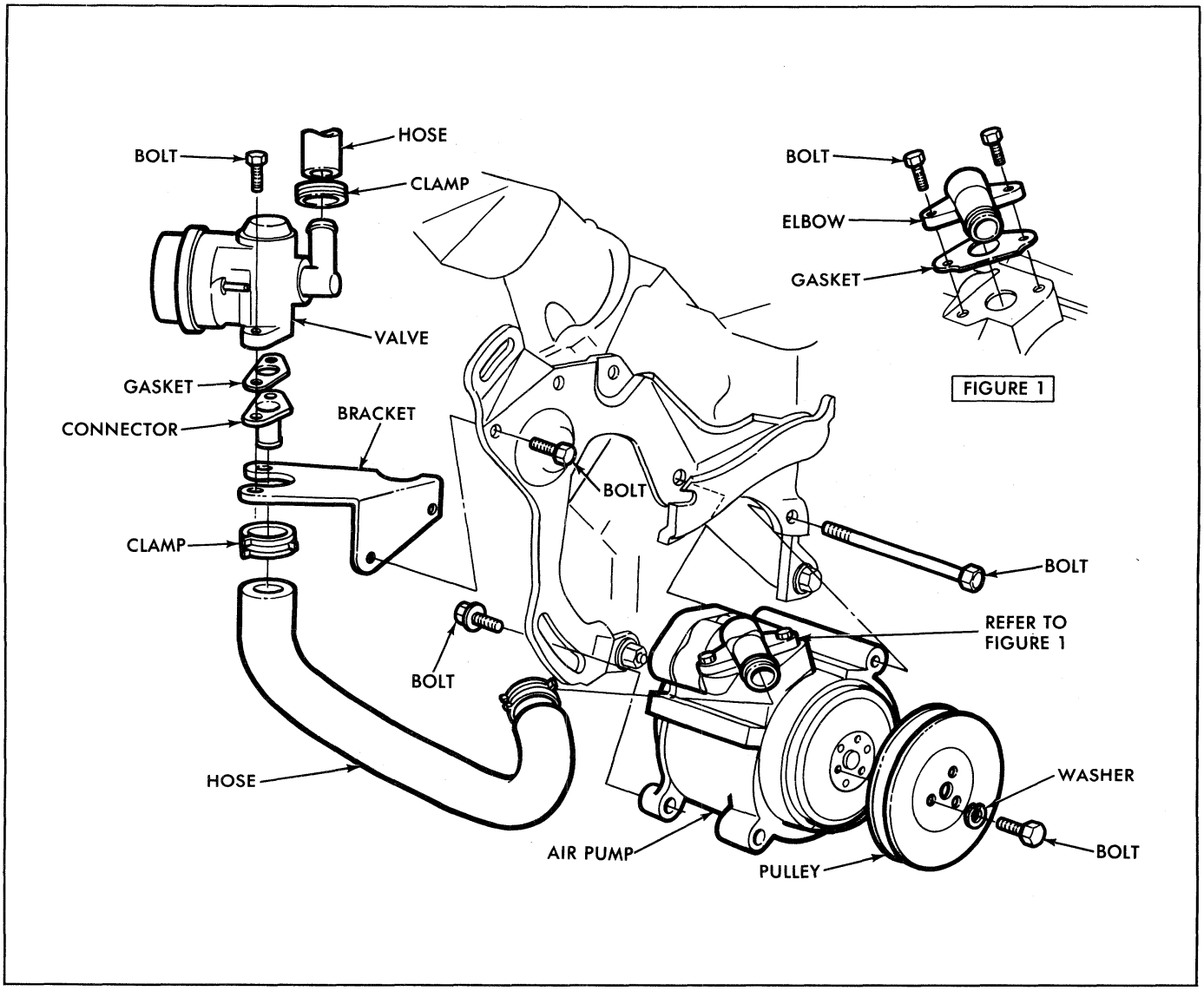


Fig. 6E-7 Air Injection Reactor System

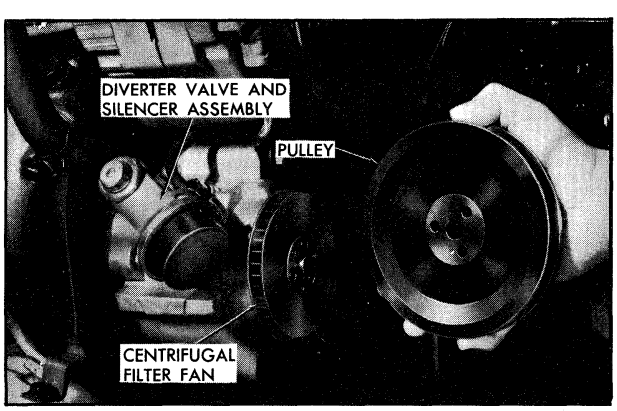


Fig. 6E-8 AIR Pump

lead into the exhaust passages directly behind the valves. Main air passages at the front of each cylinder head are counter-bored and chamfered to provide a seat for the feeder tube packing gland. The glands bottom on the chamfered counter-bore shoulders.

d. Diverter Valve (Fig. 6E-9)

The diverter valve is attached to a bracket on the front of the engine. It senses manifold vacuum through a three-sixteenths inch fitting in the intake manifold except E.F.I. cars which sense it at the throttle body. During sudden deceleration an overly rich air/fuel mixture occurs momentarily which can produce objectionable afterfire in the exhaust system. To prevent this possibility of afterfire the diverter valve senses the sudden engine vacuum increase and an internal spool valve closes off air from the air pump being injected into the exhaust system and opens a passage to momentarily divert air through the valve and silencer to atmosphere. Approximate duration of the valve openings is four to eight seconds. This valve also controls pressure within the system by relieving excessive pump output to the atmosphere through the silencer.

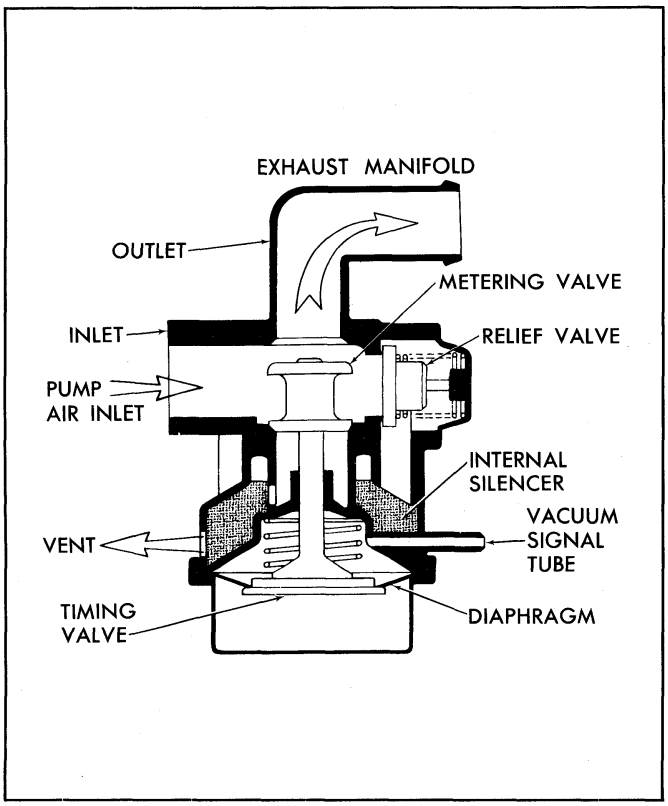


Fig. 6E-9 Diverter Valve-Sectional View

e. Check Valve

The air injection manifold is fitted with a screw-on check valve near the right cylinder head. This valve has a one-way diaphragm which prevents hot exhaust gas from backing up into the hose and pump and causing damage. This will protect the system in the event of pump belt failure, abnormally high exhaust system pressure, or air delivery hose ruptures.

AIR INJECTOR REACTOR SYSTEM (AIR) SEVILLE ONLY

GENERAL DESCRIPTION

The belt-driven air pump is located at the front of the engine near the center, Fig. 6E-10. Power take-off for the pump is at the crankshaft pulley. Pump speed is 1.16 times crankshaft speed. Intake air passes through a centrifugal fan at the front of the pump, where foreign materials are separated from the air by centrifugal force. Air is delivered to the air injection manifolds by formed flexible hoses fitted to an exhaust tube on the diverter valve at the rear of the pump, hoses are secured to all fittings by clamps.

The diverter valve is attached to the rear of the pump. It senses manifold vacuum through a three-sixteenths inch fitting at the throttle body. During sudden deceleration a rich air/fuel mixture occurs momentarily which can produce objectionable backfire in the exhaust system. To prevent this possibility of backfire, the diverter valve senses the sudden engine vacuum increase and an internal spool valve closes off air from the air pump being injected into the exhaust system and opens a passage to momentarily divert air through the valve and silencer to atmosphere.

Approximate duration of the valve openings is four seconds. This valve also controls pressure within the system by diverting excessive pump output to the atmosphere through the silencer.

The AIR, Fig. 6E-11, manifolds have flare nuts which thread into special bosses on the cylinder head. Each flare nut holds an extension in place which directs the air stream towards the head of the exhaust valve.

Each air injection manifold is fitted with a screw-on check valve. The valve has a one-way diaphragm which prevents hot exhaust gas from backing up into the hose and pump and causing damage. This will protect the system in the event of the pump belt failure, abnormally high exhaust system pressure, or air delivery hose ruptures.

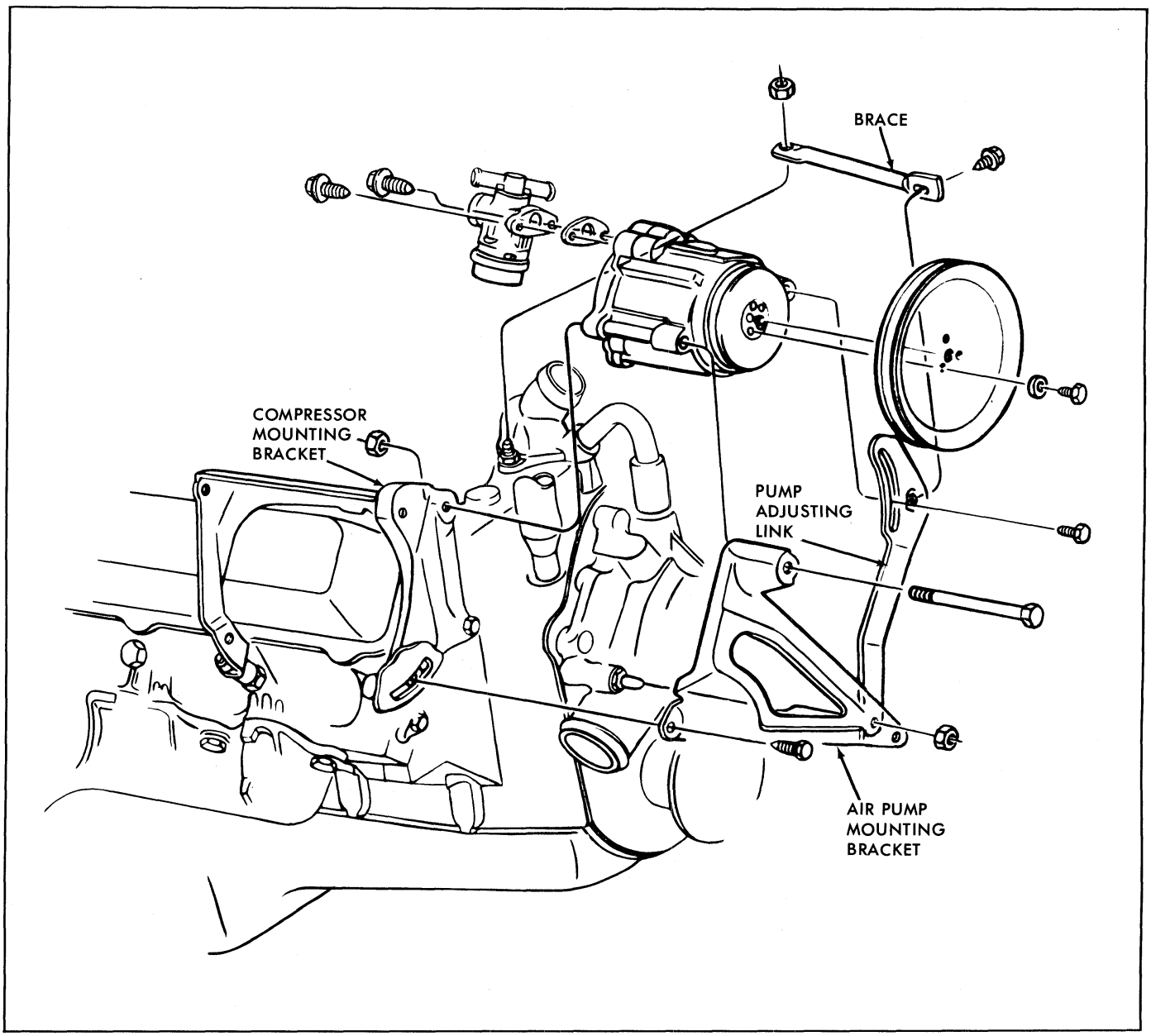


Fig. 6E-10 AIR Pump

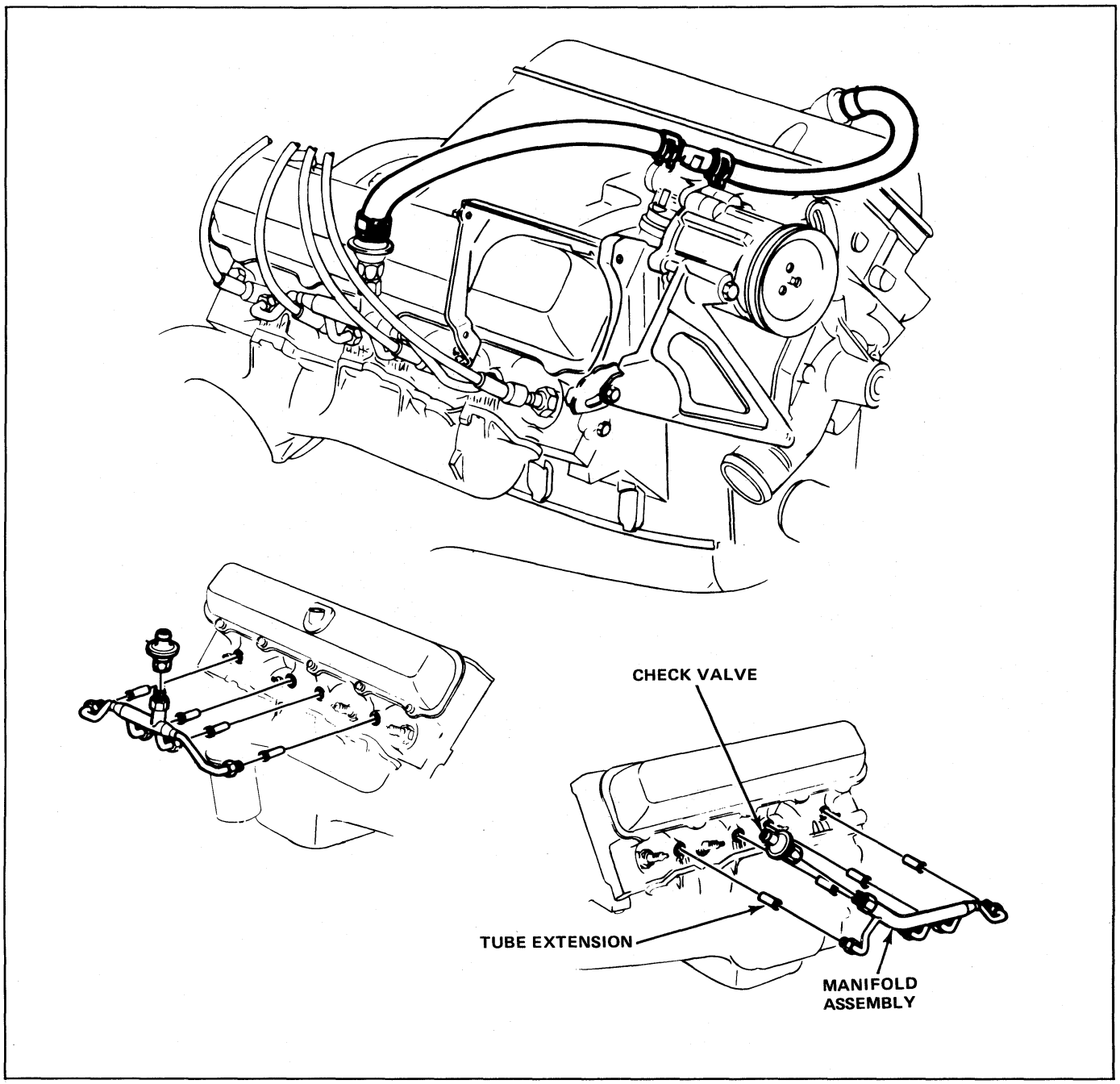


Fig. 6E-11 Air Injection Reactor System

A I R PUMP DIAGNOSIS CHART

CONDITION	CAUSE	CORRECTION
Excessive Belt Noise	Loose belt. Seized pump.	Tighten belt. Replace pump.
Excessive Pump Noise, Chirping, Rumbling or Knocking	Leak in hose. Loose hose. Hose touching other engine parts. Diverter valve failure. Check valve failure. Pump mounting fasteners loose. Centrifugal fan damaged or broken. Pump failure.	Locate source of leak and correct. Reassemble and replace or tighten hose clamp. Adjust hose position. Replace valve. Replace valve. Retorque all mounting screws. Replace centrifugal fan. Replace pump.
No air supply.	Loose belt. Leak in hose. Leak at hose fitting. Diverter valve failure. Check valve failure. Pump failure.	Tighten belt. Locate source of leak and correct. Reassembly and replace or tighten hose clamps. Replace valve. Replace valve. Replace pump.

ON CAR SERVICE

AIR System Diverter Valve

a. Inspection

1. The check valve should be inspected whenever the hose is disconnected from the check valve or whenever check valve failure is suspected. (A pump that had become inoperative and had shown indications of having exhaust gases in the pump would indicate check valve failure.)

2. Blow through the check valve (toward the cylinder head) then attempt to suck back through check valve. Flow should only be in one direction (toward the air manifold).

b. Removal

1. Release clamp and disconnect air hose from check valve.

2. Unscrew check valve from manifold fitting.

c. Installation

1. Screw check valve onto manifold fitting.

2. Position air hose on check valve and secure with clamp.

AIR System Check Valve

a. Inspection

1. Check condition and routing of all lines especially the signal line. All lines must be secure, without crimps and not leaking.

2. Disconnect signal line at valve. A vacuum signal must be available with engine running. Reconnect signal line to valve.

3. With engine stabilized at idle speed, no air should be escaping through the silencer. Manually open and quickly close the throttle, a momentary blast of air should discharge through silencer for at least one second.

4. Defective valves should be replaced.

b. Removal

1. Disconnect vacuum hose from diverter valve.

2. Release clamp and remove air hose from fitting on diverter valve.

3. Remove two screws securing diverter valve to pump or bracket and remove diverter valve assembly.

4. Remove gasket material from diverter valve and pump flanges or connector.

Installation

1. Position new gasket on pump flange or connector.
2. Position diverter valve on pump flange or bracket and secure with two screws.
3. Connect air hose to diverter valve fitting and secure with clamp.
4. Connect vacuum hose to fitting on diverter valve.

AIR Pump Centrifugal Filter

The centrifugal filter fan should not be cleaned, either with compressed air or solvents.

CAUTION: *Centrifugal fan should not be removed from pump unless it is damaged, as removal procedures will destroy impeller.*

a. Removal

1. Remove pump drive belt.
2. Remove three screws and remove pump pulley, Fig. 6E-10.
3. Break remaining portion of centrifugal fan off pump hub, being careful that fragments do not enter air intake hole.

b. Installation

1. Position new centrifugal fan on pump hub.
2. Position pump pulley against centrifugal fan.
3. Install three pulley screws and tighten equally to 60 inch-pounds. This will press centrifugal fan onto pump hub. Do not drive centrifugal fan on with hammer.

NOTE: The slight amount of interference with the housing bore is normal. After a new fan has been installed, it may squeal upon initial operation or until its O.D. sealing lip has worn in. This may require a short period of pump operation at various engine speeds.

4. Install pump drive belt.
5. Adjust drive belt tension as described on Page 6B-12.

AIR Pump

Servicing of this pump should be limited to replacement of the entire pump. Do not open pump for any reason. Do not clamp it in a vise or use a hammer or pry bar on the pump housing. If pry bar is used during belt tensioning, pry as close to rear of pump cover as possible.

a. Inspection

Accelerate engine to approximately 1500 RPM and observe air flow from hose. If air flow increases as engine is acceleratred, pump is operating satisfactorily. If air flow does not increase or is not present, proceed as follows:

1. Check for proper drive belt tension.
2. Check for a leaky pressure relief valve. Air may be heard leaking with the pump running.

NOTE: The AIR System is not completely noiseless. Under normal conditions noise rises in pitch as engine speed increases. To determine if excessive noise is the fault of the Air Injection Reactor System, operate the engine with the pump drive belt removed. If excessive noise does not exist with the belt remove proceed as follows:

3. Check for a seized AIR Injection Pump.
4. Check hoses, tubes and all connections for leaks and proper routing.
5. Check AIR injection pump for proper mounting.
6. If none of the above conditions exist and the air injection pump has excessive noise remove and replace pump unit.

b. Removal - Except Seville

1. Raise care and place on jack stands.
2. Remove air hose from air pump elbow.
3. Remove three screws securing pulley to pump and remove pulley and belt.
4. Remove mounting bolt at top of AIR pump.
5. Remove adjusting bolt from bottom rear of pump and remove pump.

c. Installation - Except Seville

1. Lift pump up through space between lower radiator hose and oil filter.
2. Position pump against mounting bracket and loosely install upper screw.
3. Loosely install adjusting bolt at lower rear of pump.
4. Install pulley and drive belt. Adjust drive belt as described on Page 6B-12.
5. Tighten both mounting and adjusting screws to 25 foot-pounds (33.9 N·m).
6. Connect air hose to elbow on air pump and secure with clamp.

AIR Pump - Seville Only

a. Removal

1. Remove three screws securing pulley to AIR pump and remove pulley and drive belt.
2. Remove two screws securing diverter valve to pump and position valve and hoses out of way.
3. Remove link adjusting screw.
4. Remove pivot bolt and remove pump by lifting straight up.

b. Installation

1. Position pump to front of engine and loosely install pivot bolt and nut.
2. Loosely install adjusting link screw.
3. Using a new gasket, position diverter valve to pump and secure with two screws. Torque screws to 80 in.-lbs. (9.0 N·m).
4. Install pulley and snugly install three mounting screws.
5. Tension drive belt as described on Page 6B-18.
6. Torque pulley mounting screws to 60 in.-lbs. (81.3 N·m).

THERMOSTATIC AIR CLEANER

GENERAL DESCRIPTION

A thermostatic air cleaner assembly, Fig. 6E-12, is installed on all cars, except E.F.I., to reduce the amount of carbon monoxide in the exhaust gases. This reduction is accomplished by regulating the temperature of the air at the air cleaner inlet.

The thermostatic air cleaner assembly includes a temperature sensor, vacuum motor, control damper assembly and connecting vacuum hoses. The vacuum motor, controlled

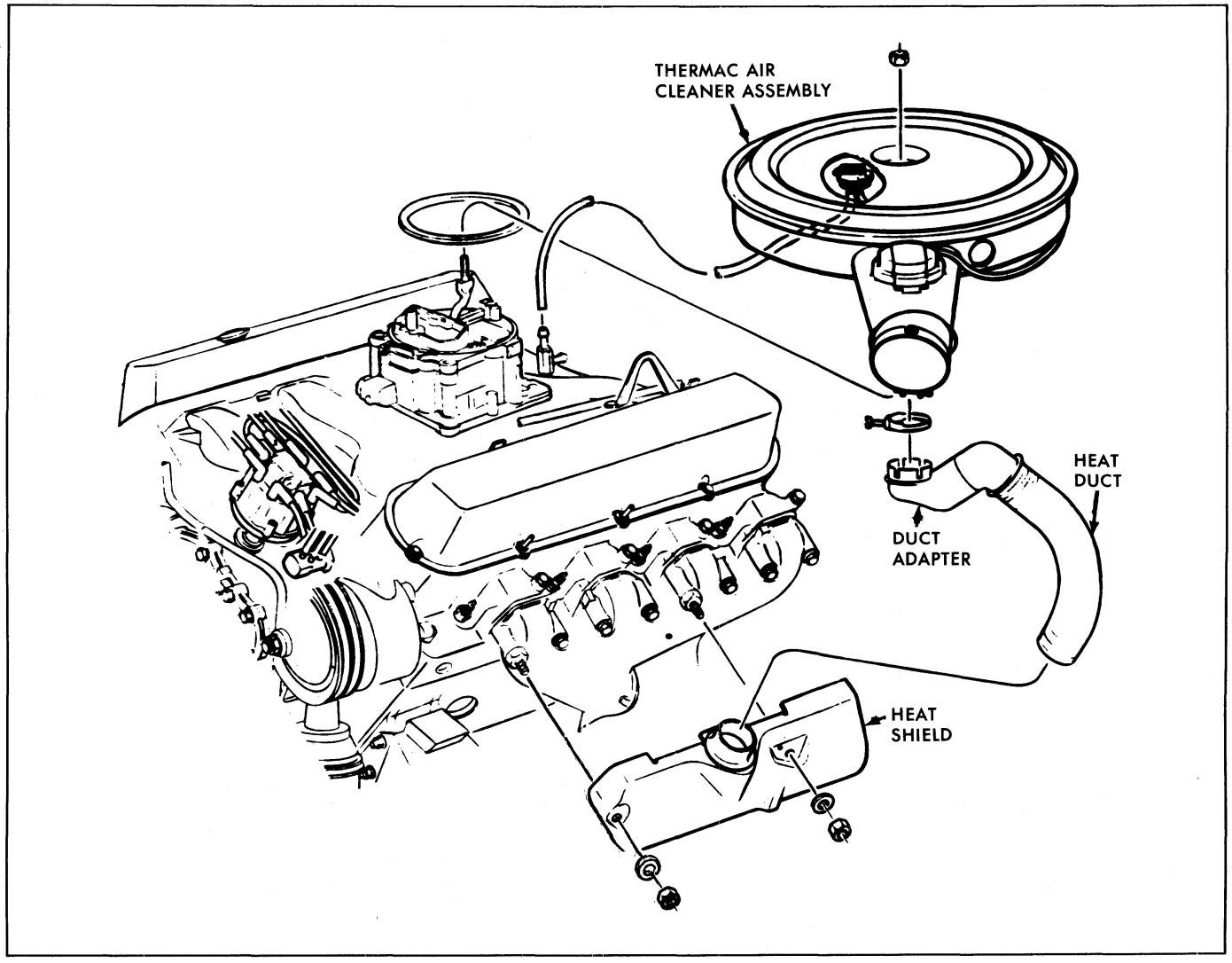


Fig. 6E-12 Thermac Air Cleaner-Typical-Except E.F.I.

by the temperature sensor, operates the air control damper assembly to control the flow of preheated air (from a heat shield around the exhaust manifold) or non-preheated (outside) air.

The thermostatic air cleaner is designed to maintain a minimum air temperature of 105°F (41°C) entering the carburetor. By maintaining this minimum temperature, the carburetor is calibrated to minimize exhaust emissions.

If the temperature of the air entering the air cleaner, Fig. 6E-13, is 85°F. (29°C.) or below, the temperature sensor is closed to allow engine vacuum to be directed to the vacuum motor closing the damper assembly to outside air. With the damper closed, underhood air will flow through the openings at the ends of the exhaust manifold heat shield where it is heated by the exhaust manifold. This preheated air then flows up through the heat tube to the air cleaner. This is the hot air delivery mode.

As the temperature inside the air cleaner reaches approximately 100°F (38°C), the sensor valve begins to open and bleed off vacuum from the vacuum motor. This allows the vacuum motor diaphragm spring to partially open the damper, allowing outside air to be mixed with the heated air to keep the intake air temperature at approximately 100°F (38°C). Under full throttle conditions (less than 4-6" H.G.) the vacuum will no longer hold the valve open to hot air. Diaphragm spring pressure closes the hot air pipe allowing only "cool" air to enter the carburetor.

During a "no vacuum or engine off condition", the damper will be positioned to close heat tube.

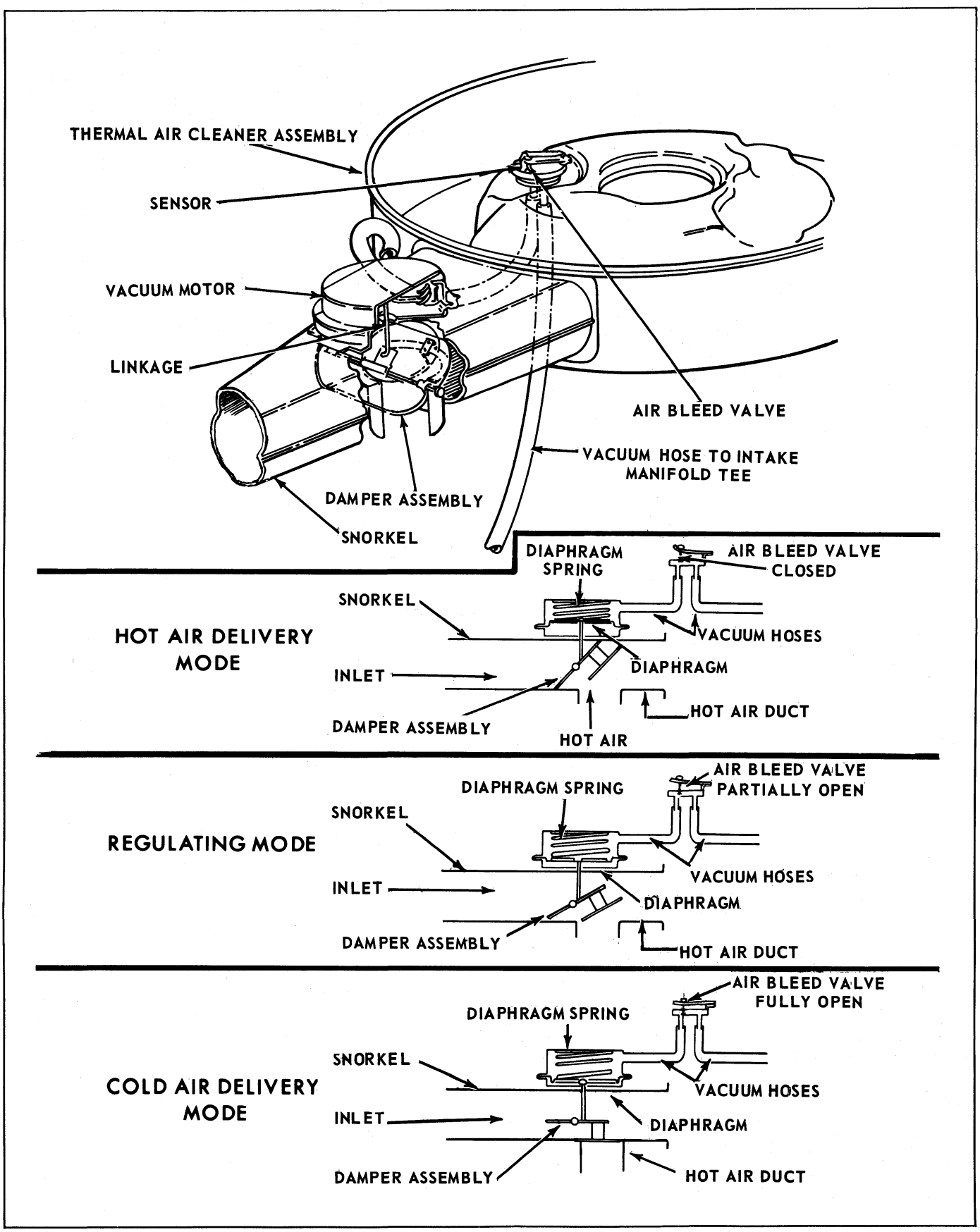


Fig. 6E-13 Thermac Air Cleaner Operation-Except E.F.I.

DIAGNOSIS

Testing Thermostatic Air Cleaner

1. Check heat tube and vacuum hoses for condition and secure connections. Repair or replace as required before further testing.

2. With engine off, remove air cleaner cover and tape Thermometer, J-5421, to air cleaner base next to sensor.

3. Allow a short time for thermometer reading to stabilize. Read thermometer and proceed on following basis: If temperature is below 80°F (26°C), continue with step 4. If temperature is above 80°F (26°C), remove air cleaner and allow it too cool to approximately 75°F (24°C).

4. Install a vacuum gage in the vacuum line between sensor and vacuum motor.

5. Check position of control damper by looking in end of snorkel. Damper should be open.

6. Install cover on air cleaner without nut and start engine.

7. If ambient temperature is above 85°F (29°C), proceed to step 10.

8. If ambient temperature is below 85°F (69°C), observe position of damper in snorkel. When damper begins to move toward the open (outside air) position, immediately remove air cleaner cover and record temperature and vacuum readings.

9. Replace air cleaner cover and continue watching damper.

10. If ambient temperature has risen above 85°F (29°C), it is only necessary to make sure damper is completely open by 105°F (41°C). When damper moves to full open position, again remove air cleaner cover and record temperature and vacuum readings.

11. Compare reading obtained in steps 8 and 10 with chart:

Damper Position	Temperature Reading	Vacuum Reading in Hg.
Starts to Open	85°F (29°C)	Full
Full Open	105°F (41°C)	4"-6"

12. Replacement of thermac air cleaner components should be based on following information.

a. If temperature is within specifications, thermac air cleaner is functioning properly.

b. If temperature is out of specification, but vacuum is correct, replace sensor as described on Page 6E-15.

c. If damper does not open at correct temperature, proceed to Step 13.

13. With engine at idle speed, disconnect damper assembly vacuum hose at sensor unit. Damper door should move to open (outside air) position. If damper does not open, check linkage for a binding condition.

14. Reconnect damper assembly vacuum hose with engine at idle speed. With vacuum gage reading of at least 9 in. Hg. (connect to manifold vacuum fitting if sensor is open) damper door should close snorkel passage (hot air position). If damper does not close, there is a vacuum leak in the vacuum motor diaphragm. Replace vacuum motor as described on Page 6E-16.

ON CAR SERVICE

Thermostatic Air Cleaner - Temperature Sensor

a. Removal

1. Detach hose between sensor and manifold fitting and remove air cleaner from engine.

2. Remove hose between sensor and vacuum motor, Fig. 6E-14.

3. Pry retainer away from sensor vacuum fitting and remove retainer.

4. Note position of sensor and remove sensor with gasket from positiion in air cleaner.

b. Installation

1. Install gasket on sensor and install sensor to air cleaner in original position, Fig. 6E-15.

2. Press retainer on vacuum connections.

3. Connect vacuum hose between sensor and vacuum motor. Install vacuum hose to remaining fitting.

4. Install air cleaner, making sure heat tube engages heat shroud on exhaust manifold.

5. Connect vacuum hose between sensor and manifold fitting.

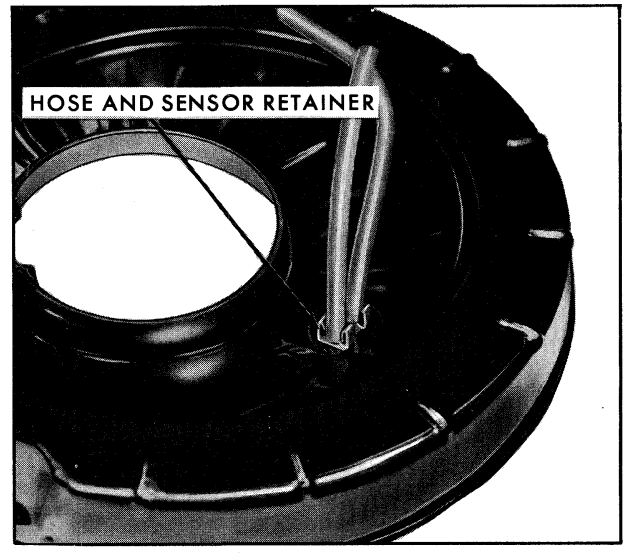


Fig. 6E-14 Thermac Air Cleaner Sensor Hoses

Thermostatic Air Cleaner Vacuum Motor

a. Removal

1. Disconnect hose between sensor and manifold fitting and remove air cleaner from engine.
2. Disconnect vacuum hose between motor and sensor.
3. Drill a 1/16″ hole in the center of each spotweld holding vacuum motor to snorkel. Enlarge hole as necessary to remove retainer.
4. Remove retainer and lift motor slightly off air cleaner.
5. Twist motor to one side to disengage link from valve and remove motor.

b. Installation

1. Install link in valve and position motor on air cleaner snorkel.
2. Position retainer strap over motor and secure with two sheet metal screws.
3. Check operation of valve to see that screws do not interfere.
4. Connect vacuum hose between motor and sensor. Install vacuum hose on remaining fitting.
5. Install air cleaner, making sure heat tube engages heat shroud on exhaust manifold.
6. Connect vacuum hose between sensor and manifold fitting.

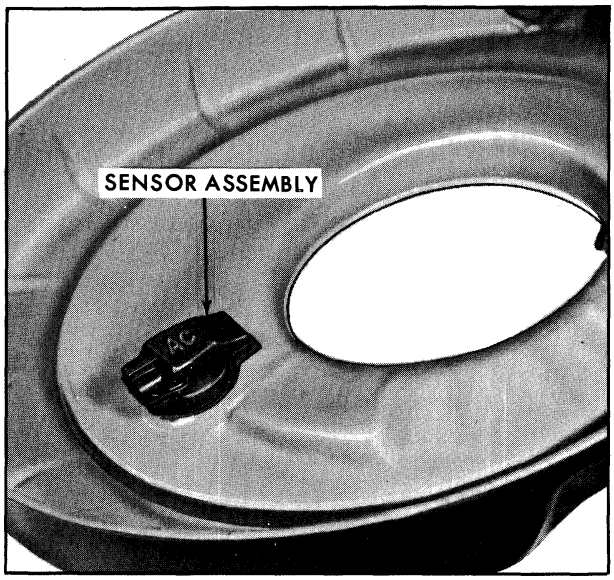


Fig. 6E-15 Positioning Thermac Air Cleaner Sensor

EXHAUST GAS RECIRCULATION (E.G.R.)

GENERAL DESCRIPTION

The exhaust Gas Recirculation system (E.G.R.) is used on all engines to reduce oxides of nitrogen emissions in the engine exhaust. On E.F.I. cars it is controlled by the Exhaust Pressure Transducer and the E.C.U.

There are three types of E.G.R. valves for 1977.

One valve, which is ported vacuum operated is used on all carburetor cars, except California. It requires one gasket which is not an orifice gasket.

The second valve is back-pressure operated and is used on carbureted California cars. The design includes the transducer incorporated into a valve. An orifice gasket is not used with this valve.

The third valve is used on E.F.I. engines with 4 different orifice gaskets. See Fig. 6E-21.

During the combustion process nitrogen, which makes up 80 per cent of the air, will tend to combine with oxygen at temperatures above 2500 degrees (1371°C). During the combustion process, temperatures in the engines cylinders will go well above 2500 degrees F. (1371°C) which forms oxides of nitrogen.

To lower formation of nitrogen oxides, it is necessary to reduce combustion temperatures. This is done by introducing exhaust gases into the engine cylinders with the air fuel mixture for combustion.

The E.G.R. valve is mounted at the rear of the intake manifold, Fig. 6E-16. Exhaust gas from the exhaust crossover is metered by the E.G.R. valve into an intake passage permitting flow into the cylinders.

Operation (Without Transducer)

All engines use two temperature sensitive control valves in the vacuum signal line to the EGR valve. The Thermal Vacuum Switch (TVS), located in the coolant crossover, blocks EGR vacuum when engine coolant is less than 120°F. The Thermal Vacuum Valve, (TVV), located over the right cylinder head, blocks EGR vacuum when engine metal is below 65°F. EGR is activated only after both thermal controls have switched.

The E.G.R. Valve, used on all except California cars, Fig. 6E-17, is operated by a ported vacuum. It is fully closed with vacuum less than 2 inches; it opens between 2 inches and 7″ Hg; and is fully open with more than 7″ Hg of vacuum. At idle and wide open throttle ported vacuum is low, the valve is closed and recirculation does not occur. At part throttle ported vacuum is high, the valve is open and exhaust gas recirculation is at maximum.

All engines use a temperature sensitive control valve in the vacuum signal line to the E.G.R. valve.

The valve is closed below 64.5° $\pm$ 3.5°F. (18° $\pm$ -16°C) engine metal temperature blocking vacuum to the E.G.R. valve giving better driveway when the engine is cold.

The E.G.R. control valve is open above 76°F. (24°C.) engine metal temperature allowing E.G.R. ported vacuum to be directed to the E.G.R. valve.

BACK PRESSURE EGR VALVE

An exhaust back pressure transducer, integral with the EGR valve is used on California carburetor cars.

A small diaphragm controlled valve Fig. 6E-18 inside the EGR valve assembly acts as a pressure regulator. The

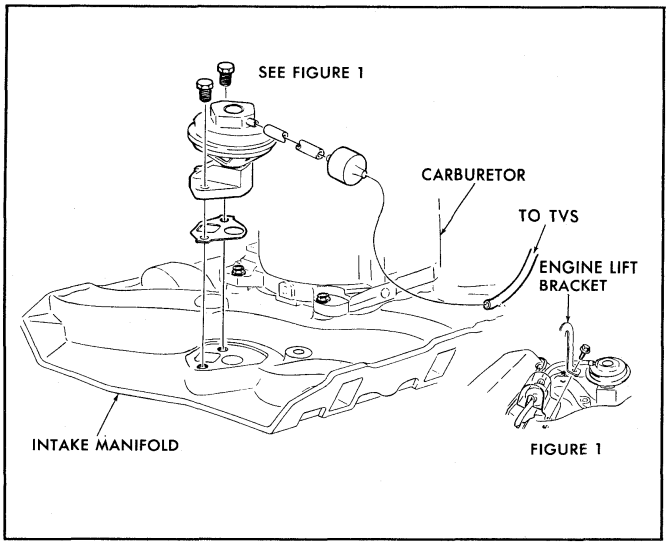


Fig. 6E-16 E.G.R. Systems-Carburetor Only

control valve receives an exhaust back pressure signal through the hollow shaft which exerts a force on the bottom of the control valve diaphragm, opposed by a light spring. A metal deflector plate prevents hot exhaust gases from flowing directly on the diaphragm.

Vacuum is applied to the EGR valve assembly from a ported source in the carburetor float bowl to assure no exhaust gas recirculation at idle. During off-idle operation manifold vacuum is applied to the vacuum chamber through a restriction in the signal tube. When engine load is light, and exhaust back pressure is low, the control valve is open, allowing air to flow from the 6 bleeds in the diaphragm plate, through the control valve orifice, into the vacuum chamber. The air bleeds off vacuum, decreasing the signal trying to open the EGR valve. Therefore, if back pressure does not close the control valve, sealing off the air flow, there will not be any vacuum built up to open the EGR valve for exhaust gas recirculation.

When power demands are made on the engine, and exhaust gas recirculation is needed, exhaust back pressure increases, closing the control valve, thereby shutting off air flow through the valve. Vacuum builds up in the vacuum chamber until the spring force holding the EGR valve closed is overcome.

Once the EGR valve opens, the exhaust pressure decreases because some of the exhaust gas is flowing into the intake manifold through the EGR passage. In actual operation, the system will reach a balanced condition providing optimum EGR operation, Fig. 6E-19.

Any increase in engine load will momentarily increase

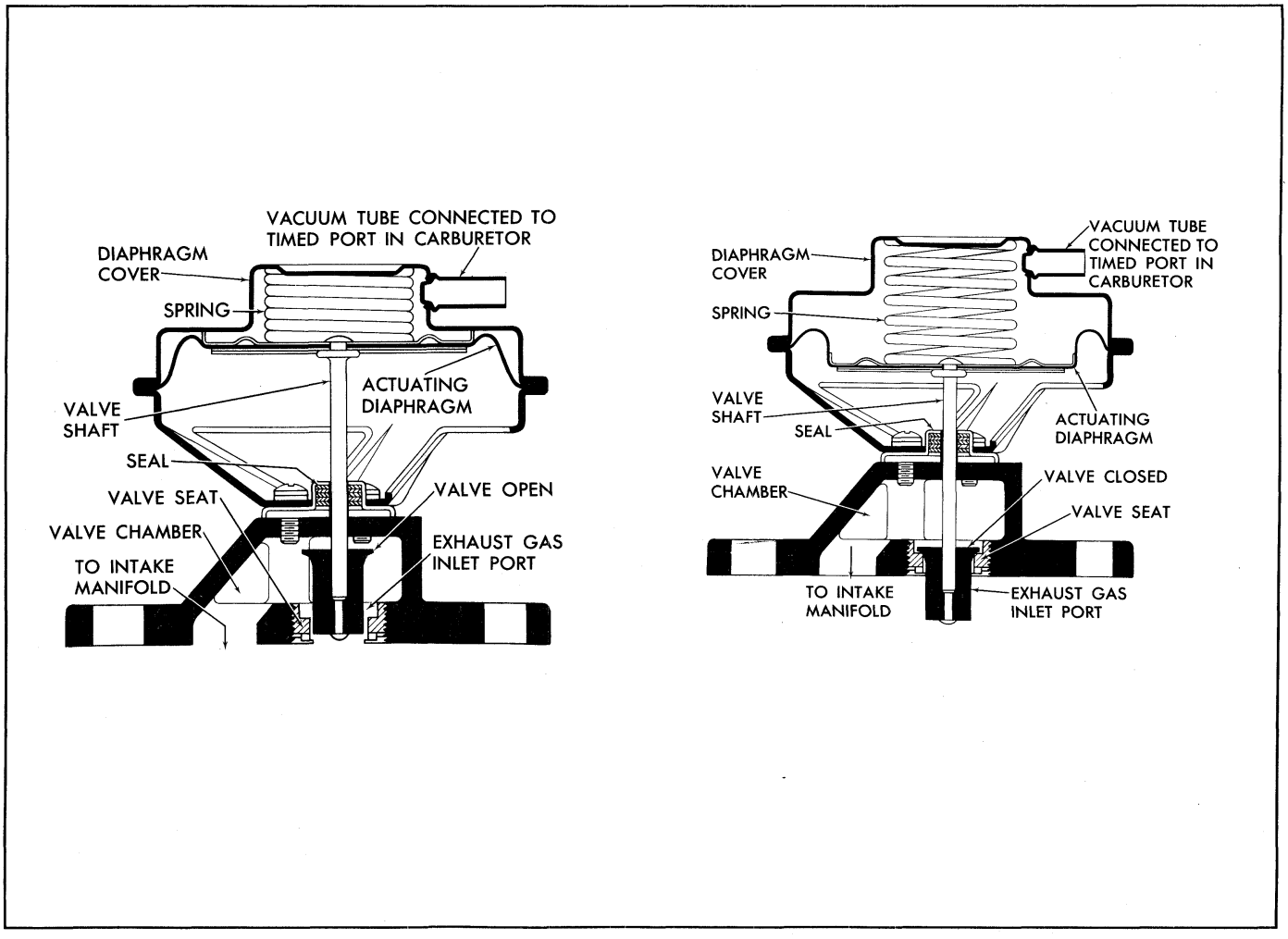


Fig. 6E-17 E.G.R. Valve Operation-Without Back Pressure

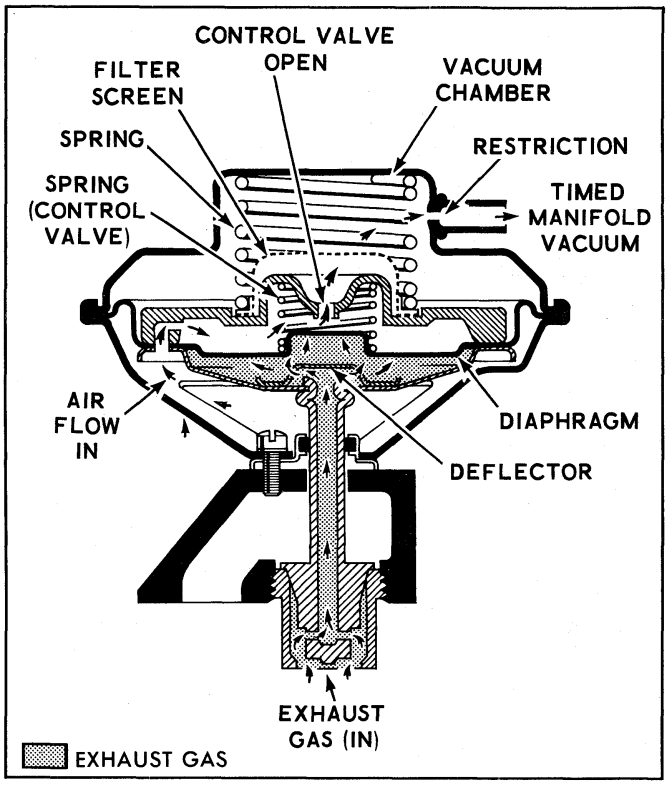


Fig. 6E-18 Back Pressure EGR Control Valve Open

the exhaust signal, causing the control valve to close, allowing a stronger vacuum signal. The system will then stabilize at a greater EGR flow.

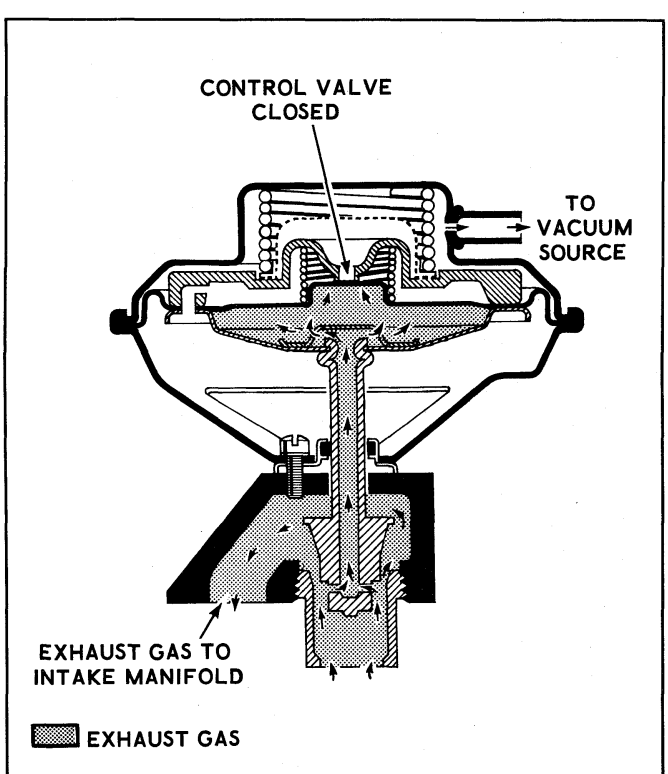


Fig. 6E-19 Back PressureEGR Control Valve Closed

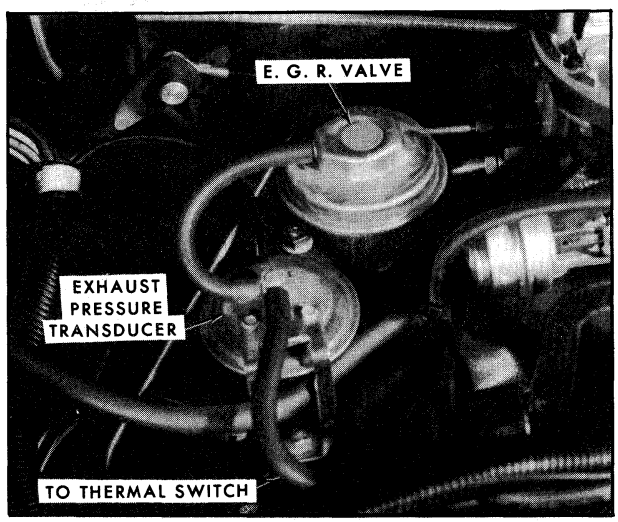


Fig. 6E-20 Exhaust Pressure Transducer-Typical

At maximum engine load, when manifold vacuum is nearly zero, there will be no EGR operation. This is because of insufficient vacuum to pull the valve open, even though high exhaust back pressure has closed the control valve.

EXHAUST PRESSURE TRANSDUCER

An exhaust pressure transducer is used on all E.F.I. cars. In Fig. 6E-20, the transducer is used in addition to the EGR valve and EGR solenoid.

The transducer, Fig. 6E-22, receives its exhaust pressure signal from a small tube leading to the spacer under the E.G.R. valve. In order for the transducer to receive the proper exhaust signal, the holes in the end of the signal tube must be open and clear. Cleaning of this area is required whenever the E.G.R. valve is cleaned.

The transducer, Fig. 6E-22, receives its exhaust pressure signal from a small tube leading to the spacer under the E.G.R. valve. In order for the transducer to receive the proper exhaust signal, the holes in the end of the signal tube must be open and clear. Cleaning of this area is required whenever the E.G.R. valve is cleaned.

The transducer is also connected to the E.G.R. vacuum port in the E.F.I. throttle body (through the EGR solenoid valve). This source vacuum is modulated by the transducer and the resulting vacuum actuates the E.G.R. valve.

The exhaust signal is imposed on the bottom side of the transducer diaphragm while the upper side is exposed to atmospheric pressure through the slots and air filter on top of the housing. A light spring provides a small preload opposing the exhaust pressure signal holding the transducer valve open.

At idle the exhaust pressure is low and the vacuum is nil resulting in no E.G.R. valve operation.

At a slightly greater air flow, the vacuum source is equal to manifold vacuum, but the exhaust pressure is not sufficient to overcome the transducer spring force and the vacuum source is bled off leaving the E.G.R. valve closed.

At some still greater airflow, the exhaust pressure will be great enough to overcome the spring force and close the transducer bleed valve. Now, the vacuum signal is routed to the E.G.R. valve to force it open.

Once the E.G.R. valve opens, the exhaust pressure decreases because of the exhaust gases flowing into the intake

Series	Application	Gasket - Orifice
Except Seville	Except California	Except Eldorado 160 8508* - .600"
		Eldorado 160 8507* - .640"
	California	Except Eldorado 160 8508* - .600"
		Eldorado Not Available
Seville	Except California	417 173* - .390"
	California	551 147* - .422"

*Use this part or the equivalent

Fig. 6E-21 E.F.I./EGR Orifice and Gaskets

manifold vacuum through the E.G.R. passage. In actual operation the system will reach a balanced condition providing optimum E.G.R. operation.

Any increase in engine load will momentarily increase the exhaust signal causing the transducer bleed valve to close allowing a stronger vacuum signal to the E.G.R. valve resulting in greater E.G.R. flow. The system will stabilize at a greater E.G.R. flow.

At maximum engine load, manifold vacuum, which provides the vacuum source, will be nearly zero, therefore, in spite of high exhaust pressures, there will be no E.G.R. operation.

Vacuum to the transducer is controlled by the E.G.R. solenoid. Operation of the solenoid is the responsibility of the Electronic Fuel Injection ECU. The ECU keeps the solenoid valve closed below approximately 130°F (54.5°C.) coolant temperature, blocking the signal to the transducer. This allows improved cold starts and engine warmup. Above approximately 130°F (54.5°C.) the ECU opens the solenoid valve so that ported vacuum may be routed to the transducer.

The E.G.R. valve is mounted at the right side of the intake manifold on EFI cars (left side on Seville). Exhaust gas from the exhaust port is metered by the E.G.R. valve into an intake passage permitting flow into the cylinders.

The chart, Fig. 6E-21, shows the application of EGR Orifice Gaskets.

This metering gasket must be installed between the transducer and the intake manifold.

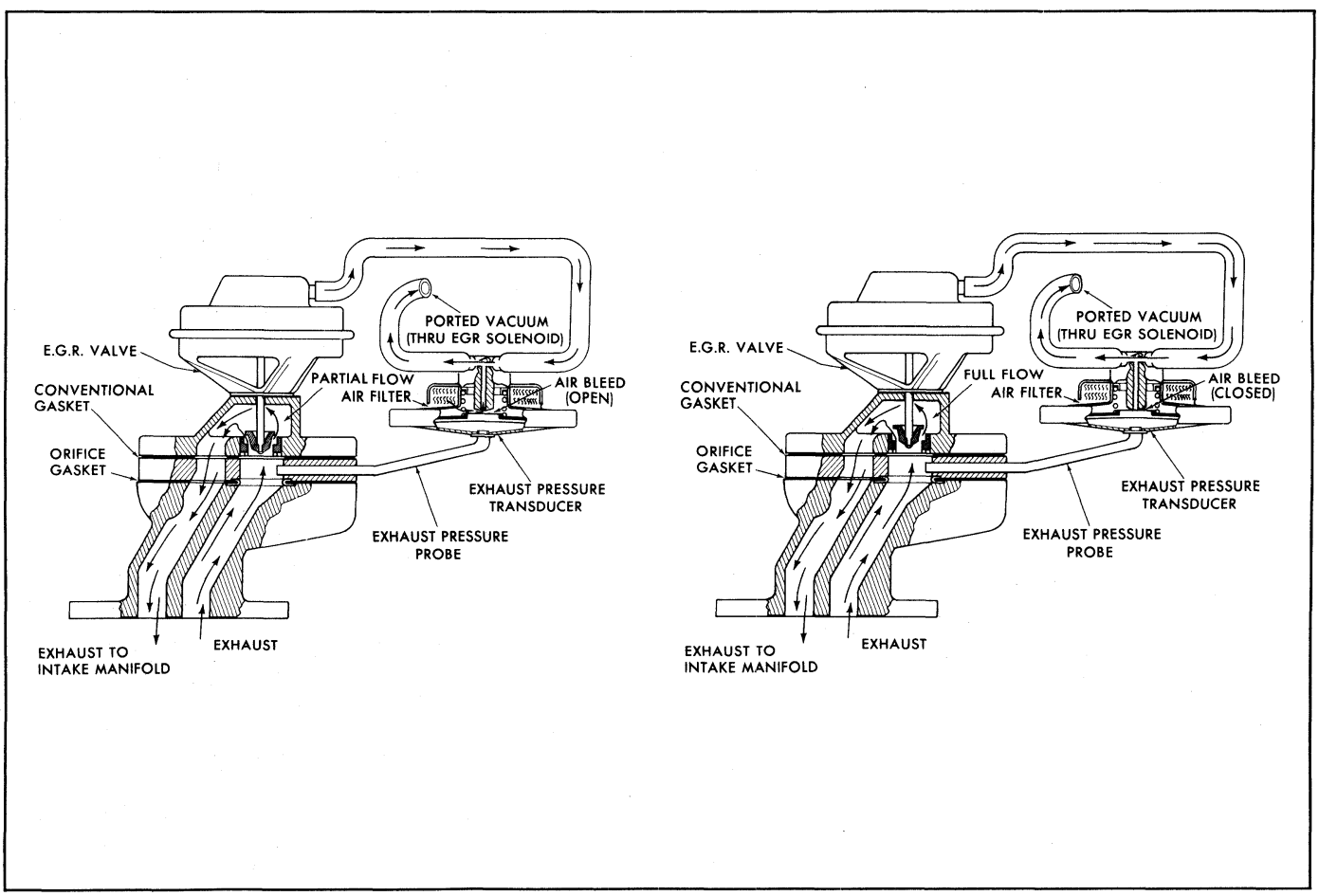


Fig. 6E-22 Back Pressure Transducer E.G.R. Valve Operation

DIAGNOSIS

ON CAR FUNCTIONAL TEST - EGR VALVE (EXCEPT BACK PRESSURE MODELS)

1. With the engine running, the car in "Park", set the fast idle cam on second step to hold throttle open (approximately 1400 - 1600 RPM). Engine coolant temperature must be above 120°F. (49°C.)

2. Place finger beneath EGR valve in a manner to feel movement of diaphragm.

3. Disconnect the vacuum hose and watch for movement of the diaphragm downward (valve closed). This should be accompanied by increase in engine speed.

4. Reconnect the hose. Diaphragm should move upward (valve open). Engine RPM should decrease.

NOTE: A slight vibration of the diaphragm plate assembly may be noticed in back pressure models. This is due to the control valve modulating under light load and does not indicate an undesirable condition nor one requiring correction.

5. If diaphragm doesn't move:

a. Verify engine speed. Should be approximately 1400 - 1600 RPM.

b. Verify temperature: should be above 120°F. (49°C.)

c. Check for vacuum at hose. If no vacuum present, find cause for no vacuum. (Plugged or leaking hose or carburetor port, malfunctioning EFE/EGR TVS switch.)

d. In back pressure models, check control valve operation described in Step 6.

6. If diaphragm moves with no change in engine RPM: Check manifold EGR passages for blockage.

OFF CAR FUNCTION TEST - CONTROL VALVE (BACK PRESSURE EGR MODELS ONLY)

1. Remove vacuum hose.

2. Remove two attaching bolts and EGR valve assembly from intake manifold, discard gasket.

3. Apply external vacuum (10" or more) to signal tube. A constant vacuum supply must be used.

4. Valve should not open. If it does, control valve is stuck closed, Clean the valve. As described on page 6E-23.

5. With the vacuum still applied, direct a stream of air from a low pressure source into the valve exhaust gas intake.

6. Valve should open completely. If it does not open at all, control valve is stuck open or exhaust passages are plugged. Clean the valve as described on page 6E-23.

7. If EGR valve and control valve are both functioning properly, clean the mounting surfaces, then using a new gasket, install the valve to the intake manifold.

8. Connect vacuum hose.

EGR SYSTEM DIAGNOSIS CHART

Condition	Possible Cause	Correction
Engine idles abnormally rough and/or stalls.	EGR valve vacuum hoses misrouted.	Check EGR valve vacuum hose routing. Correct as required, Fig. 6C-25 and 6C-26.
	Leaking EGR valve.	Check EGR valve for correct operation.
	EGR valve gasket malfunction or loose attaching bolts.	Check EGR attaching bolts for tightness. Tighten as required. If not loose, remove EGR valve and inspect gasket. Replace as required.
	EGR thermal vacuum valve and/or EGR-TVS.	Check vacuum into valve from carburetor EGR port with engine at normal operating temperature and at curb idle speed. Then check the vacuum out of the EGR thermal control valve to EGR valve. If the two vacuum readings are not equal within ± 1/2 Hg., then diagnose EGR vacuum control.
	Improper vacuum to EGR valve at idle.	Check vacuum from carburetor EGR port with engine at stablized operating temperature and at curb idle speed. If vacuum is more than 1.0 in Hg., refer to carburetor idle.
(with back pressure EGR valve)	Improper carburetor vacuum signal at idle.	Check vacuum from carburetor to exhaust back pressure transducer with engine at stablized operating temperature and at curb idle speed. If vacuum is more than 1.0 in Hg., refer to carburetor idle diagnosis.

EGR SYSTEM DIAGNOSIS CHART

Condition	Possible Cause	Correction
Engine runs rough on light throttle acceleration, poor part fuel economy.	EGR valve vacuum hose misrounted.	Check EGR valve vacuum hose routing. Correct as required, Fig. 6C-2 and 6C-3.
	Malfunctioning vacuum control valve.	Same as listing in "Engine Idles Rough" condition.
	EGR flow unbalanced due to deposit accumulation in EGR passages or under carburetor.	Clean EGR passages of all deposits as described on Page 6E-22.
	Sticky or binding EGR valve.	Remove EGR valve and inspect. Clean or replace as required.
	Wrong or no EGR gaskets.	Check and correct as required.
(Cars with a back pressure transducer valve.)	Malfunctioning exhaust back pressure transducer valve.	Functional check as described on Page 6E-20.
	Exhaust system restricted causing excessive back pressure.	Inspect exhaust system for restriction and replace or repair as requested.
(Cars with back pressure EGR valve.)	Control valve blocked or air flow restricted.	Check internal control valve function.
Engine stalls on decelerations.	Restriction in EGR vacuum line.	Check EGR vacuum lines for kinks, bends, etc. Remove or replace hoses as required. Check EGR vacuum control valve function.
		Check EGR valve for excessive deposits causing sticky or binding operation. Clean or repair as required.
	Sticking or binding EGR valve.	Remove EGR valve and inspect clean or repair as required.
(Cars with a back pressure transducer valve.)	Exhaust back pressure transducer malfunction.	Check function as described on page 6E-20.
(Cars with a back pressure EGR valve.)	Control valve blocked or air flow restricted.	Check internal control valve function.
Part throttle engine detonation.	Insufficient exhaust gas recirculation flow during part throttle accelerations.	Check EGR valve hose routing Fig. 6C-25 & 6C-26. Check EGR valve operation as described on page 6E-16. Repair or replace as required. Check EGR thermal control valve and/or EGR-TVS as listed in "Engine Idles Rough" section. Replace valve as required. Check EGR passages and valve for excessive deposit. Clean as required.
(Cars with a back pressure transducer valve.)	Exhaust back pressure transducer malfunction.	Check function as described on page 6E-20.
(Cars with a back pressure EGR valve.)	Control valve blocked or air flow restricted.	Check internal control valve function.
Engine starts but immediately stalls when cold.	EGR valve hoses misrouted.	Check EGR valve hose routings. Fig. 6C-25 and 6C-26.
	EGR system malfunctioning when engine is cold.	Perform check to determine if the EGR thermal control valve and/or EGR-TVS are operational. Replace as required.
(Cars with a back pressure transducer valve.)	Exhaust back pressure transducer malfunction.	Check function as described on page 6E-20.
(Cars with a back pressure EGR valve.)	Control valve blocked or air flow restricted.	Check internal control valve function.

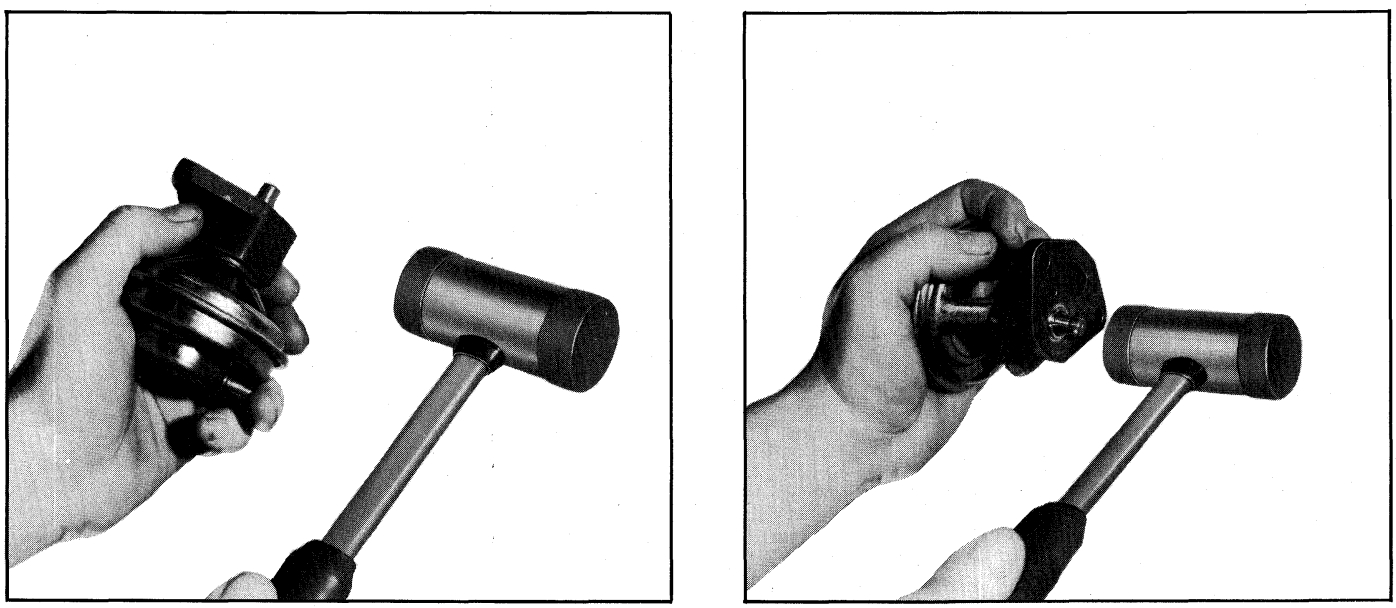


Fig. 6E-23 Cleaning E.G.R. Valve

ON CAR SERVICE

E.G.R. Valve Cleaning (Fig. 6E-23)

CAUTION: *Do not wash valve assembly in solvents or degreaser permanent damage to valve diaphragm may result.*

1. Remove vacuum hose from E.G.R. Valve Assembly.
2. Remove two attaching nuts and E.G.R. Valve Assembly from intake manifold, discard gasket.
3. Hold the valve assembly in hand, then tap lightly on the sides and end of the valve with a small plastic hammer to remove the exhaust deposits from the valve seat, Fig. 6E-23. Empty loose particles. DO NOT PUT IN A VISE.
4. With a wire wheel, buff the exhaust deposits from the mounting surface and around the valve.
5. Depress the valve diaphragm and look at the valve seating area through the valve outlet for cleanliness. If valve or seat are not completely clean, repeat Step 3.
6. Look for remaining exhaust deposits in the valve outlet and seat area. Remove deposit build up with a screwdriver or other suitable sharp tool.
7. Clean mounting surfaces of intake manifold and valve assembly, then using a new gasket install the valve assembly to the intake manifold. Torque the nuts to 10 ft. lbs. (13.5 N·m).
8. Check all Vacuum lines for splitting, kinks, or obstructions.
9. Connect the vacuum hose.

E.G.R. Port Cleaning (Fig. 6E-24)

1. Remove carburetor as described on Page 6C-12.
2. Remove vacuum hose from E.G.R. valve.
3. Remove two E.G.R. attaching nuts and E.G.R. valve assembly from intake manifold, discard gasket.
4. Tape the forward hole, in the manifold on E.G.R. valve assembly mounting pad.
5. Remove the deposits from the intake manifold E.G.R. ports (in the manifold under the carburetor primary valve area) by HAND, using a 9/16″ drill bit then a screwdriver to clean the holes and chamfer. DO NOT USE AN ELECTRIC DRILL.
6. Brush any small particles down the two ports into the E.G.R. passage.
7. Plug the left E.G.R. port and using compressed air, blow through the right port.
8. Plug the right E.G.R. port and blow through the left E.G.R. port. Remove tape from E.G.R. valve assembly mounting surface.
9. Clean and install E.G.R. valve.
10. Install carburetor as described on Page 6C-13.

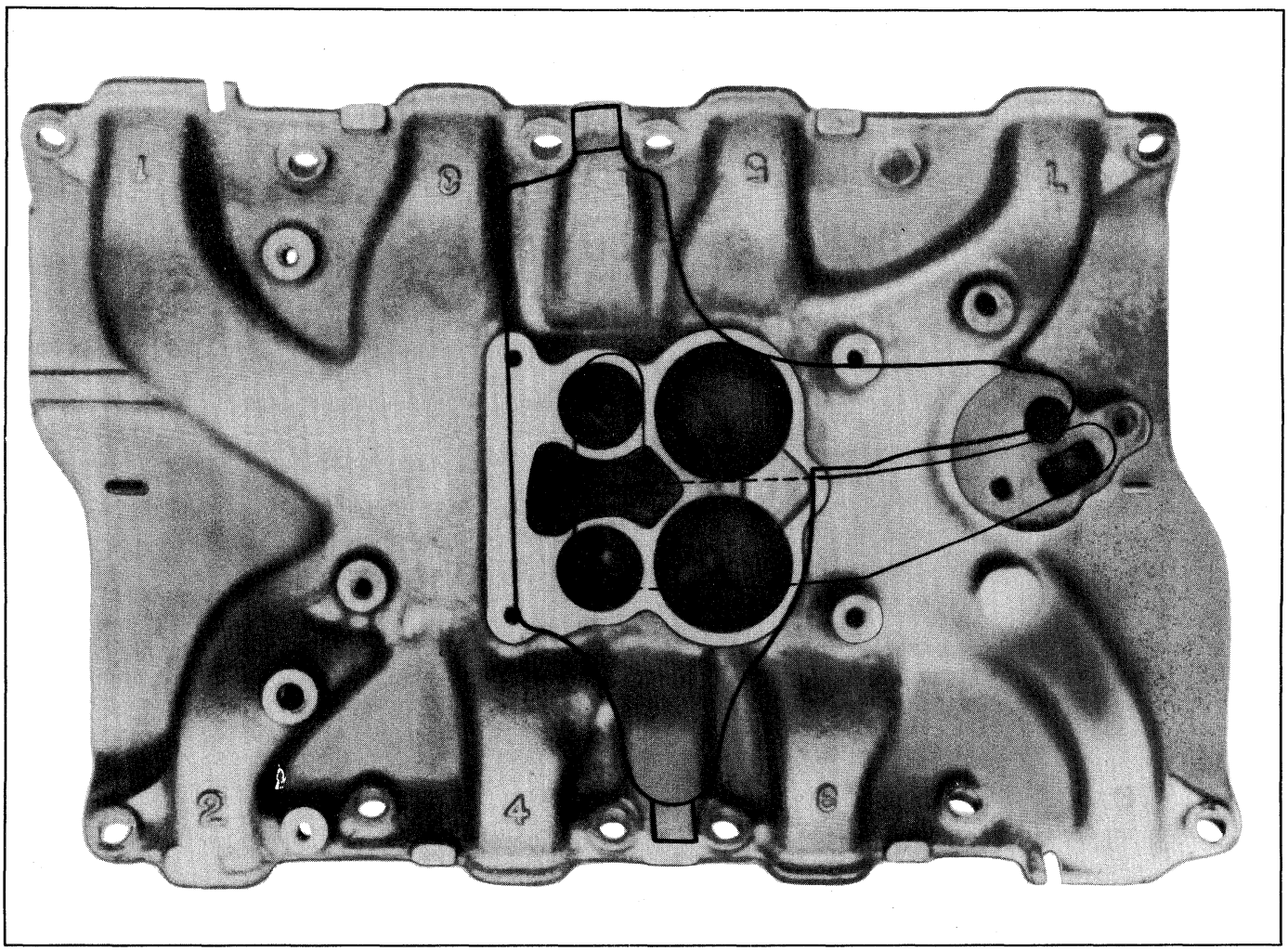


Fig. 6E-24 E.G.R. Passages in Intake Manifold

VACUUM CONTROLS
GENERAL DESCRIPTION

Various types of vacuum controls are used in the emission control system to modify or control the operation of the various emission control components to optimize emission control effectiveness, while minimizing any negative effect on driveability. The types of vacuum control valves used are:

Thermal Vacuum Switch - TVS
Thermal Vacuum Valves - TVV
Vacuum Solenoid Valves - VSV

Refer to the vacuum hose schematics on Page 6E-25 and 6E-26 for usage of these valves.

THERMAL VACUUM SWITCH (TVS)

a. Exc. EFI and Seville

The outer two ports of the TVS located in the upper left front of the cylinder block control EFE valve operation. They allow manifold vacuum, from the float bowl on non-California carburetor cars and from the intake manifold on California carburetor cars, to the EFE Valve below approximately 120°F. (50°C.) coolant temperature. Manifold vacuum closes the EFE valve, forcing the exhaust gases through the crossover passage, in the intake manifold to quickly warm it for better fuel vaporization. At approximately 120°F. (50°C.) coolant temperature, the TVS changes position, blocks off manifold vacuum and allows the EFE valve to open resulting in normal flow of gases through the exhaust system.

The inner two ports of the TVScontrol operation of the EGR valve. They allow ported vacuum, from the carburetor throttle bowl on non-California cars and from the carburetor float bowl on California cars, to the EGR system above approximately 120°F. (50°C.) coolant temperature.

b. E.F.I. California

The three port TVS, located in the upper left front of the cylinder block, except Seville, and the front right hand side of the intake manifold on Sevilles, allows ported vacuum to the distributor vacuum advance below approximately 220°F. (104°C.) coolant temperature. At approximately 220°F. (104°C.) coolant temperature, the TVS blocks off

ported vacuum and allows full manifold vacuum to the distributor.

E.G.R. THERMAL VACUUM VALVE (EXCEPT EFI)

A temperature sensitive control valve is in the vacuum signal line to the EGR valve. It is closed below approximately 64°F. (19°C.) engine metal temperature, blocking vacuum to the EGR Valve, giving better driveaway when the engine is cold. This valve is opened above 76°F. (25°C.) engine metal temperature allowing ported vacuum to be directed to the EGR valve.

E.G.R. VACUUM SOLENOID (EFI Only)

The EGR vacuum solenoid valve is controlled by the ECU and is installed in the signal line to the EGR valve. The ECU keeps the solenoid valve closed below the approximate coolant temperature specified in the chart, blocking the signal to the EGR valve. This allows improved cold starts and engine warm up. The ECU opens the solenoid valve above the approximate coolant temperature specified in the chart, allowing ported vacuum to be directed to the EGR exhaust-pressure transducer and EGR valve.

DISTRIBUTOR EFI VACUUM SOLENOID

California E.F.I. (Except Eldorado and Seville)

The distributor vacuum solenoid valve is controlled by the ECU and installed in the signal line to the distributor vacuum advance. The ECU keeps the solenoid closed below approximately 130°F. (55°C.) coolant temperature blocking the signal to the vacuum advance. The ECU opens the solenoid valve above approximately 130°F. (43°C.) coolant temperature allowing vacuum to be directed to the distributor vacuum advance.

Application	Coolant Temperature
All Cars (Except California)	125°F. (51°C.) Except Eldorado 110°F. (43°C.) Eldorado
All California Cars (Except Seville)	130°F. (55°C.) Except Eldorado 115°F. (46°C.) Eldorado
Seville California Only	132°F. (55°C.)

DISTRIBUTOR VACUUM SOLENOID

California (Eldorado and Seville)

The distributor vacuum solenoid, controlled by the ECU is installed in the signal line to the vacuum retard side of the dual action distributor. The ECU allows manifold vacuum to the retard side of dual action distributor below approximately 115°F. on Eldorado and Seville at 132°F. (55°C.). At approximately 115°F. on Eldorado and Seville at 132°F. (55°C.) the ECU closes the solenoid venting manifold vacuum on the retard side.

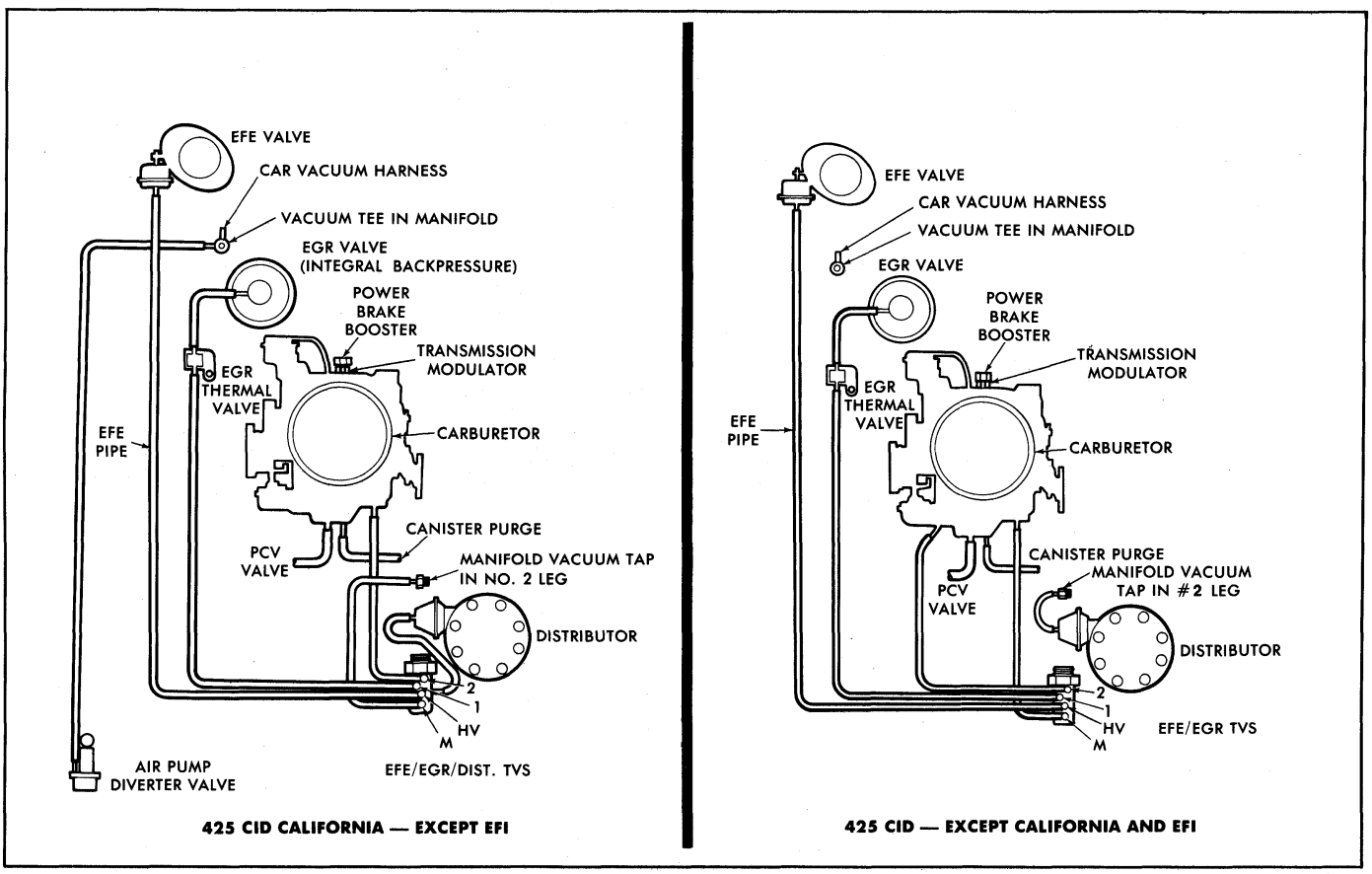
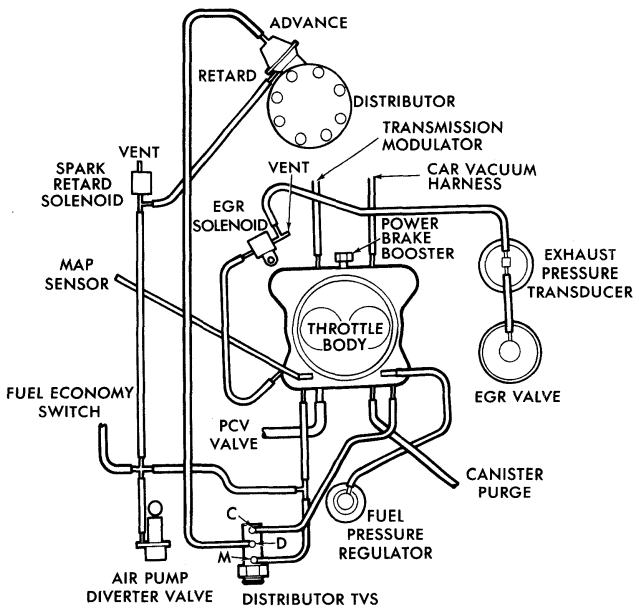
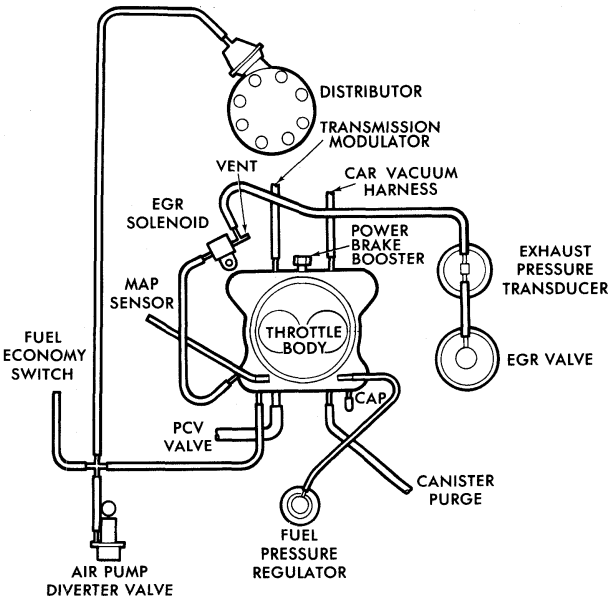


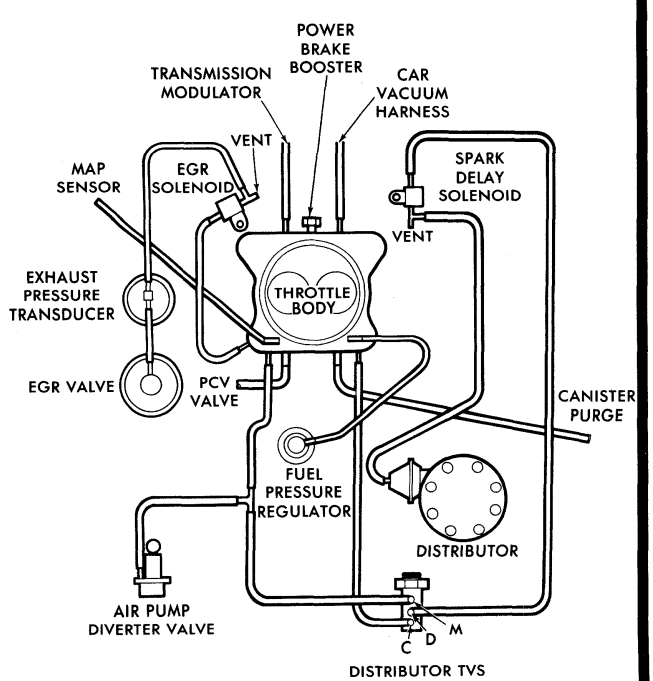
Fig. 6E-25 Vacuum Diagrams Except EFI



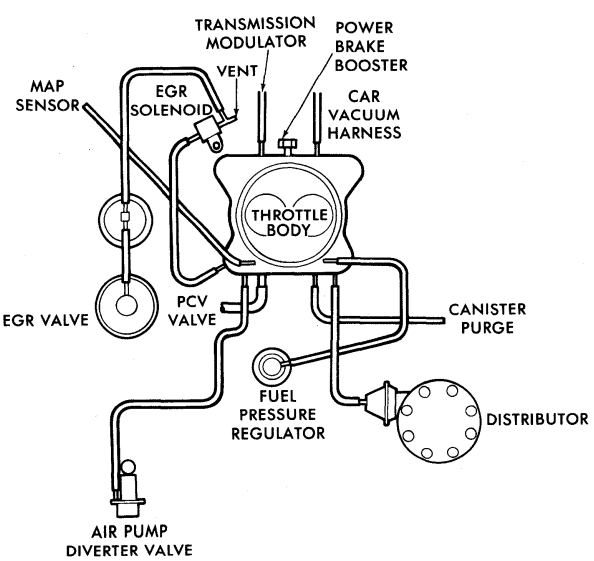
350 CID — CALIFORNIA



350 CID — EXCEPT CALIFORNIA



425 CID EFI — CALIFORNIA



425 CID EFI — EXCEPT CALIFORNIA

Fig. 6E-26 Vacuum Diagrams EFI Only

EXHAUST SYSTEM
TABLE OF CONTENTS

General Description 6F-1
On Car Service 6F-1
Torque Specifications 6F-13
Special Tools 6F-14

GENERAL DESCRIPTION

The exhaust system on all Cadillac cars, except the Eldorado and Seville incorporates (in order from front to rear), a crossover Y-exhaust pipe, a catalytic converter, an intermediate pipe, a muffler and a muffler-to-resonator pipe with integral resonator, Fig. 6F-1.

On Fleetwood Limousines and Commercial Chassis, a longer intermediate pipe is used because of the additional length of these vehicles.

The exhaust system on the Eldorado, Fig. 6F-2, consists of two exhaust pipes, a converter adapter, a catalytic converter, an intermediate pipe, muffler and a muffler to resonator pipe with an integral resonator assembly.

All, except Seville, exhaust systems are supported at the rear of the converter; rear of the muffler; and rear of the resonator, by rubber isolated hangers to provide proper alignment.

The exhaust system, except Eldorado and Seville, incorporates a vibration damper at rear of converter. It is used to absorb exhaust system vibrations and should be reinstalled as shown in Fig. 6F-1, whenever the converter is replaced.

Figures 6F-3 and 6F-4 show the Seville exhaust system. The system consists of the following parts: crossover pipe, manifold outlet pipe, catalytic converter, converter outlet pipe, resonator and kick-up pipe assembly muffler and muffler outlet pipe.

The exhaust system is supported at the front of the converter; the inlet and outlet of the muffler; and the tail pipe by rubber isolated hangers.

Catalytic Converter

The catalytic converter, Figs. 6F-1, 6F-2, 6F-3, and 6F-4 is an emission control device added to the exhaust system to reduce hydrocarbon and carbon monoxide pollutants from the exhaust gas. The converter contains pellets coated with catalytic material containing platinum and palladium. The catalytic material promotes burning or oxidization of the pollutants as the exhaust gas passes thru the converter on its way to the tailpipe.

In the event that the catalytic pellets must be replaced, see Page 6F-9.

NOTE: The catalytic converter requires the use of unleaded fuel only.

Unleaded gasoline is used to reduce combustion chamber deposits and to prevent lead contamination of the catalyst that will render it ineffective. Contamination of the catalyst by the use of leaded fuels will require frequent replacement of the catalytic material.

ON CAR SERVICE

The 1977 Exhaust System is new for all cars, except Eldorado and Seville, and has several new service features.

The catalytic converter assembly front attachment to the manifold "Y" pipe has a joint with a conventional "U" bolt clamp. The rear attachment to the intermediate pipe is a ball socket clamp joint. The converter assembly is mounted at the rear by a bracket to the rear transmission support through rubber bushings.

The intermediate pipe is a welded assembly with the muffler. This assembly is supported by a slotted rubber insulator and spade type hanger mounted rear of the muffler to the frame rear suspension crossmember.

The kick-up pipe, resonator and tailpipe are a welded assembly supported by a rear hanger and bracket mounted to the frame by the rear bumper energy absorber upper mounting bolts. The mounting bracket and tailpipe bracket are connected by an insulator.

Whenever a change is noticed in the sound of the exhaust system, or when exhaust gas can be detected inside the vehicle, inspect the complete exhaust system for broken or damaged parts, deterioration, broken seams or loose connections which may cause leaks. In addition, inspection for these conditions should be performed every 4 months, never to exceed 6,000 miles.

When exhaust system service is required, Fig. 6F-5 thru 6F-7 provide the necessary information for proper alignment and proper arrangement and positioning of parts. Step-by-step procedures for the replacement of individual exhaust system parts are not included as no special steps are required. Refer to Page 6F-12 for servicing of the catalytic converter.

Exhaust System Alignment

NOTE: Exhaust system should be properly aligned to avoid contact with frame or floor pan. (minimum 5/8 inch (15 mm). Blade-type exhaust system hangers are designed to minimize noise transfer through hangers. If system contacts frame or blade is bound up or restricted, vibration and noise can be transmitted into car.

Position clamps and blades so that hanger blades are horizontal and centered from side to side in the rubber slots of the support brackets. The support brackets should also be horizontal. A light coat of silicone lubricant (not petroleum base lubricant) should be applied in rubber slots of brackets.

If it is necessary to reposition pipes, heat may be used in front of rear axle. Allow pipes to cool before touching them. Do not use acetylene torch behind rear axle.

After adjusting hangers or repositioning pipes, recheck the entire system for adequate clearance to frame members and floor plan (minimum 5/8 inch), and tighten all clamps according to torques specified in the following chart.

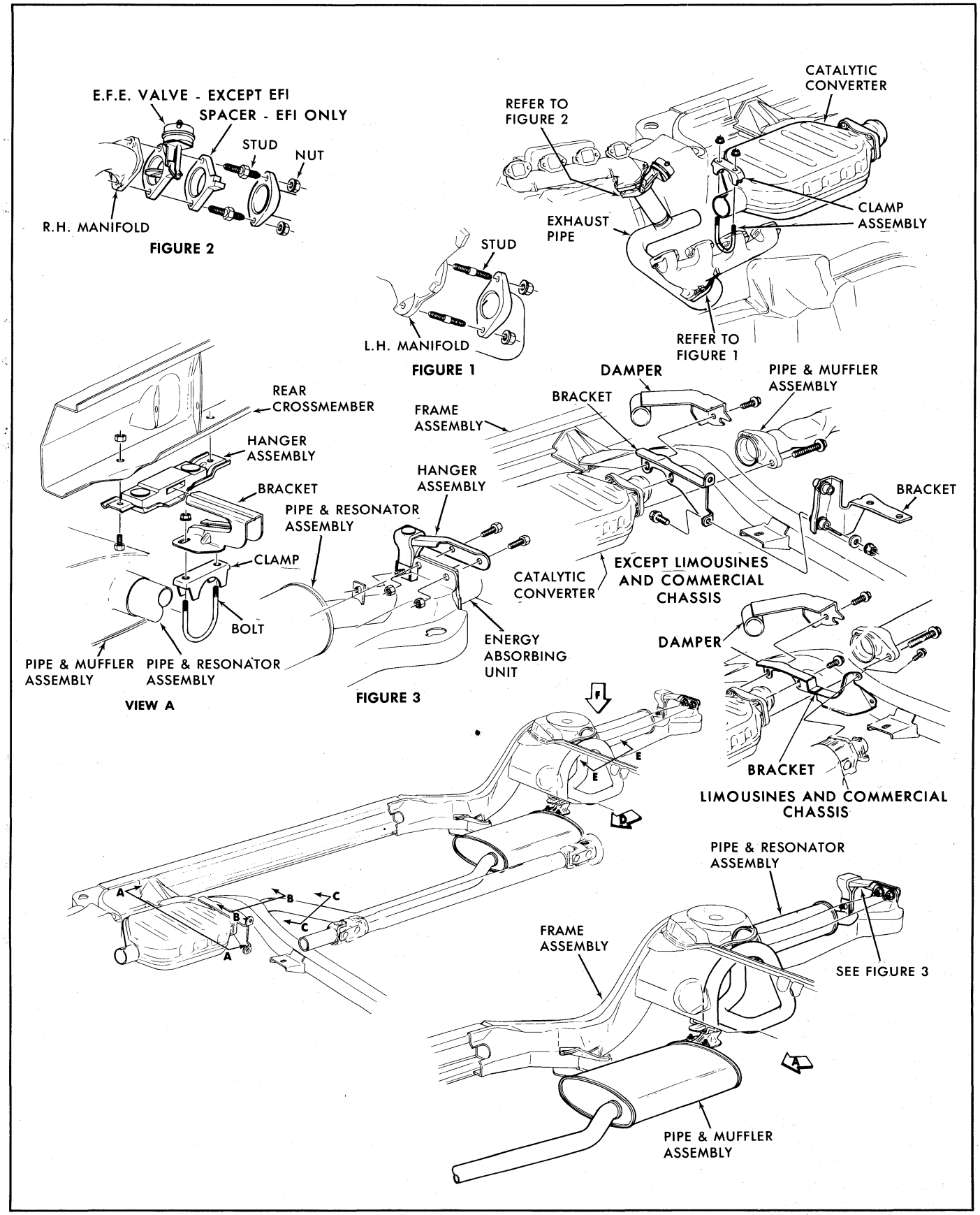


Fig. 6F-1 Exhaust System–Except Eldorado and Seville

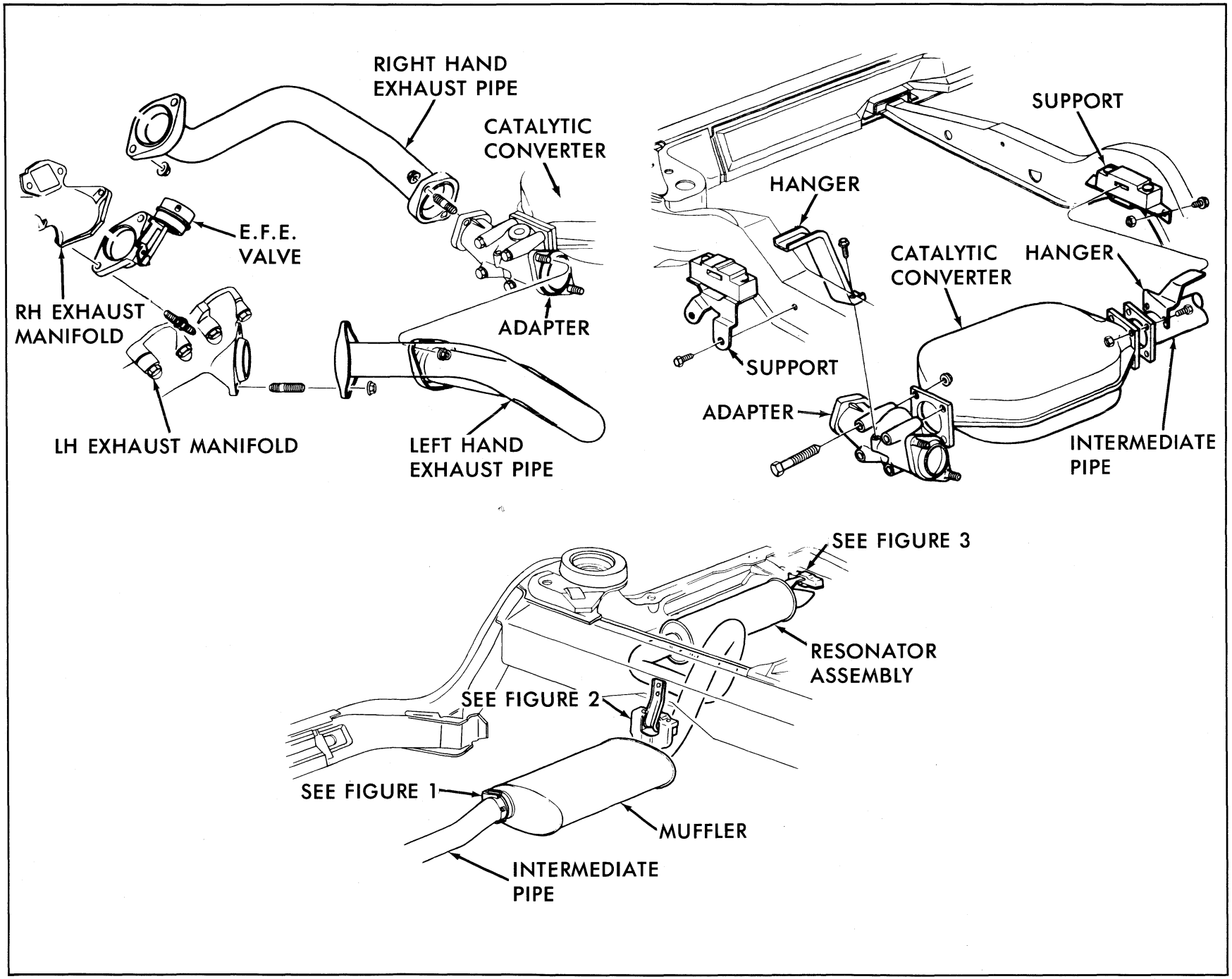
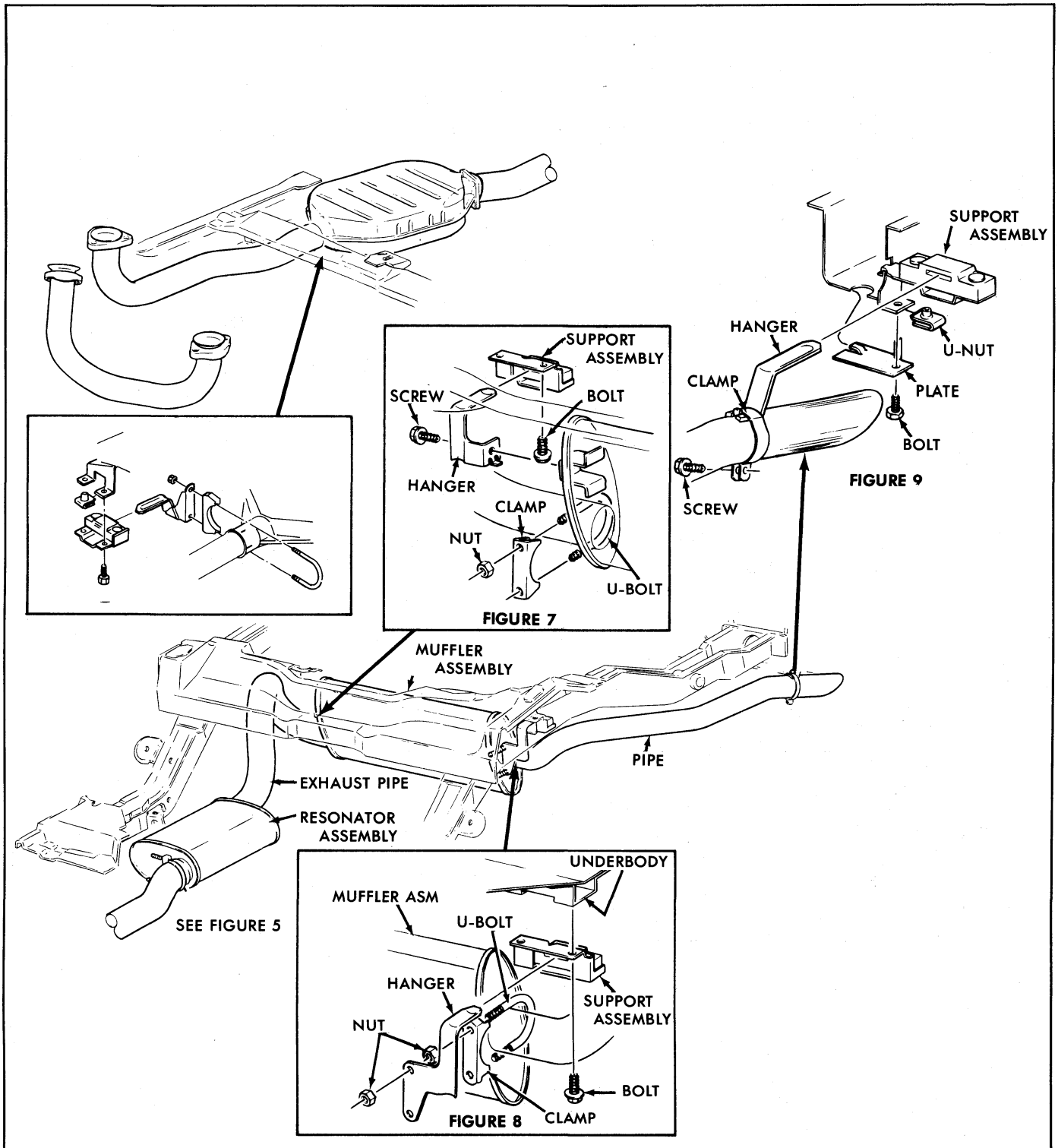


Fig. 6F-2 Exhaust System–Eldorado



EXHAUST SYSTEM

Fig. 6F-3 Exhaust System–Seville

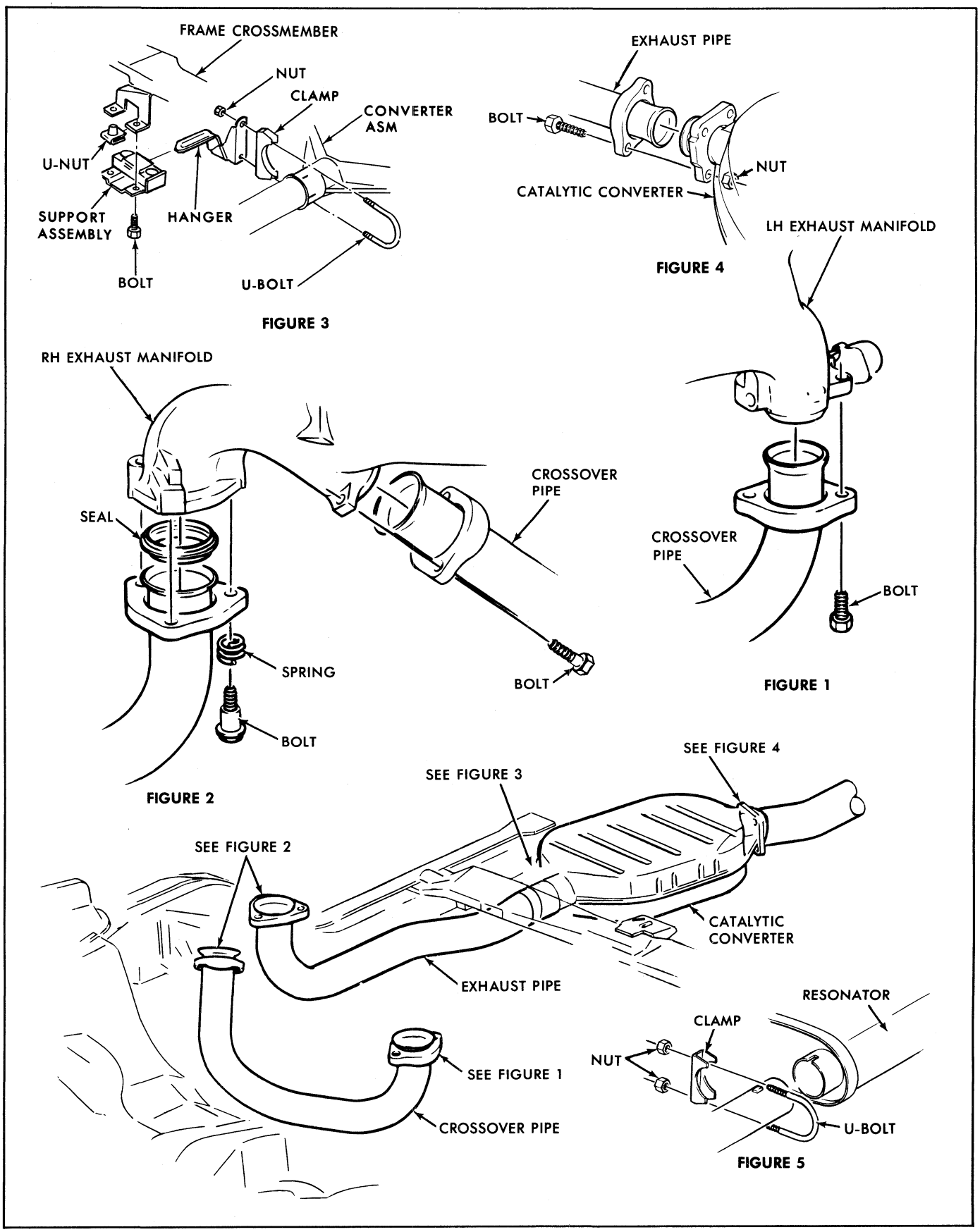


Fig. 6F-4 Exhaust System–Seville

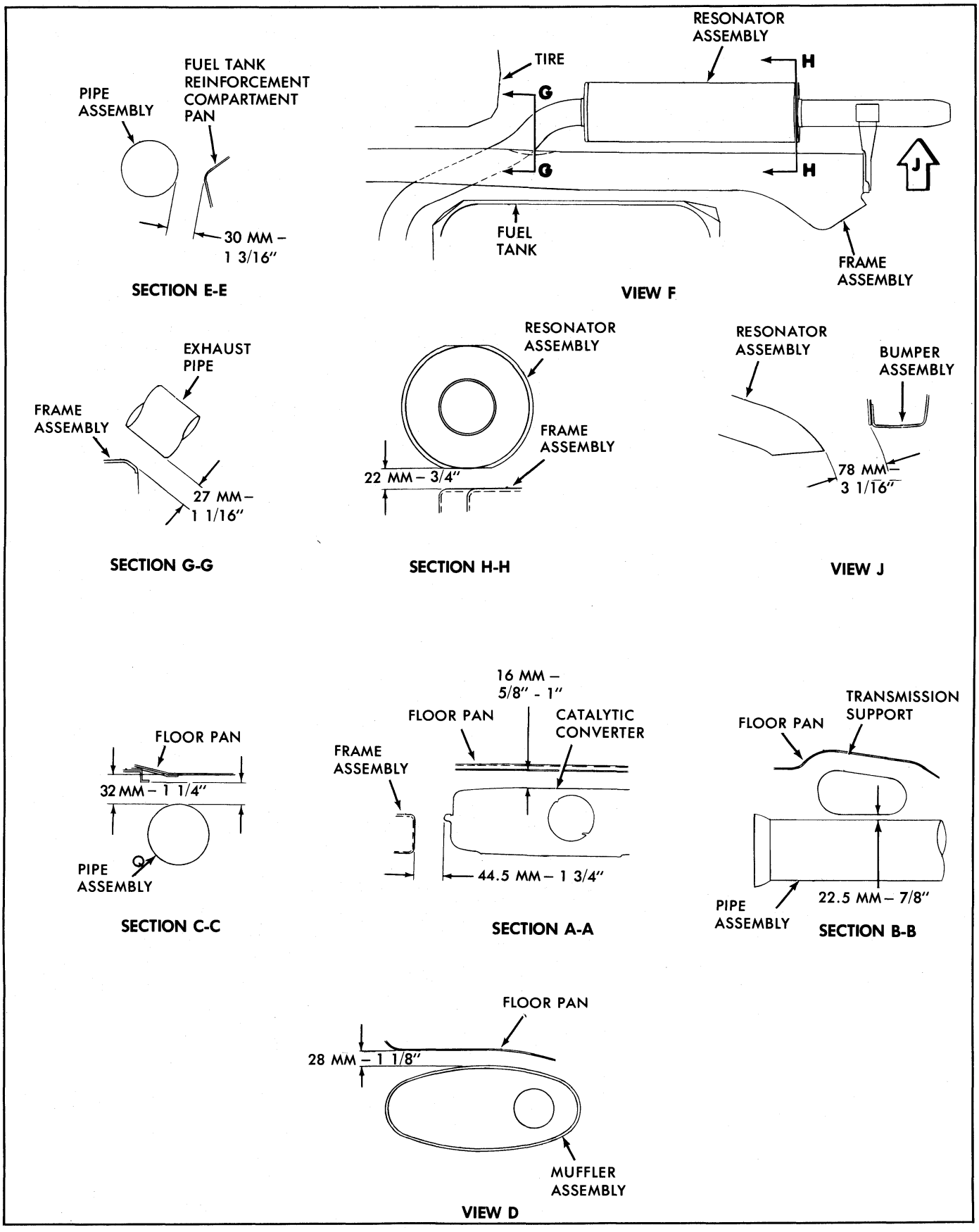


Fig. 6F-5 Exhaust System Clearances-Except Eldorado and Seville

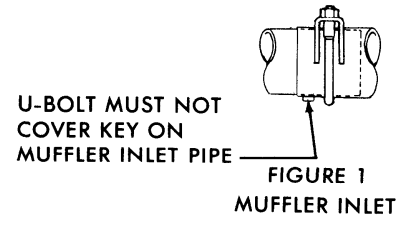
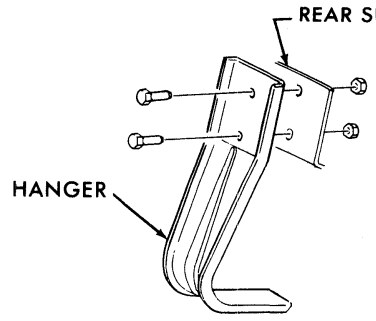


FIGURE 1
MUFFLER INLET



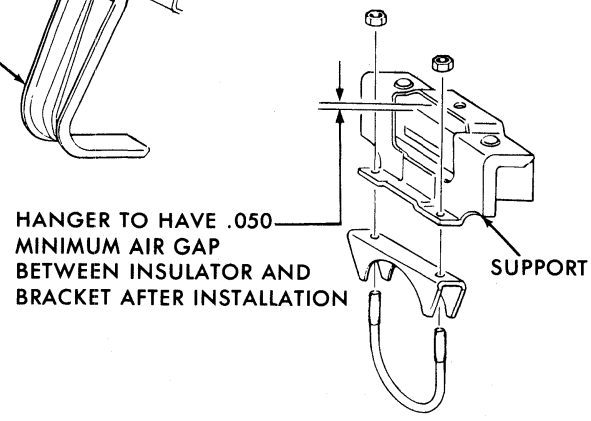


FIGURE 2
MUFFLER HANGER

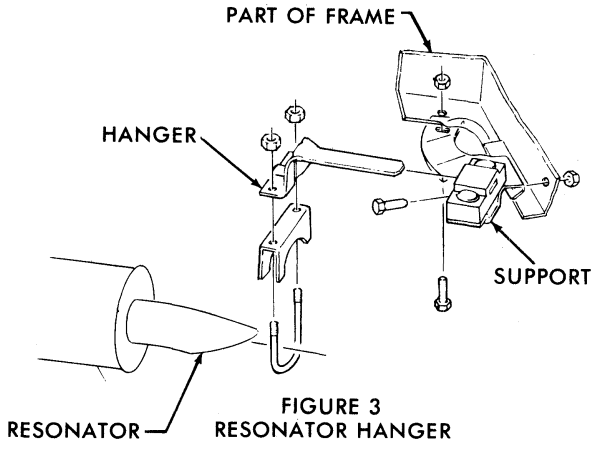
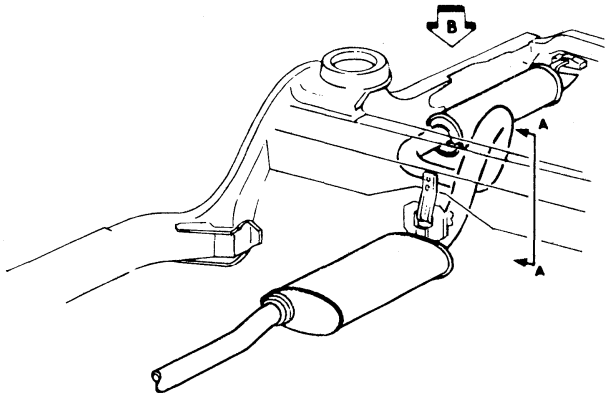
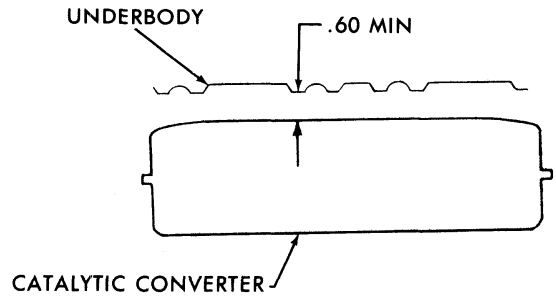
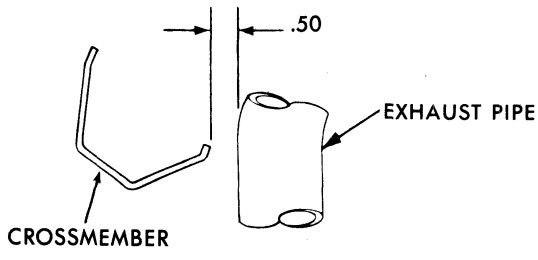


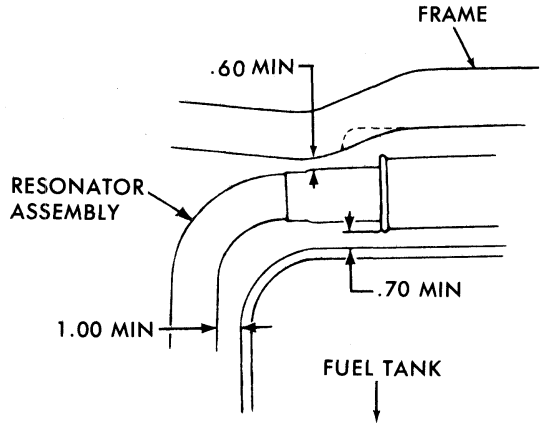
FIGURE 3
RESONATOR HANGER







SECTION A-A



VIEW B

Fig. 6F-6 Exhaust System Clearances-Eldorado

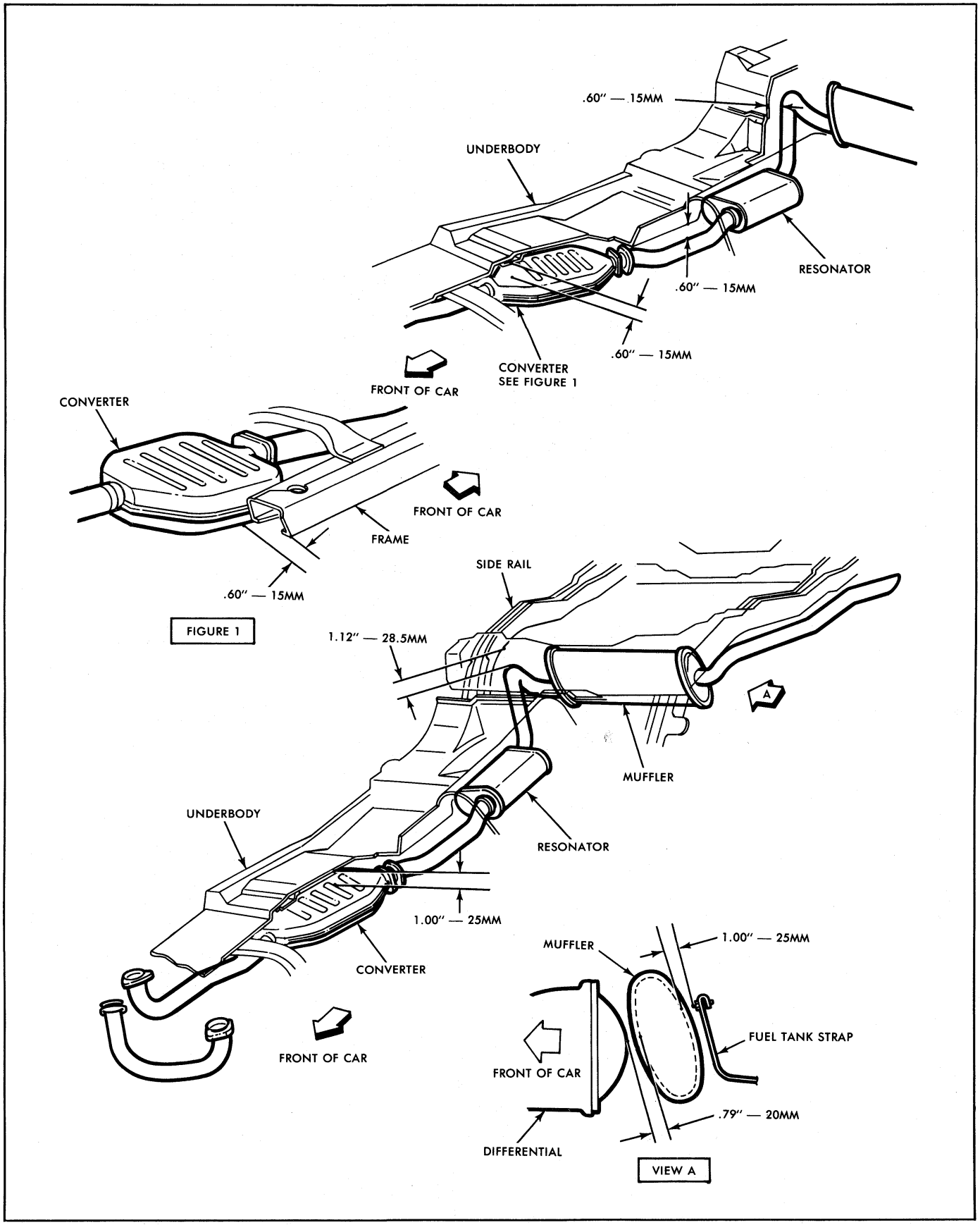


Fig. 6F-7 Exhaust System Clearances Seville

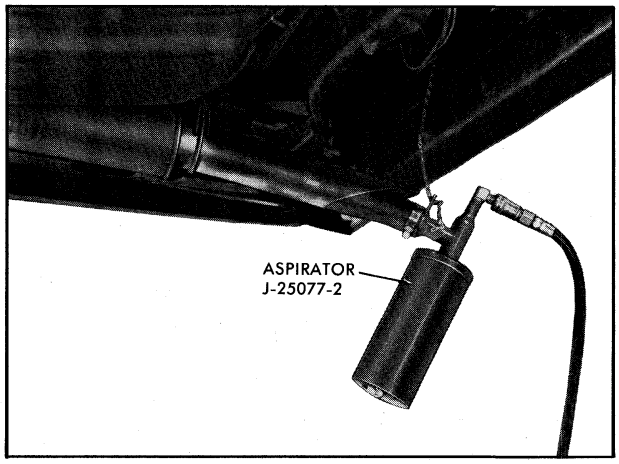


Fig. 6F-8 Installing Aspirator

Check entire system to see that there is adequate clearance with frame and body members - at least 5/8 inch (15 mm). Make sure that exhaust system components have at least 5/8 inch (15 mm) clearance from the floor pan to avoid possible overheating of the floor pan and possible damage to the passenger compartment carpets. The weight of the exhaust system should be evenly distributed on all brackets and hangers as indicated by an equal deflection at each hanger.

Catalyst Replacement-On Car

In the event catalyst replacement becomes necessary servicing should be limited to the following procedures.

a. Removal

1. Install aspirator and connect air supply to create a vacuum in the converter to hold beads in place when fill plug is removed, Fig. 6F-8.

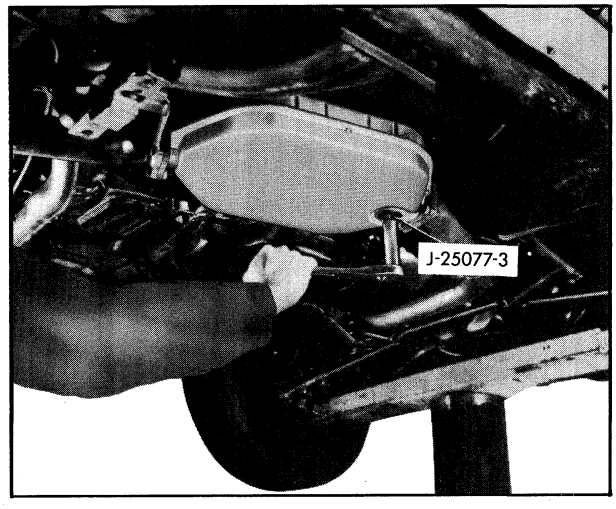


Fig. 6F-9 Removing Converter Fill Plug

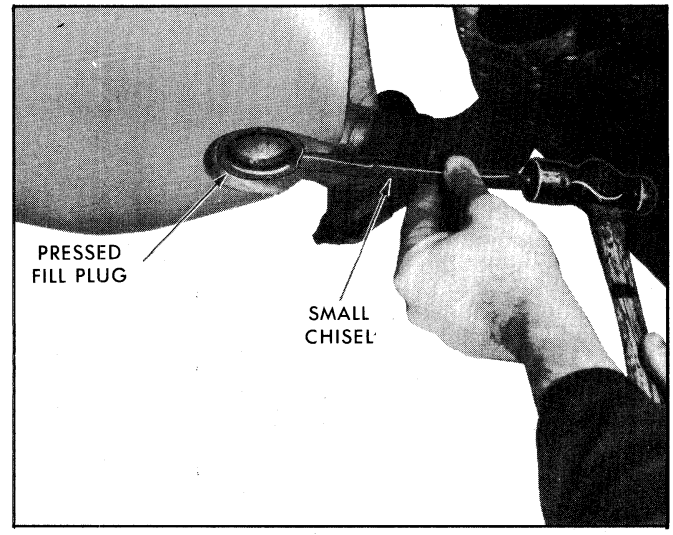


Fig. 6F-10 Deforming Filler Plug

NOTE: Separate hoses should be attached to the aspirator and the vibrator with maximum available pressure. Minimum of 60 psi in each hose.

2. Remove converter fill plug using one of the following methods depending on the type of filler plug.

a. Remove plug with 3/4" hex wrench or Tool No. J-25077-3, Fig. 6F-9.

b. Drive a small chisel between the converter shell and the fill plug. Use care not to damage converter shell, Fig. 6F-10. Continue to deform fill plug until it can be removed with pliers, Fig. 6F-11.

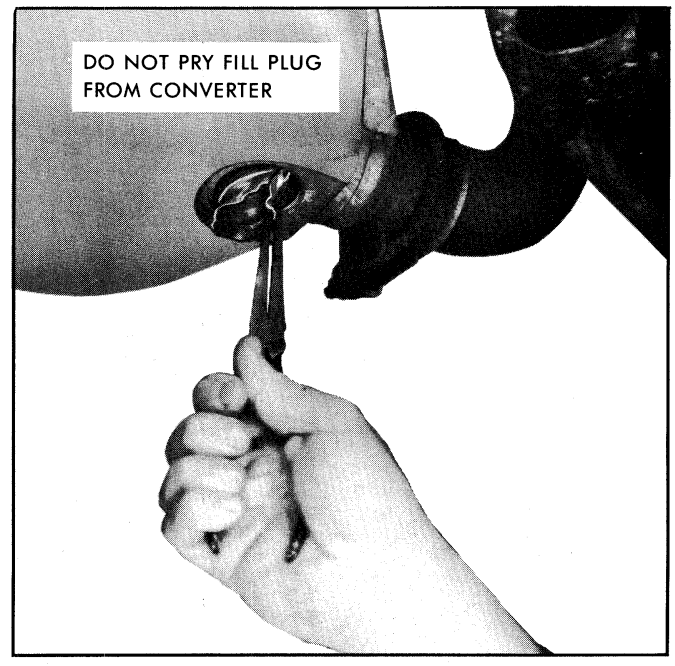


Fig. 6F-11 Removing Filler Plug

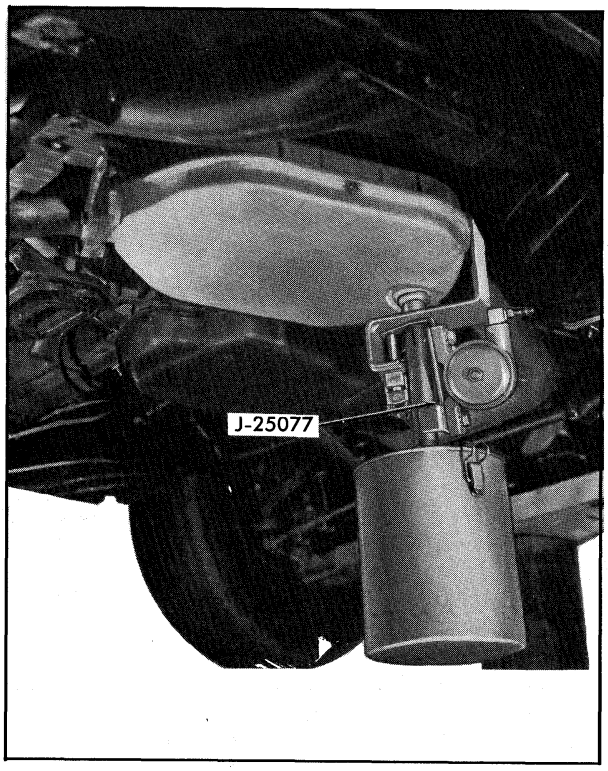


Fig. 6F-12 Installing Vibrator

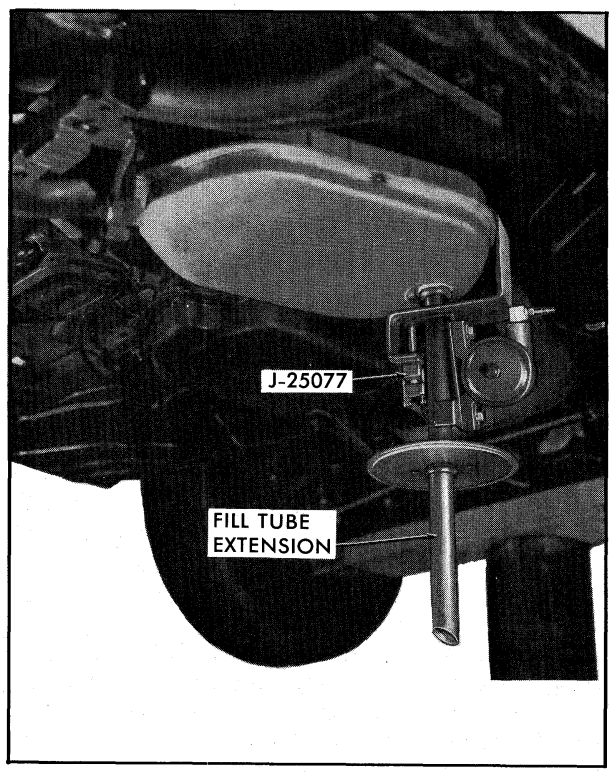


Fig. 6F-14 Fill Tube Extension

NOTE: Do not pry fill plug from converter, as damage to fill plug sealing surfaces could result.

3. Clamp on vibrator, Fig. 6F-12.
4. Install empty catalyst container to converter, Fig. 6F-13.

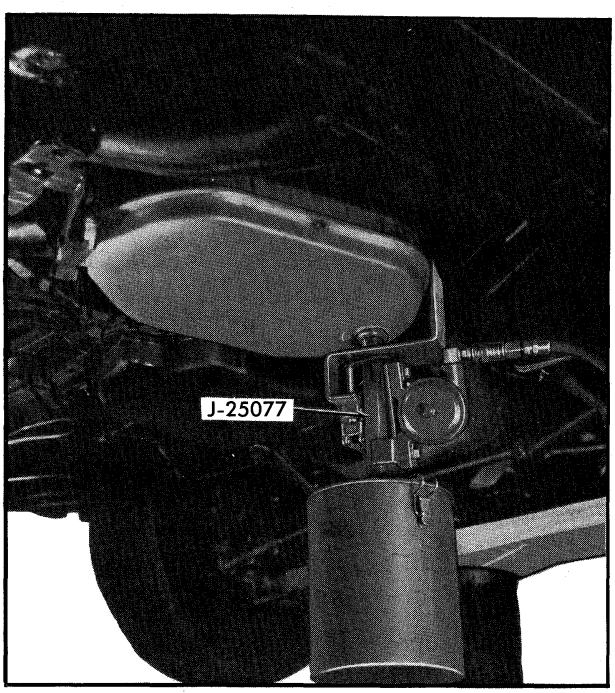


Fig. 6F-13 Removing Catalyst

5. Disconnect air supply to aspirator and connect air supply to vibrator. Catalyst will now drain from the converter into the empty container.
6. When all the catalyst has been removed from the converter, disconnect air supply to vibrator and remove container from the converter.
7. Discard used catalyst.

b. Installation

1. Fill container with approved replacement catalyst.
2. Install fill tube extension to the fixture, Fig. 6F-14.
3. Connect air supply to aspirator and vibrator.
4. Attach catalyst container to the fixture.

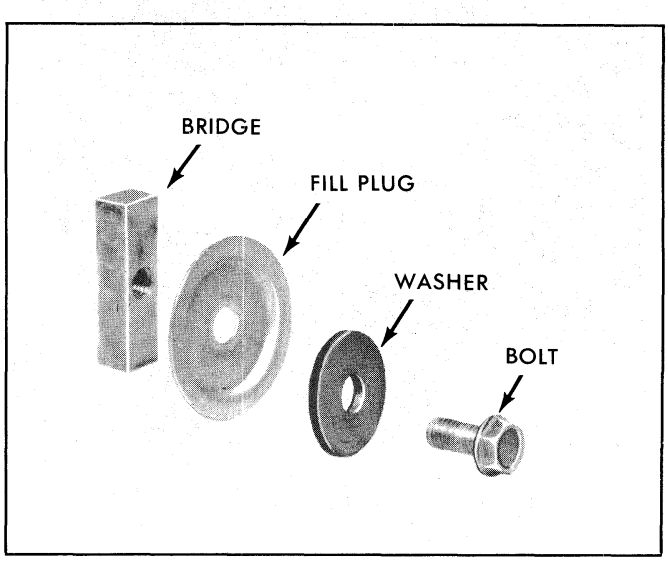


Fig. 6F-15 Service Fill Plug

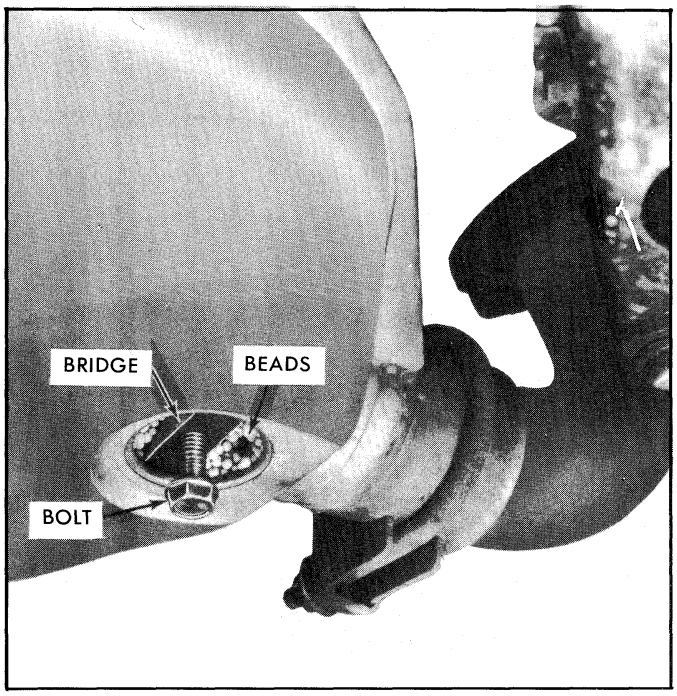


Fig. 6F-16 Positioning Fill Plug Bridge

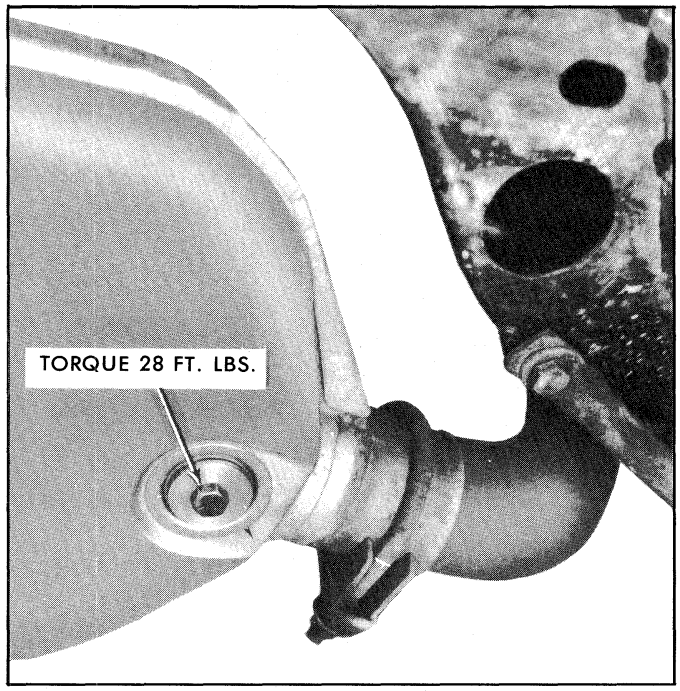


Fig. 6F-18 Fill Plug Installed

5. After the catalyst stops flowing, disconnect air supply to the vibrator.

6. Remove vibrator and check that catalyst has filled the converter flush with fill plug hole. Add catalyst if required.

7. If replacing reusable plug, apply an anti-seize compound to the fill plug, install and tighten to 50 ft. lbs.

8. Pressed plugs are replaced with a service fill plug, Fig. 6F-15, as follows:

a. Install the bolt into the bridge and position the bridge into the converter opening. Move bolt and bridge back and forth to dislodge catalyst beads until bridge is positioned as shown in Fig. 6F-16.

b. Remove bolt from bridge and install washer and fill plug, dished side out, over bolt.

c. While holding the fill plug and washer against the bolt head, Fig. 6F-17, thread the bolt 4 or 5 turns into the bridge. Release the fill plug, and the aspirator will pull the fill plug into position.

NOTE: If fill plug is allowed to seat against the converter before installing bolt, the threaded hole in the bridge will fill with beads and it will be difficult to start the bolt.

d. After making sure fill plug is correctly seated, tighten the bolt and torque to 28 ft. lbs., Fig. 6F-18.

8. Disconnect air supply to aspirator and remove.

9. Start car and check for leaks.

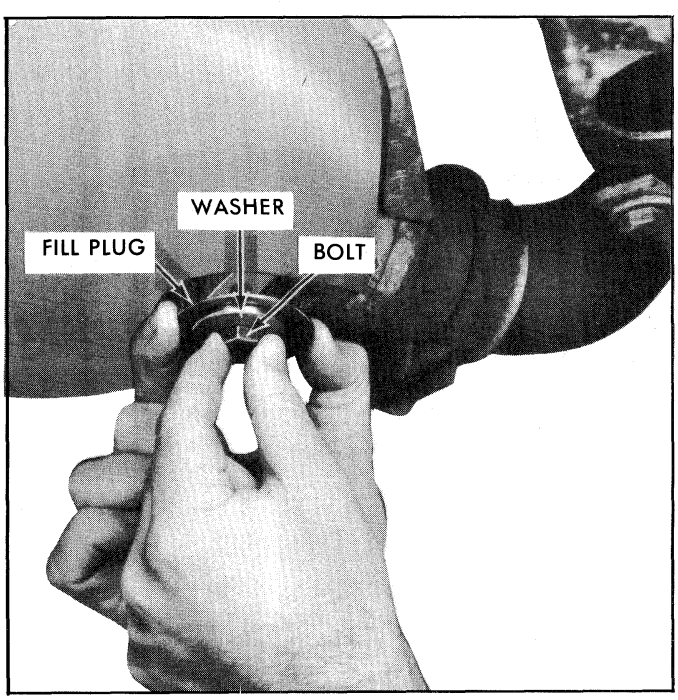


Fig. 6F-17 Installing Fill Plug

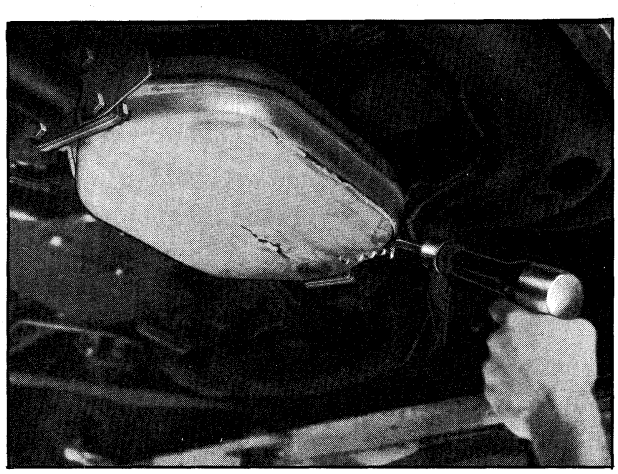


Fig. 6F-19 Removing Converter Bottom Cover-1

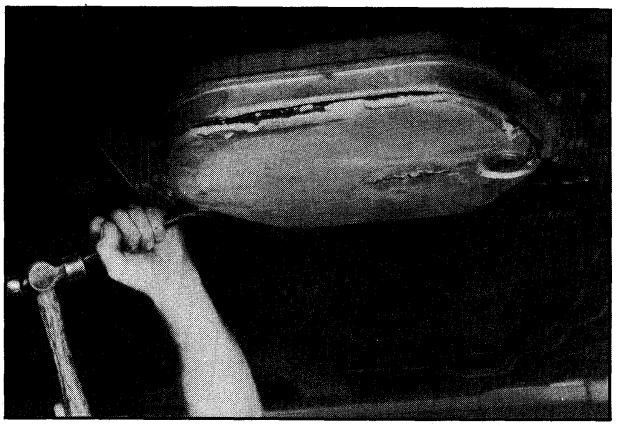


Fig. 6F-20 Removing Converter Bottom Cover-2

Catalytic Converter Bottom Cover Replacement

If the bottom cover of the catalytic converter is torn or severely damaged, the cover can be replaced on car with a repair kit.

1. Remove bottom cover by cutting close to the bottom outside edge, Figs. 6F-19 and 6F-20. Do not remove the fill plug. Depth of the cut must be very shallow to prevent damage to the inner shell of the converter.

2. Remove insulation, Fig. 6F-21.

3. Inspect inner shell of converter for damage. If there is damage in the inner shell, the converter assembly must be replaced.

4. Place new insulation in the replacement cover. Apply sealing compound, Part No. 8998245 or equivalent, all around the cover after the insulation is in position. Apply extra sealer at front and rear opening for the pipes.

5. Install replacement cover on converter, Fig. 6F-22.

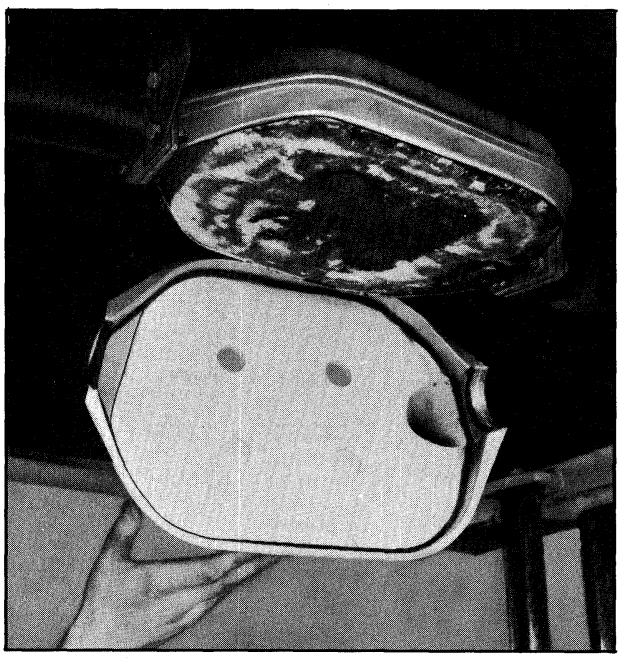


Fig. 6F-22 Installing Replacement Cover on Converter

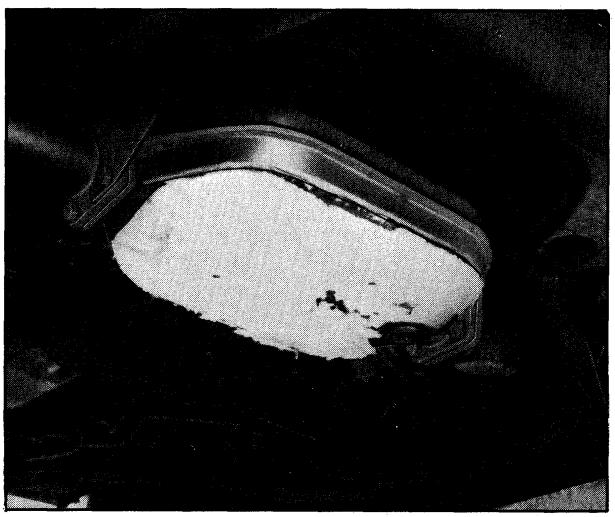
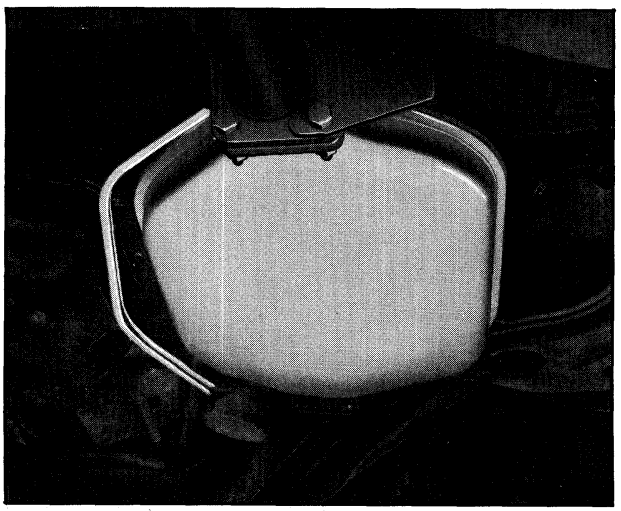


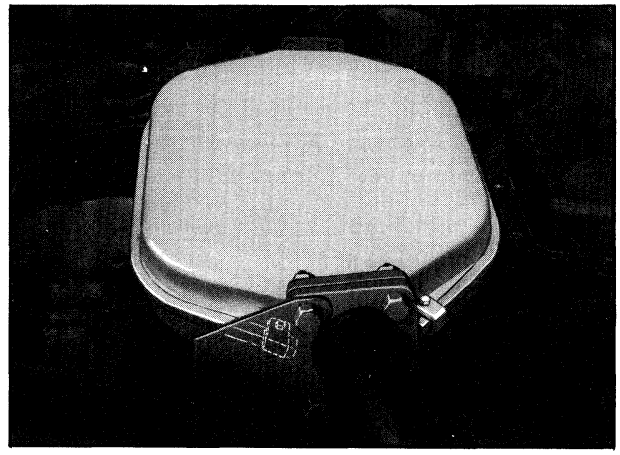
Fig. 6F-21 Removing Converter Insulation



6F-23 Installing Cover Retaining Channels

6. Install cover retaining channels on both sides of converter, Fig. 6F-23.

7. Attach four clamps over retaining channels, two clamps at each end of converter, Fig. 6F-24.



6F-24 Installing Clamps on Retaining Channels

TORQUE SPECIFICATIONS

Material Number	Application	Thread Size	Torque	
			Ft. Lbs.	N·m
286 M	Exhaust Manifold Stud Bolts—Except Seville	3/8 — 24	35	47
286 M	Exhaust Pipe to Manifold Nuts—Except Seville	3/8 — 24	30	40
280 M	Exhaust Pipe to Manifold Bolt—Seville	3/8 — 16	30	40
260 M	Crossover Pipe to R.H. Manifold Bolt—Seville	3/8 — 16	18	24
280 M	Crossover Pipe to L.H. Manifold Bolt—Seville	3/8 — 16	30	40
	Exhaust Y-Pipe to Converter Clamp Nut—			
	Except Eldorado and Seville		35	47
286 M	Exhaust Pipe to Adapter Nut—Eldorado	3/8 — 16	30	40
	Adapter to Converter—Eldorado		35	47
280 M	Exhaust Pipe to Converter Bolt—Seville	3/8 — 16	30	40
	Converter to Outlet Pipe—			
	Except Eldorado and Seville		18	24
	Eldorado		35	47
280 M	Seville	3/8 — 16	30	40
286 M	Muffler/Resonator Clamp Nuts	3/8 — 16	35	47
	Tail Pipe Hanger Screw/Nut—			
	Except Eldorado and Seville		120 in. lbs.	13
300 M	Eldorado (Clamp)		35	47
286 M	Seville	3/8 — 16	30	40
6010 M	Exhaust System Hanger Screw	20 — 9	10	13

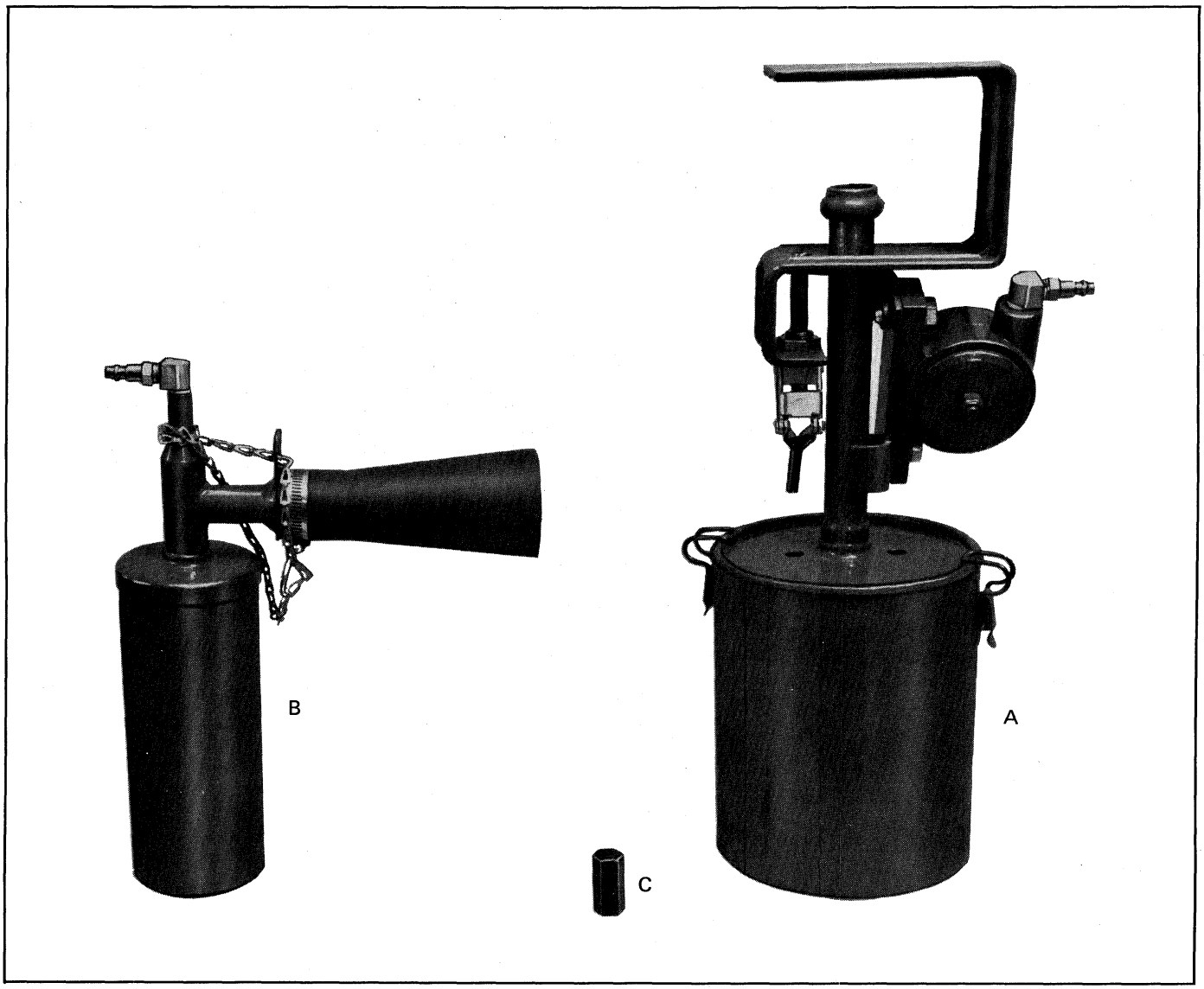


Fig. 6F-25 Special Tools

Key	Tool No.	Name
A	J-25077	Vibrator
B	J-25077-2	Aspirator
C	J-25077-3	Filler Plug Remover

TRANSMISSION
TABLE OF CONTENTS

General Description - Transmission 400 ..... 7A-1
Diagnosis 7A-2
Preliminary Checking Procedure 7A-3
Downshift Solenoid Circuit Check (C-Car and Seville) 7A-19
Oil Leaks 7A-20
On-Car Service 7A-24
Manual Linkage Adjustment (C-Car and Seville) 7A-24
Transmission Downshift Switch (C-Car and Seville). 7A-25
Checking and Adding Fluid 7A-26
Units That Can Be Removed with Transmission in Car 7A-27
Transmission Removal and Installation 7A-30
Governor Removal and Installation 7A-32
Lateral Strut Rod R&I - (Seville) 7A-32
Unit Overhaul 7A-33
Converter 7A-33
Front Unit End Play Checking Procedure 7A-36
Rear Unit End Play Checking Procedure 7A-37
Transmission Disassembly, Cleaning, Inspection and Assembly of Individual Units 7A-40
Forward Clutch Assembly - Disassembly 7A-49
Direct Clutch Assembly - Disassembly 7A-52
Major Transmission Components - Installation 7A-60
Transmission Case Repairs 7A-69
Bushing Service 400 - 425 ..... 7A-72
Specifications 7A-70
General Description Transmission 425 Eldorado 7B-1
Diagnosis 7B-3
Downshift Solenoid Circuit Check 7B-3
Oil Leaks 7B-3
On-Car Service 7B-8
Manual Linkage Adjustment 7B-8
Checking and Adding Fluid 7B-8
Transmission Removal and Installation 7B-10
Unit Overhaul 7B-13
Specifications 7B-47

GENERAL DESCRIPTION

TRANSMISSION

A modified model 400 Turbo Hydra-Matic transmission with a shorter output shaft and extension housing is used on 1977 C-cars. Due to the difference in axle ratios and fuel systems, there are nine different transmissions used on 1977 Cadillac cars.

Refer to the 1973 shop manual for information pertaining to theory of operation, hydraulic system description, valve and hydraulic control functions and oil circuit diagrams.

The Turbo Hydra-matic transmission is a fully automatic unit consisting primarily of a 3-element hydraulic torque converter and a compound planetary gear set. Three multiple-disc clutches, two roller clutch units, and two bands provide the friction elements required to obtain the desired functions of the compound planetary gear set, Fig. 7A-1 and 7A-2.

The torque converter, the clutches, and roller clutches, couple the engine to the planetary gears through oil pressure, providing three forward speeds and reverse. The torque converter, when required, will supplement the gears by multiplying engine torque.

The torque converter is of welded construction and is serviced as an assembly. The unit is made up of two vaned sections, or halves, that face each other in an oil filled housing. The pump half of the converter is connected to the engine and the turbine half is connected to the transmission.

When the engine makes the converter pump revolve, it sends oil against the turbine, making it revolve also. The oil then returns in a circular flow back to the converter pump, continuing this flow as long as the engine is running.

The converter also has a smaller vaned section, called a stator, that funnels the oil back to the converter pump through smaller openings, at increased speed. The speeded up oil directs additional force to the engine-driven converter pump, thereby multiplying engine torque.

A hydraulic system pressurized by an internal-external type gear pump provides the working pressure required to operate the friction elements and automatic controls.

External control connections to the transmission are:

Manual Linkage - To select the desired operating range.

Engine Vacuum - To operate a vacuum modulator unit.

12 Volt Electrical Signals - To operate an electrical detent solenoid.

Gear or torque ratios of the transmission are as follows:

First = 2.48:1 gear ratio
Second = 1.48:1 gear ratio
Third = 1.0:1 gear ratio
Reverse = 2.08:1 gear ratio

Each gear ratio can be multiplied by as much as 2, depending upon the slip speed of the converter pump and turbine.

A vacuum modulator is used to sense engine torque input to the transmission automatically. The vacuum modulator transmits this signal to the pressure regulator, which controls line pressure, so that all torque requirements of the transmission are met and proper shift spacing is obtained at all throttle openings.

The detent solenoid is activated by a switch at the carburetor. When the throttle is opened sufficiently to close this switch, the solenoid in the transmission is activated, causing a downshift at speeds below approximately 70 miles per hour. At lower speeds, downshifts will occur at lesser throttle openings without use of the switch.

The oil cooler is located in the right hand tank of the radiator. The transmission is cooled by directing oil from the converter to the radiator. Oil returning from the radiator feeds the transmission lubrication system.

The oil system incorporates an intake pipe and filter assembly. The filter assembly should be replaced after 100,000 miles of use under normal operating conditions. It should be replaced after the first 50,000 miles if heavy duty operation is encountered, such as constant use in heavy metropolitan traffic, pulling trailers, etc. In addition, replace filter assembly when a major transmission failure occurs and flush the oil cooler and cooler lines. This is particularly important in the case of a converter failure.

The transmission quadrant has six selector positions,

that enable the driver to control the operation of the transmission under various driving conditions. The six selector positions appear on the quadrant in the following sequence, from left to right; P-park, R-reverse, N-neutral, DRIVE left, DRIVE right (intermediate) and L-lo.

P - Park position positively locks the output shaft to the transmission case by means of a locking pawl and prevents the vehicle from rolling either forward or backward. For this reason, it is recommended that the engine be started with transmission selector lever in Park position. If it is necessary to re-start the engine with the car rolling, place selector lever in Neutral.

R - Reverse enables the vehicle to be operated in a reverse direction.

N - Neutral position enables the engine to be started and run without driving the vehicle. It is recommended that Neutral be used to start the engine only if it is necessary to re-start the engine with the car rolling. At all other times Park should be used.

Drive (left) - is used for all normal driving conditions and maximum economy. Drive (left) has three gear ratios from starting to direct drive. Downshifts are available for safe passing, by depressing the accelerator pedal.

Drive (right) - adds performance for congested traffic or hilly terrain. This range has the same starting ratio as Drive (left), but prevents the transmission from shifting above second speed to retain acceleration when extra performance is desired. Engine braking is provided in this range.

L - Lo range permits operation at the lowest ratio, and should be used where only the lowest gear ratio is desired, such as in pulling a heavy load or descending a steep grade. When selector lever is moved from Drive to Lo range at normal highway speeds, the transmission will shift to second gear and remain in second gear until vehicle speed is reduced to approximately 45 mph. The transmission will then shift to first gear and remain in first gear regardless of vehicle or engine speed, until selector lever is moved back into either of the Drive positions.

1977 transmission models and their applications are listed below:

Engine	DeVILLE & BROUGHAM Axle Ratio	DeVILLE & BROUGHAM Trans. Model	LIMOUSINE & COMMERCIAL Axle Ratio	LIMOUSINE & COMMERCIAL Trans. Model	SEVILLE Axle Ratio	SEVILLE Trans. Model
Carb. Exc. California	2.28:1 Std. 3.08:1 Opt.	AA AD	3.08:1 Std. No Option	AD	— —	— —
E.F.I. Exc. California	2.28:1 Std. 3.08:1 Opt.	AB AD	N.A.		2.56 Std. 3.08 Opt.	AC AH
Carb. California	2.73:1 Std. 3.08:1 Opt.	AD AD	3.08:1 Std. No Option	AD	— —	— —
E.F.I. California	2.73:1 Std. 3.08:1 Opt.	AE AE	N.A.		2.56 Std. 3.08 Opt.	AC AH
Carb. — High Altitude	3.08:1 Std. No Option	AL	3.08:1 Std. No Option	AL	— —	— —
E.F.I. — High Altitude	3.08:1 Std. No Option	AD	N.A.		3.08 Std. No Option	AH

DIAGNOSIS

Turbo Hydra-Matic 400 Diagnosis Procedure

NOTE: The following information, unless specifically noted elsewhere, is applicable to the Eldorado. See Page 7B-1.

CAUTION: *In the event of a major transmission malfunction, replace filter assembly, flush oil cooler and lines before installing new fluid. This is particularly important in the case of a converter or pump malfunction.*

This Diagnosis Guide should be used in the following sequence to positively locate the problem:

1. Perform the "Preliminary Checking Procedure" on Page 7A-6 recording the readings in the Oil Pressure Reading row. After taking the pressure readings, place Low, Normal or High in each box of the Oil Pressure Pattern row.

2. Road test the car as described in Part B if problem is not known.

3. Refer to the "Transmission Malfunction Related to Oil Pressure" chart on Page 7A-9. First determine if malfunction noted is in this chart. If so, compare Oil Pressure Pattern row on Page 7A-6 and Page 7A-9. A dash on the "Transmission Malfunction Related to Oil Pressure" chart means that the oil pressure reading has no significance under the test condition.

If transmission malfunction is found in this chart, follow the directions indicated in the Malfunction column. The oil pressure pattern will indicate where the malfunction is.

Upshift	C-Car Maximum	Seville Maximum
1-2	15 mph	15 mph
2-3	30 mph	28 mph
Upshift	**Maximum**	**Maximum**
1-2	44-48 mph	50 mph
2-3	77-83 mph	83 mph
Detent Downshifts	**Minimum**	**Minimum**
3-2	68-73 mph	65 mph
2-1	28-32 mph	24 mph

The only time it is necessary to determine a pressure drop (the control valve assembly-governor line pressure check, part b) is when there is "No 1-2 Upshift and/or Delayed Upshift" and all oil pressure readings are normal.

It will not be necessary to repeat oil pressure readings taken during preliminary checks should this be called for during further tests.

4. If malfunction cannot be determined by the chart on Page 7A-9, or if upon completion of these tests, it is not found, see the "Transmission Troubleshooting Guide", starting with Part C to locate malfunction not related to oil pressure.

All malfunctions, both those related to oil pressure and those that are not, are listed in the "Transmission Troubleshooting Guide". Always perform the "Preliminary Checking Procedure" first as it provides a positive means to isolate the problem if the malfunction can be diagnosed by this procedure.

5. After correcting malfunction, road test car as described in Part B Transmission Road Testing.

NOTE: This information pertains to all Cadillac transmissions. For additional illustrations on the Eldorado transmission, see the later portion of this section.

A. Preliminary Checking Procedure

Perform checking procedure shown on Part a.

B. Transmission Road Testing

1. Connect portable tachometer to engine. Engine rpm will identify shift points.

2. Place selector in "Drive Left" position and accelerate the vehicle from rest at a minimum throttle opening. The specifications for shift points are:

Downshifts should occur (3-2 and 2-1) as the vehicle speed decreases to 0 mph. Stop car.

3. Place selector in "Drive Right" position and accelerate the vehicle from rest. A 1-2 shift should occur at all throttle openings. No 2-3 shift can be obtained in this range. Stop car.

4. Place selector in "Low". No upshift should occur in this range regardless of the throttle opening.

5. Position the selector in "Drive Left" and accelerate the vehicle to 35 mph and move the selector to "Drive Right". A 3-2 downshift should occur, increasing the engine rpm and an engine braking effect should be noticed on deceleration.

6. With the selector in "Drive Right" at approximately 25 mph, but not over 40 mph, at closed throttle, move the selector to "Low". A 2-1 downshift should occur, increasing the engine rpm and an engine braking effect should be noticed on deceleration. Stop car.

7. Place selector in "Reverse" and check for reverse operation.

E.G.R. SYSTEM

With Exhaust Gas Recirculation (EGR), the throttle is open enough in "Drive" range 1000 rpm to cause the EGR valve to open. When the EGR valve opens, exhaust gas enters the intake manifold which lowers intake manifold vacuum. When intake manifold vacuum is lowered, the transmission line oil pressure raises accordingly, and may go above the upper specification limit. For this reason, if high line pressures are obtained, proceed as follows:

1. Disconnect the EGR vacuum line at the EGR valve and plug the vacuum line.

2. Recheck line pressures as indicated on the Preliminary Checking Procedure Chart on Page 7A-6.

3. If high line pressures are still obtained, it may be that the engine is not producing enough vacuum to lower transmission line pressure within specifications. The newer engines with emission controls characteristically have lower engine vacuum than older past model engines. To obtain line pressures suitable for evaluation, it is recommended that vacuum be applied to the modulator, using an external vacuum source such as J-23738 hand operated vacuum device or its equivalent. The unit allows definite amounts of vacuum to be applied to the modulator so that consistent line pressures may be obtained for evaluation as follows:

1. Disconnect the vacuum hose to the modulator at the modulator and plug the vacuum hose.

2. Attach the hand operated vacuum device and apply 20" of vacuum.

3. Recheck line pressures according to the Preliminary Checking Procedure Chart, on Page 7A-6.

4. If line pressures are still high, proceed to the specific diagnosis chart that applies to the malfunction encountered.

5. If line pressures are normal with external vacuum applied, check engine vacuum and vacuum systems for leaks.

C. Cause of Low Line Pressure

1. Low Transmission Oil Level.

2. Modulator Assembly see Part V.

3. Filter.

A. Blocked or restricted.*

B. "O" Ring on intake pipe and/or grommet omitted or damaged.

C. Split or leaking intake pipe.

D. Wrong filter assembly.

4. Pump.

A. Pressure regulator or boost valve stuck.

B. Gear clearance, damaged worn. (Pump will become damaged if drive gear is installed backwards, or if converter pilot does not enter crankshaft freely).

C. Pressure regulator spring, too weak.

D. Not enough spacers in pressure regulator.

E. Pump to case gasket mispositioned.

F. Malfunctioning pump body and/or cover.

G. Mismatch pump cover/pump body.

5. Internal Circuit Leaks.

A. Forward clutch leak (pressure normal in neutral and reverse-pressure low in drive).

1. Check pump rings.

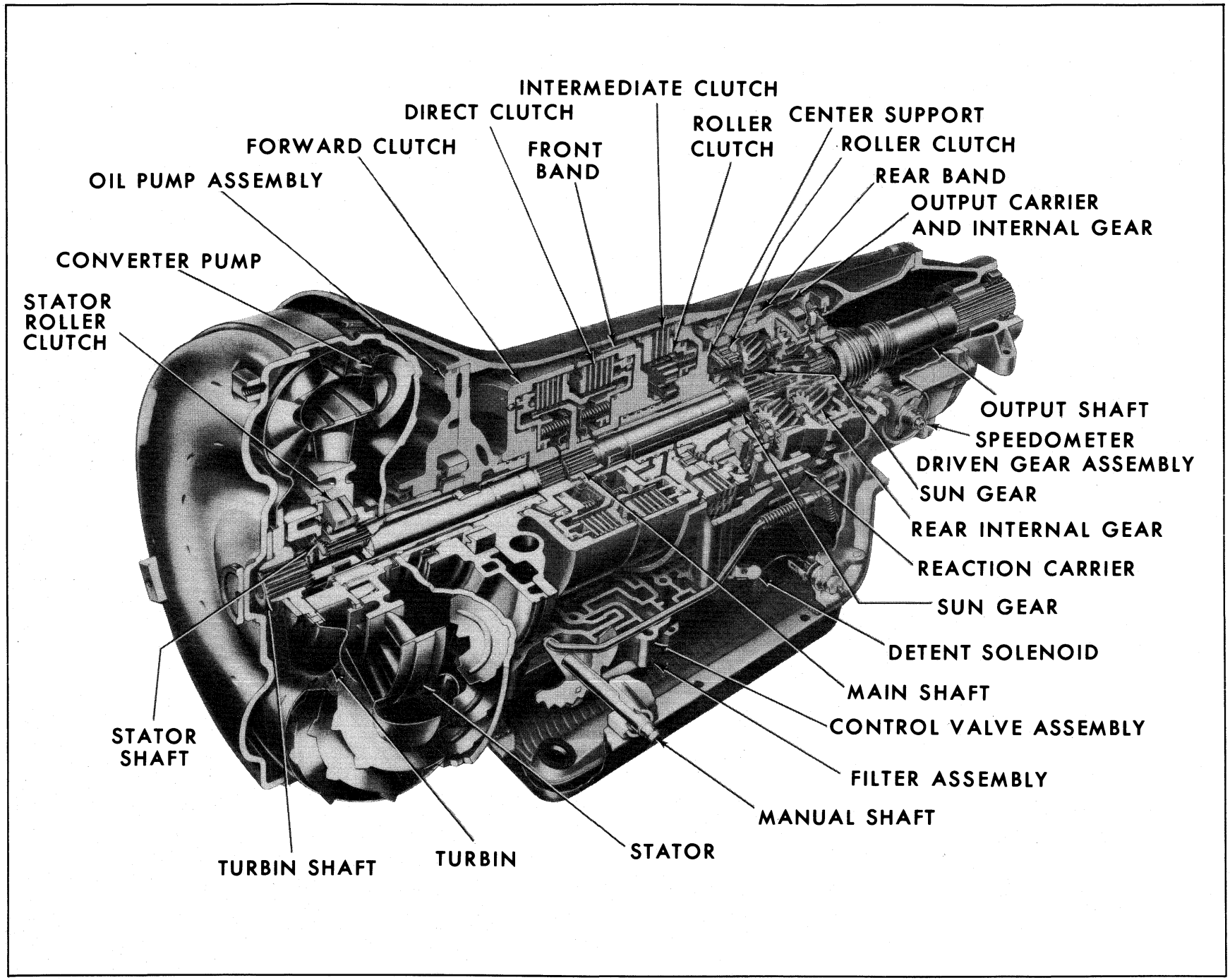
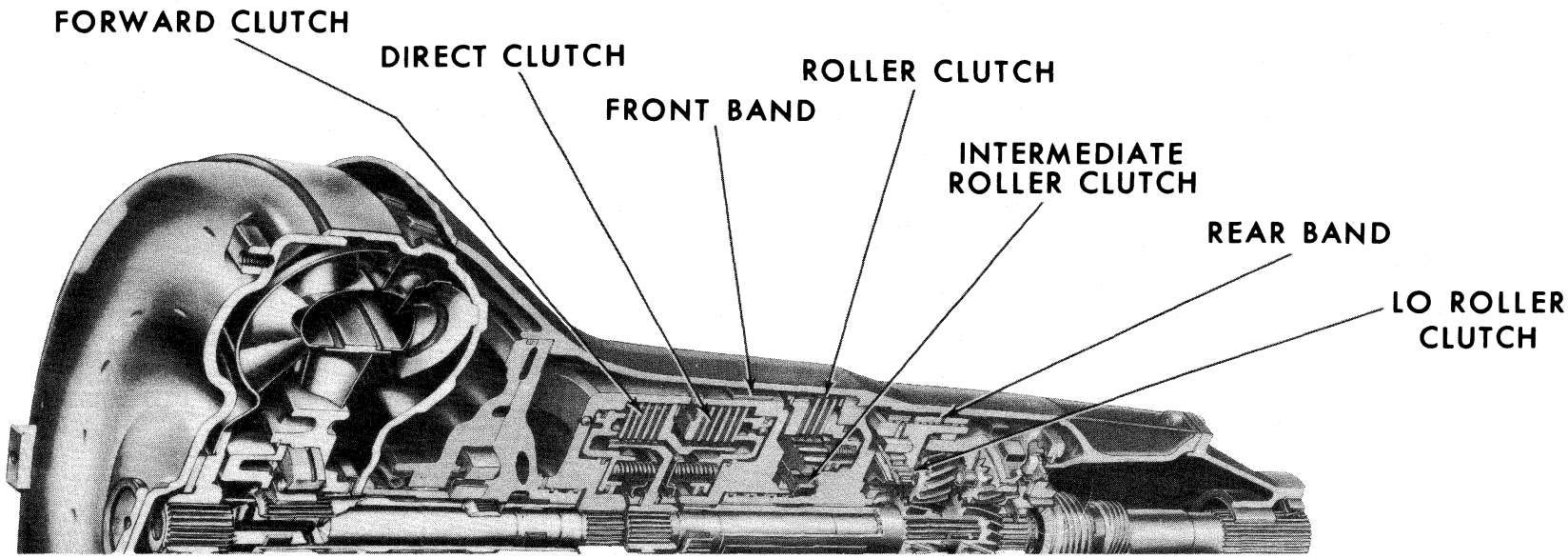


Fig. 7A-1 400 Turbo Hydra-matic Transmission Cutaway View



RANGE	GEAR	FORWARD CLUTCH	DIRECT CLUTCH	FRONT BAND	INT. CLUTCH	INT. ROLLER CLUTCH	LO ROLLER CLUTCH	REAR BAND
PARK–NEUT.		OFF	OFF	OFF	OFF	INEFFECTIVE	INEFFECTIVE	OFF
DRIVE	FIRST	ON	OFF	OFF	OFF	INEFFECTIVE	EFFECTIVE	OFF
	SECOND	ON	OFF	OFF	ON	EFFECTIVE	INEFFECTIVE	OFF
	THIRD	ON	ON	OFF	ON	INEFFECTIVE	INEFFECTIVE	OFF
INT.	FIRST	ON	OFF	OFF	OFF	INEFFECTIVE	EFFECTIVE	OFF
	SECOND	ON	OFF	ON	ON	EFFECTIVE	INEFFECTIVE	OFF
LO	FIRST	ON	OFF	OFF	OFF	INEFFECTIVE	EFFECTIVE	ON
	SECOND	ON	OFF	ON	ON	EFFECTIVE	INEFFECTIVE	OFF
REV.		OFF	ON	OFF	OFF	INEFFECTIVE	INEFFECTIVE	ON

Fig. 7A-2 Band, Roller Clutch and Clutch Application Chart

DIAGNOSIS

PRELIMINARY CHECKING PROCEDURE

CHECK TRANS. OIL LEVEL (See Page 7A-26.)

CHECK OUTSIDE MANUAL LINKAGE AND CORRECT (See Page 7A-24.)

CHECK ENGINE TIMING AND IDLE (See Section 6-C & 6-D.)

CAUTION: TOTAL RUNNING TIME FOR THIS COMBINATION NOT TO EXCEED 2 MINUTES.

INSTALL OIL PRESSURE GAGE (See Fig. 7A-3)

CONNECT TACHOMETER TO ENGINE

CHECK OIL PRESSURES IN FOLLOWING MANNER

	RANGE	OIL PRESSURE READING	NORMAL P.S.I.	OIL PRESSURE PATTERN LOW–NORMAL–HIGH
1	NEUTRAL–BRAKES APPLIED ENGINE AT 1000 RPM		55 TO 70	
2	DRIVE IDLE SET ENGINE IDLE TO SPECIFICATIONS		60 TO 85	
3	DRIVE LEFT–BRAKES APPLIED ENGINE AT 1000 RPM		60 TO 90*	
4	DRIVE RIGHT OR LO–BRAKES APPLIED ENGINE AT 1000 RPM		135 TO 160*	
5	REVERSE–BRAKES APPLIED ENGINE AT 1000 RPM		95 TO 150*	
6	DRIVE LEFT–BRAKES APPLIED ENGINE AT 1000 RPM DOWNSHIFT SWITCH ACTIVATED		90 TO 110	
7	GOVERNOR CHECK–FOR UPSHIFT PROBLEM SEE PROCEDURE, Page 7A-3.		DROP OF 10 PSI OR MORE	
8	DRIVE – 30 MPH – CLOSED THROTTLE ON ROAD, OR ON HOIST**		55 TO 70	

* IF HIGH LINE PRESSURES ARE EXPERIENCED, SEE PAGE 7A-7.

** VEHICLE ON HOIST, DRIVING WHEELS OFF GROUND, SELECTOR IN DRIVE, BRAKES RELEASED, RAISE ENGINE TO 3000 R.P.M., CLOSE THROTTLE AND READ PRESSURE BETWEEN 2000 AND 1200 R.P.M.

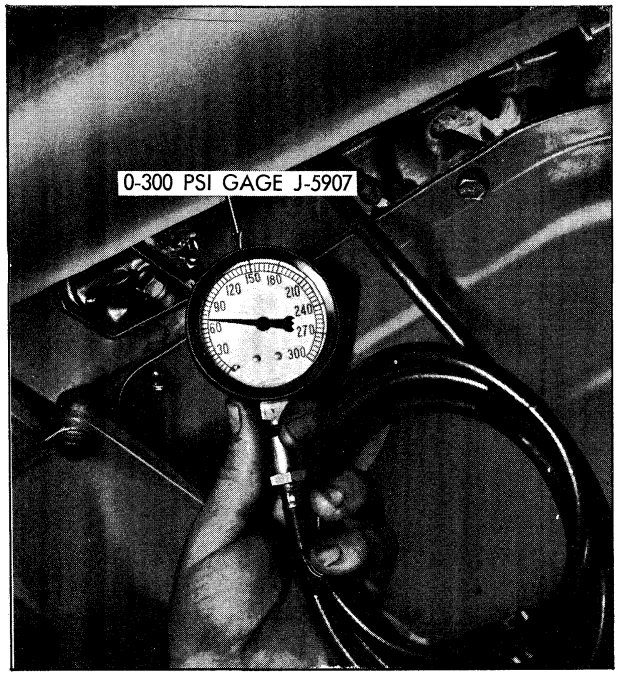


Fig. 7A-3 Oil Pressure Test Gauge

2. Check forward clutch seals.

B. Direct clutch leak (pressure normal in neutral, low, intermediate, and drive-pressure low in reverse).

1. Check center support oil seal rings.

2. Check direct clutch outer seal for damage.

3. Check rear servo and front accumulator pistons and rings for damage or missing.

6. Case Assembly.

A. Porosity in intake bore area.

B. Check case for intermediate clutch plug leak or missing plug.

C. Lo-reverse check ball mispositioned or missing (this will cause no reverse and no overrun braking in Lo range).

*There is no approved service procedure for checking or cleaning the filter, if the filter is suspected of being plugged or restricted. It must be replaced.

D. Causes of High Line Pressure

2. Vacuum Leak

A. Full leak (vacuum line disconnected.)

B. Partial leak in line from engine modulator.

C. Improper engine vacuum.

D. Vacuum operated accessory leak. (Hoses, vacuum advance, etc.).

3. Damaged Modulator.

A. Stuck valve.

B. Water in modulator.

C. Not operating properly - Part V.

4. Detent System.

A. Detent switch actuated (plunger stuck) or shorted.

B. Detent wiring shorted.

C. Detent solenoid stuck open.

D. Detent feed orifice in spacer plate blocked.

E. Detent solenoid loose.

F. Detent valve bore plug damaged.

G. Detent regulator valve pin short.

5. Pump.

A. Pressure regulator and/or boost valve stuck.

B. Incorrect pressure regulator spring.

C. Too many pressure regulator valve spacers.

D. Pump casting bad.

E. Pressure boost valve installed backwards or malfunctioning.

F. Aluminum bore plug has hole or otherwise malfunctioning.

G. Pressure boost bushing broken or otherwise malfunctioning.

6. Control Valve Assembly.

A. Spacer plate-to-case gasket off location.

B. Wrong spacer plate-to-case gasket,

E. Causes of Improper Vacuum at Modulator

1. Engine.

A. Requires tune up.

B. Loose vacuum fittings.

C. Vacuum operated accessory leak (hoses, vacuum advance, etc.)

2. Vacuum Line to Modulator.

A. Leak

B. Loose fitting.

C. Restricted orifice, or incorrect orifice size.

D. Carbon build up at modulator vacuum fitting.

E. Pinched line.

F. Grease or varnish material in pipe (no or delayed upshift-cold).

F. Causes of Oil Leaks

1. Transmission Oil Pan Leaks.

A. Attaching screws not correctly torqued.

B. Improperly installed or damaged pan gasket.

C. Oil pan gasket mounting face not flat.

2. Case Extension Leak.

A. Attaching screws not correctly torqued.

B. Rear seal assembly - damaged or improperly installed. (Propeller shaft yoke damaged).

C. Gasket - (Extension to case) damaged or improperly installed.

D. Porous casting.

E. Output shaft "O" ring damaged.

3. Case Leak.

A. Filler pipe "O" ring seal damaged or missing; misposition of filler pipe bracket to engine "Loading" one side of the "O" ring.

B. Modulator assembly "O" ring seal damaged or improperly installed.

C. Connector "O" ring seal damaged or improperly installed.

D. Governor cover, gasket and screws - damaged, loose; case face leak.

E. Damaged or porosity. Leak at speedometer driven gear housing or seal. Leak at speedometer hole plug.

F. Manual shaft seal - damaged, improperly installed.

G. Line pressure tap plug - stripped, lacking compound.

H. Vent pipe (refer to Item 5 below).

I. Porous case, or cracked at pressure plug boss.

4. Front End Leak.

A. Front seal - damaged (check converter neck for nicks, etc., also for pump bushing moved forward) garter spring missing.

B. Pump attaching screws, and seals - damaged, missing,

screws loose.

C. Converter - leak in weld.

D. Pump "O" ring seal - damaged. (Also check pump oil ring groove and case bore).

E. Porous casting (pump or case).

F. Pump - drain back hole not open.

5. Oil Comes Out Vent Pipe.

A. Transmission over-filled.

B. Water in oil.

C. Filter "O" ring damaged or improperly assembled causing oil to foam.

D. Foreign material between pump and case or between pump cover and body.

E. Case - porous, pump face improperly machined.

F. Pump - insufficient metal, porous.

G. Pump to case gasket mispositioned.

H. Pump breather hole blocked or missing.

I. Hole in intake pipe.

6. Oil Cooler Lines.

A. Connections at radiator loose or stripped.

B. Connections at case loose or stripped.

7. Modulator Assembly.

Diaphragm leaking - Part V.

g. Control Valve Assembly-Governor Line Pressure Check

1. Install oil pressure test gage, Fig. 7A-3.

2. Install tachometer.

3. Disconnect vacuum line to modulator.

4. With vehicle on hoist (driving wheels off ground), foot off brake, in drive, check line pressure at 1000 rpm.

5. Slowly increase engine rpm to 3000 rpm and determine if a line pressure drop occurs (10 psi or more).

6. If pressure drop of 10 psi or more occurs, disassemble, clean and inspect control valve assembly.

7. If pressure drop is less than 10 psi:

a. Inpect governor

1. Stuck valve.

2. Weight Freeness.

3. Restricted orifice in governor valve.

4. Check governor valve entry and exhaust (.020" min.). For procedure, refer to current service manual.

b. Governor feed system

1. Check screen in control valve assembly or case.

2. Check for restrictions in governor pipe.

3. Check for fit of governor pipes in case holes.

h. Causes of Burned Clutch Plates

NOTE: Burned clutch plates can be caused by incorrect usage of clutch plates. Also, anti-freeze in transmission fluid can cause severe damage, such as large pieces of composition clutch plate material peeling off.

1. Forward Clutch.

A. Check ball in clutch housing damaged, stuck or missing.

B. Clutch piston cracked, seals damaged or missing.

C. Low line pressure.

D. Manual valve mispositioned.

E. Restricted oil feed to forward clutch (Examples: Clutch housing to inner and outer areas not drilled, restricted or porosity in pump).

F. Pump cover oil seal rings missing, broken or undersize; ring groove oversize.

G. Case valve body face not flat or porosity between channels.

H. Manual valve bent and center land not ground properly.

2. Intermediate Clutch.

A. Rear accumulator piston oil ring, damaged or missing.

B. 1-2 accumulator valve stuck in control valve assembly.

C. Intermediate clutch piston seals damaged or missing.

D. Center support bolt loose.

E. Low line pressure (See Part c).

F. Intermediate clutch plug in case missing.

G. Case valve body face not flat or porosity between channels.

H. Manual valve bent and center land not ground properly

PRELIMINARY DIAGNOSIS CHART
TRANSMISSION MALFUNCTION RELATED TO OIL PRESSURE

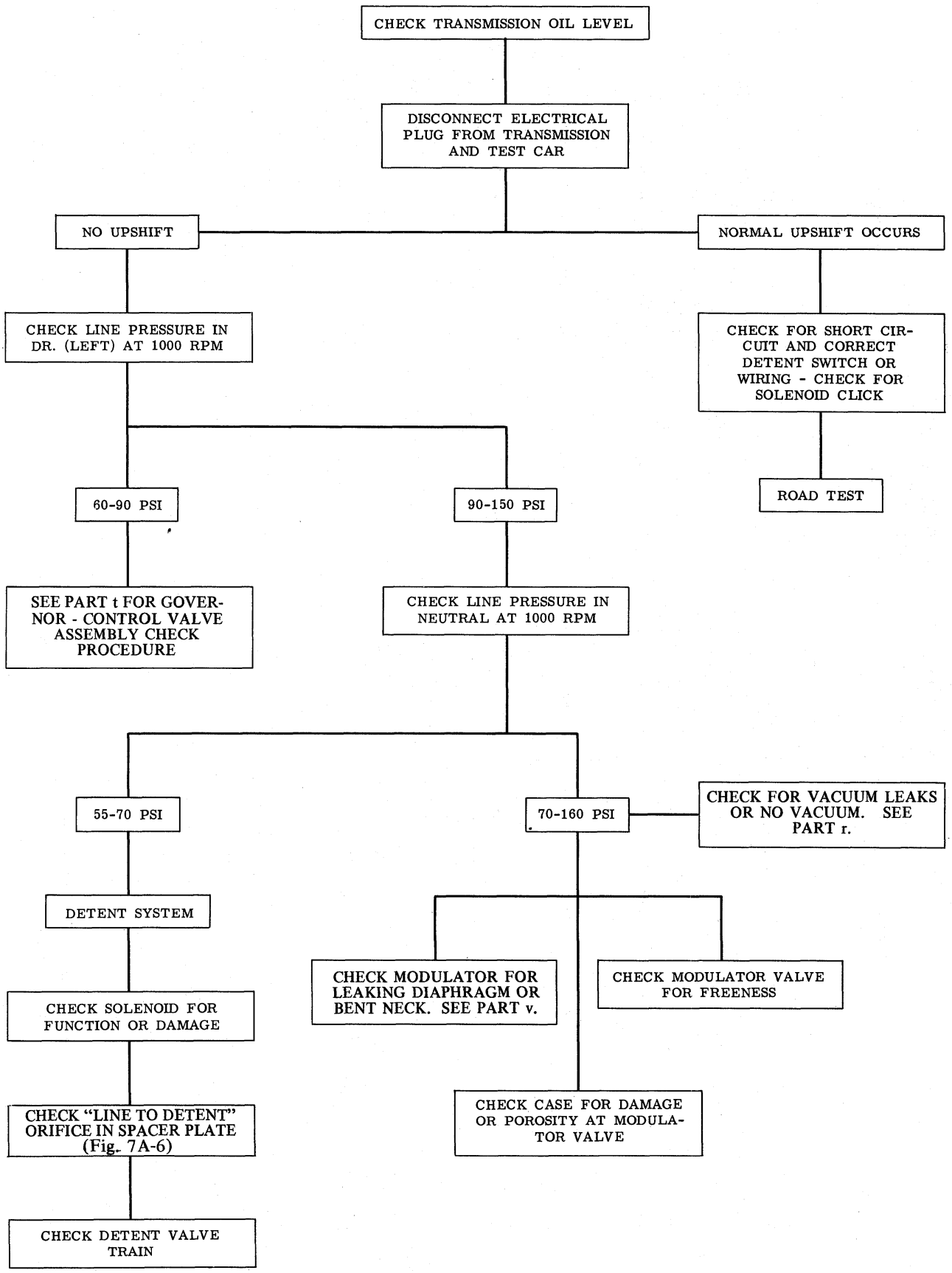
(PRESSURES OBTAINED BY THE PRELIMINARY CHECKING PROCEDURE, PAGE 7A-6)

	1	2	3	4	5	6	7	8	
MALFUNCTION	NEUTRAL BRAKES APPLIED 1000 RPM	DRIVE IDLE	DRIVE LEFT– BRAKES APPLIED 1000 RPM	DRIVE–R BRAKES APPLIED 1000 RPM	REVERSE BRAKES APPLIED 1000 RPM	DRIVE LEFT– BRAKES APPLIED 1000 RPM DOWNSHIFT SWITCH ACTIVATED	PRESSURE DROP OCCURS WHILE ENGINE RPM INCREASES FROM 1000 TO 3000 RPM WHEELS FREE TO MOVE*	DRIVE 30 MPH CLOSED THROTTLE	POSSIBLE CAUSE OF MALFUNCTION
	OIL PRESSURE	OIL PRESSURE	OIL PRESSURE	OIL PRESSURE	OIL PRESSURE	OIL PRESSURE		OIL PRESSURE	
NO 1-2 UPSHIFT AND/OR DELAYED UPSHIFT	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	10 PSI DROP OR MORE	NORMAL	MALFUNCTION IN CONTROL VALVE ASSY.
	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	LESS THAN 10 PSI DROP	NORMAL	MALFUNCTION IN GOVERNOR OR GOVERNOR FEED SYSTEM
	NORMAL	HIGH	HIGH	NORMAL	NORMAL	NORMAL		HIGH	MALFUNCTION IN DETENT SYSTEM
	HIGH	HIGH	HIGH	NORMAL	HIGH	–	–	–	MALFUNCTION IN MODULATOR OR VACUUM FEED SYSTEM TO MODULATOR
SLIPPING–REVERSE	NORMAL	NORMAL	NORMAL	NORMAL	LOW	NORMAL		NORMAL	OIL LEAK IN FEED SYSTEM TO THE DIRECT CLUTCH
SLIPPING–1ST GEAR	NORMAL	LOW TO NORMAL	LOW TO NORMAL	LOW TO NORMAL	NORMAL	LOW TO NORMAL	–	LOW TO NORMAL	OIL LEAK IN FEED SYSTEM TO THE FORWARD CLUTCH
DOWNSHIFT WITH ZERO THROTTLE AND NO ENGINE BRAKING IN DRIVE	NORMAL	HIGH	NORMAL	NORMAL	NORMAL	–	–	HIGH	STATOR AND DETENT WIRES SWITCHED
NO DETENT DOWNSHIFTS	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	LOW		NORMAL	MALFUNCTION IN DETENT SYSTEM

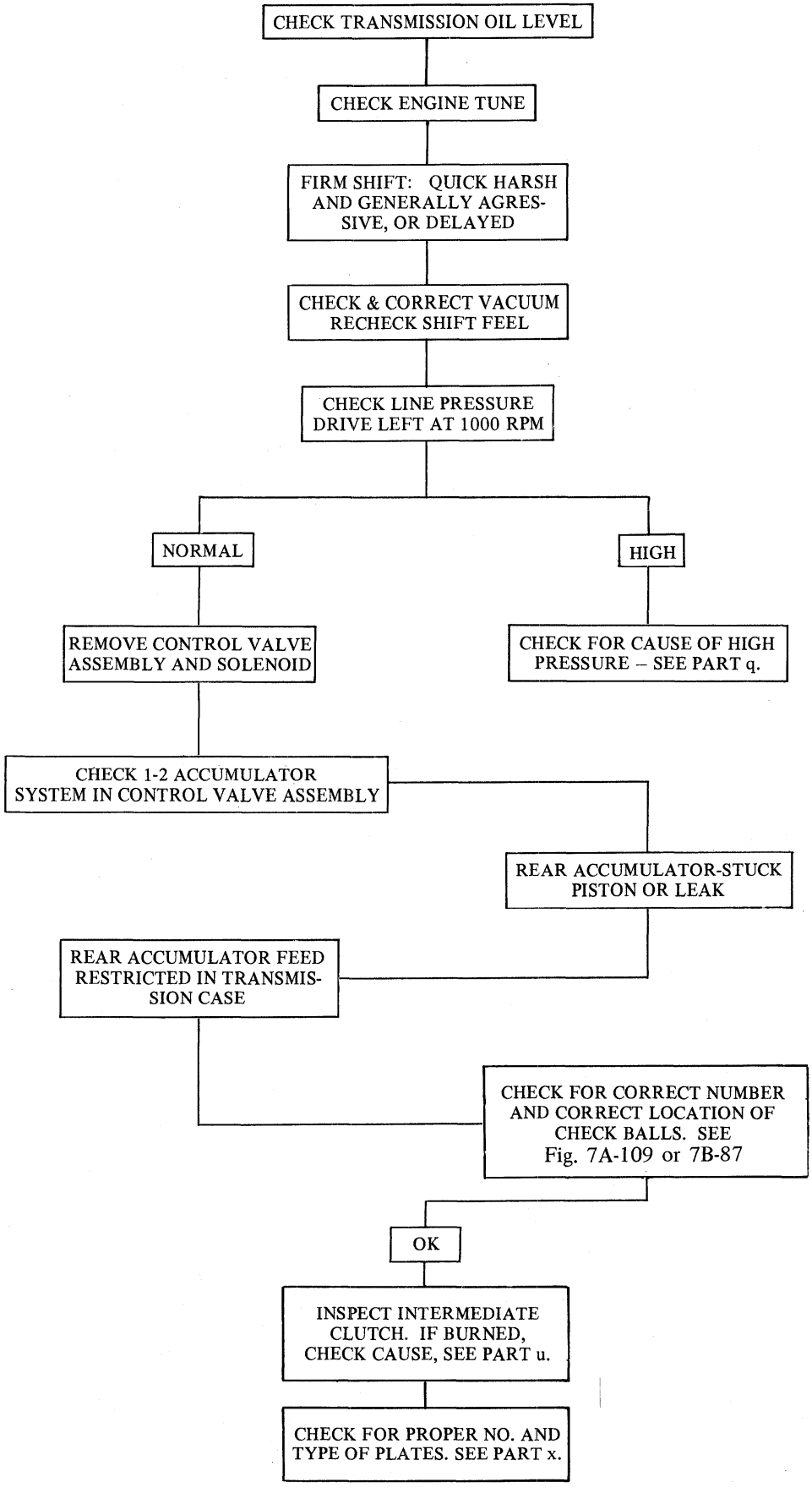
* DRIVE RANGE, VACUUM LINE DISCONNECTED FROM MODULATOR.

NOTE: A DASH (–) IN THE ABOVE CHART MEANS THAT THE OIL PRESSURE READING HAS NO MEANING UNDER THE TEST CONDITION.

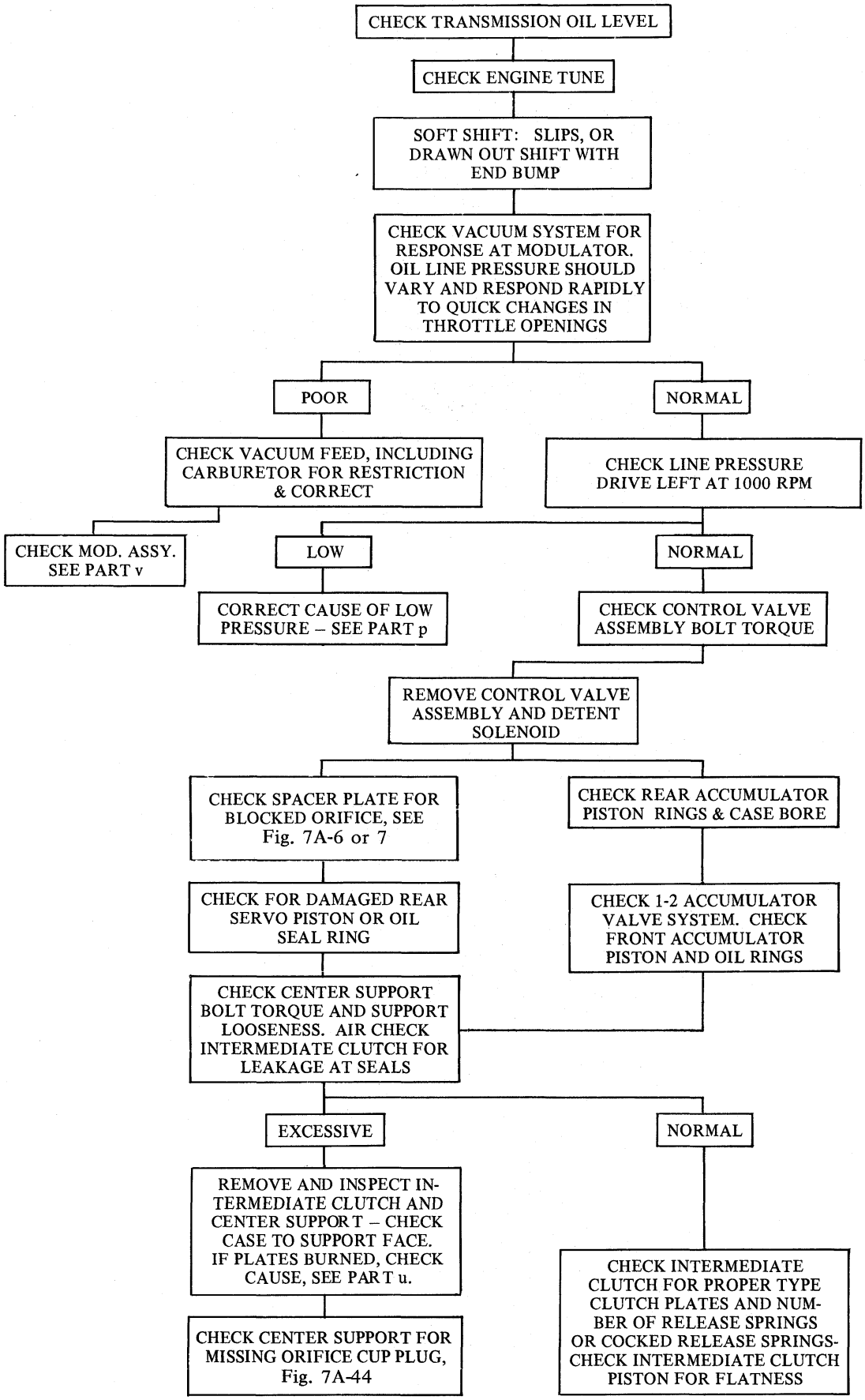
I. No. 1-2 Upshift and/or Delayed Upshift



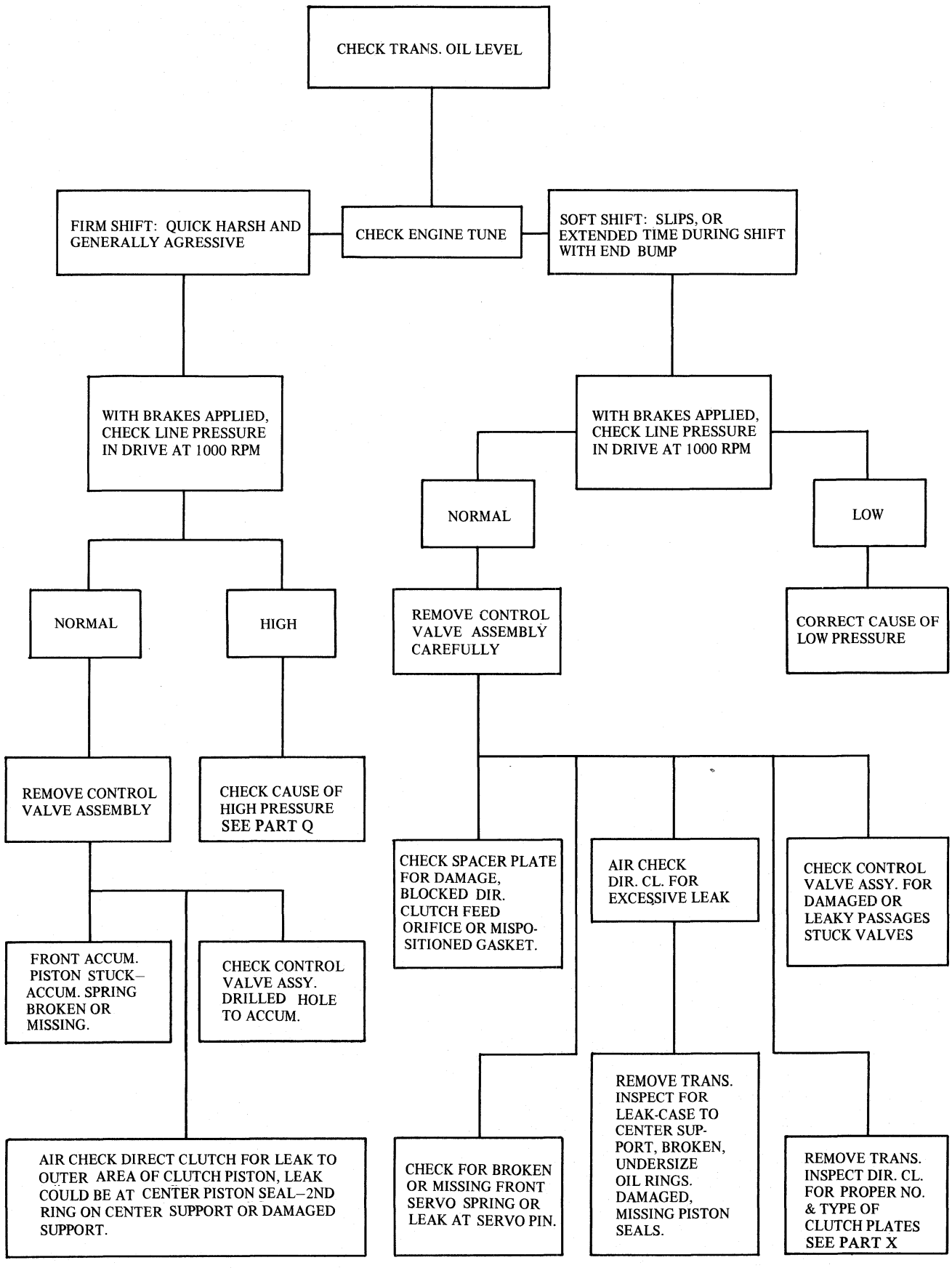
J. 1-2 Shift Feel Complaint—Firm Shift



K. 1-2 Shift Feel Complaint—Soft Shift



L. 2-3 Shift Complaint



M. Drive in Neutral

CHECK OUTSIDE MANUAL LINKAGE & CORRECT

- INTERNAL LINKAGE -
MANUAL VALVE DISCONNECTED OR END BROKEN,
INSIDE DETENT LEVER PIN BROKEN

- PUMP ASSEMBLY -
TRANSMISSION FLUID PRESSURE LEAKING INTO
FORWARD CLUTCH APPLY PASSAGE

- FORWARD CLUTCH -
BURNED PLATES - CHECK CAUSE - PART u
INCORRECT CLUTCH PLATE USAGE - PART x

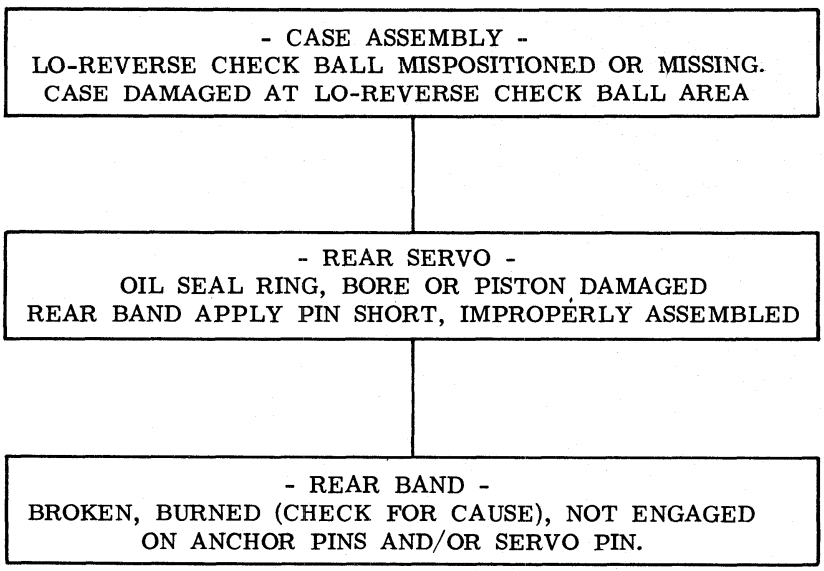
N. Will not Hold in Park or Will Not Release from Park

CHECK OUTSIDE MANUAL LINKAGE & CORRECT, PAGE 7A-24

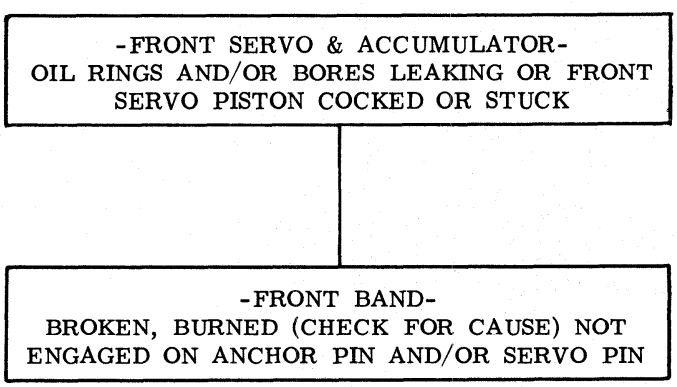
- INTERNAL LINKAGE -

1. Parking brake rod assembly (Check actuator for chamfer)
2. Parking pawl broken, chamfer omitted.
3. Parking brake bracket loose, burr or rough edges or incorrectly installed.
4. Parking pawl return spring missing, broken, incorrectly hooked.
5. Broken lugs on output carrier.

O. No Engine Braking—Lo Range—1st Gear



P. No Engine Braking—Intermediate Range—2nd Gear



Q. No Reverse or Slips in Reverse

CHECK TRANSMISSION OIL LEVEL – PAGE 7A-26

CHECK OUTSIDE MANUAL LINKAGE & CORRECT – PAGE 7A-24

WITH BRAKES APPLIED, CHECK LINE PRESSURE IN REVERSE @ 1000 RPM

NORMAL

- CONTROL VALVE ASSEMBLY -

1. 2-3 Valve train stuck open (This will also cause a 1-3 upshift in drive range)
2. Reverse feed passage - Cross channel leak, porosity in case or valve body passage, gaskets leaking.

- REAR SERVO & ACCUMULATOR -

1. Servo piston seal ring damaged or missing
2. Short band apply pin (This may also cause no overrun braking or slips in overrun braking-lo range)
   Refer to Page 7A-36 for pin selection.
3. Rear servo piston or bore.

- FORWARD CLUTCH -
Clutch does not release (will also cause Drive in Neutral)

- DIRECT CLUTCH BURNED -
Check cause - PART u

- REAR BAND -
Broken, burned, loose lining, apply pin or anchor pins not engaged.

CENTER SUPPORT
Oil seal rings or grooves damaged or worn.

LOW

CORRECT CAUSE - PART p

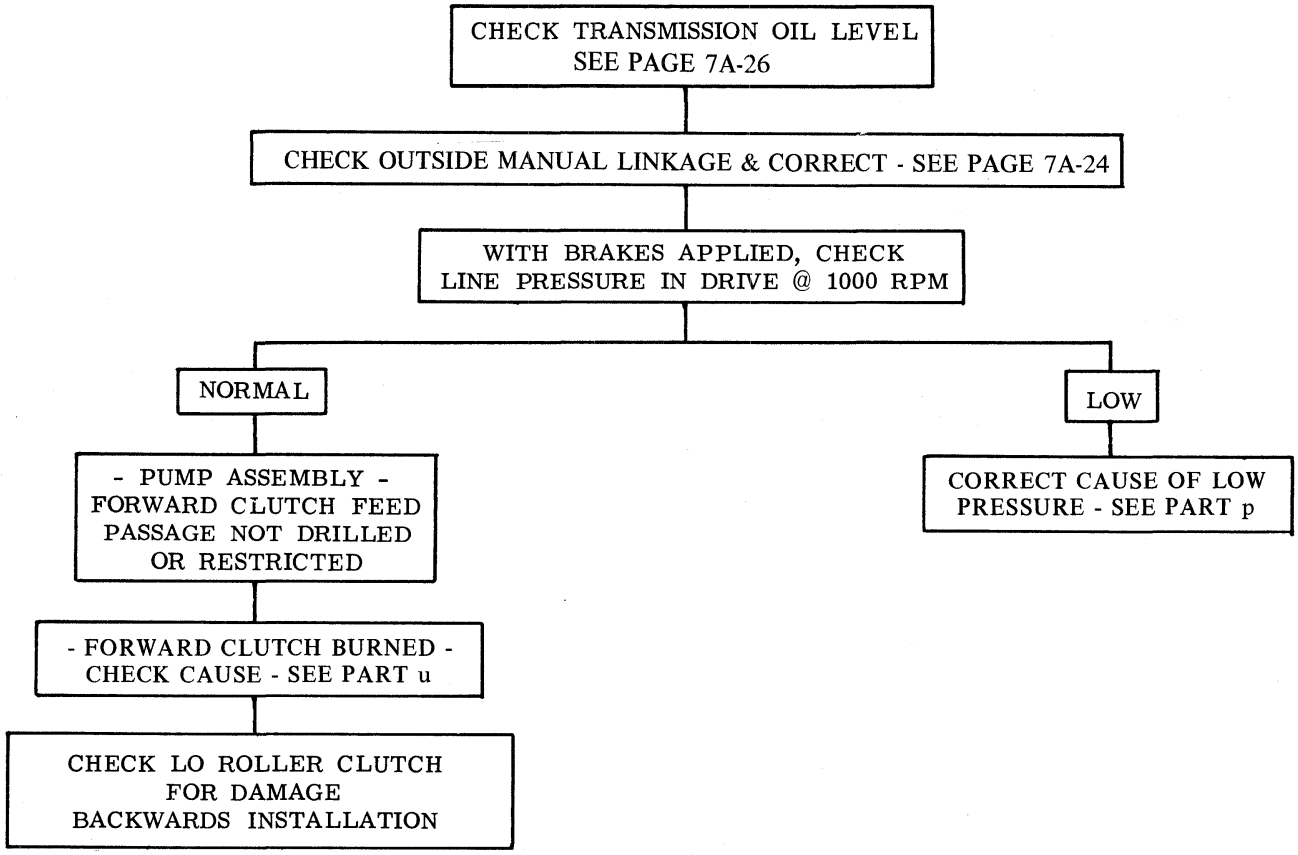
R. 1st and 2nd Speeds Only, No 2-3 Upshift

- CONTROL VALVE ASSEMBLY -
STUCK 2-3 VALVE, GASKET MISPOSITIONED OR LEAKING

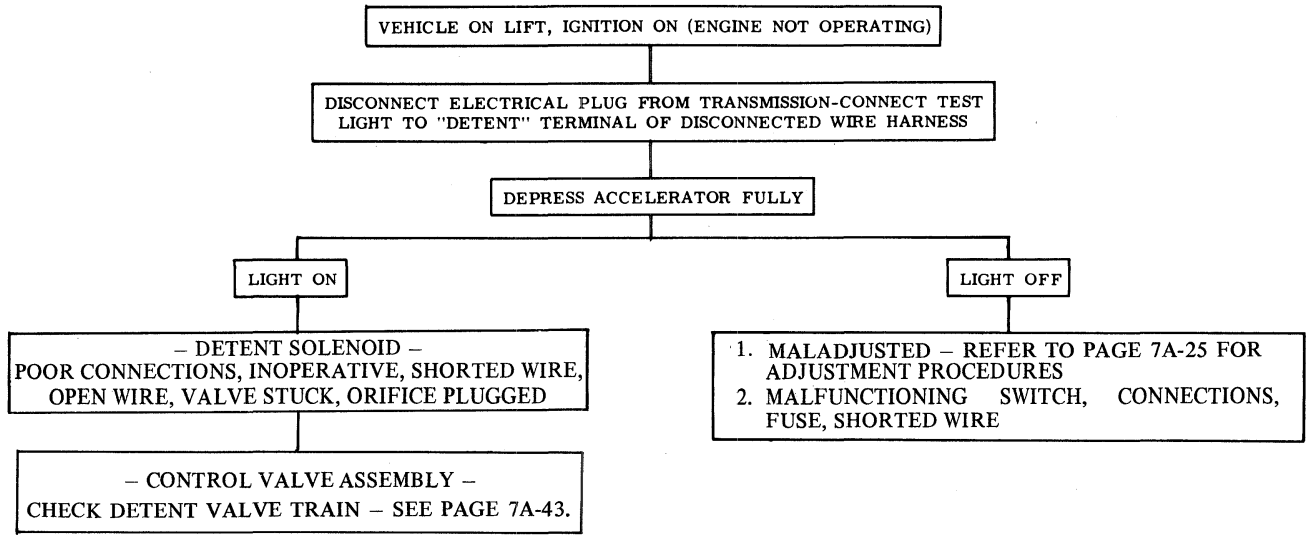
- DIRECT CLUTCH -
BURNED, CHECK CAUSE - Part u

-IMPROPER VACUUM -
CHECK CAUSE, PART r

S. No Drive in Drive Range

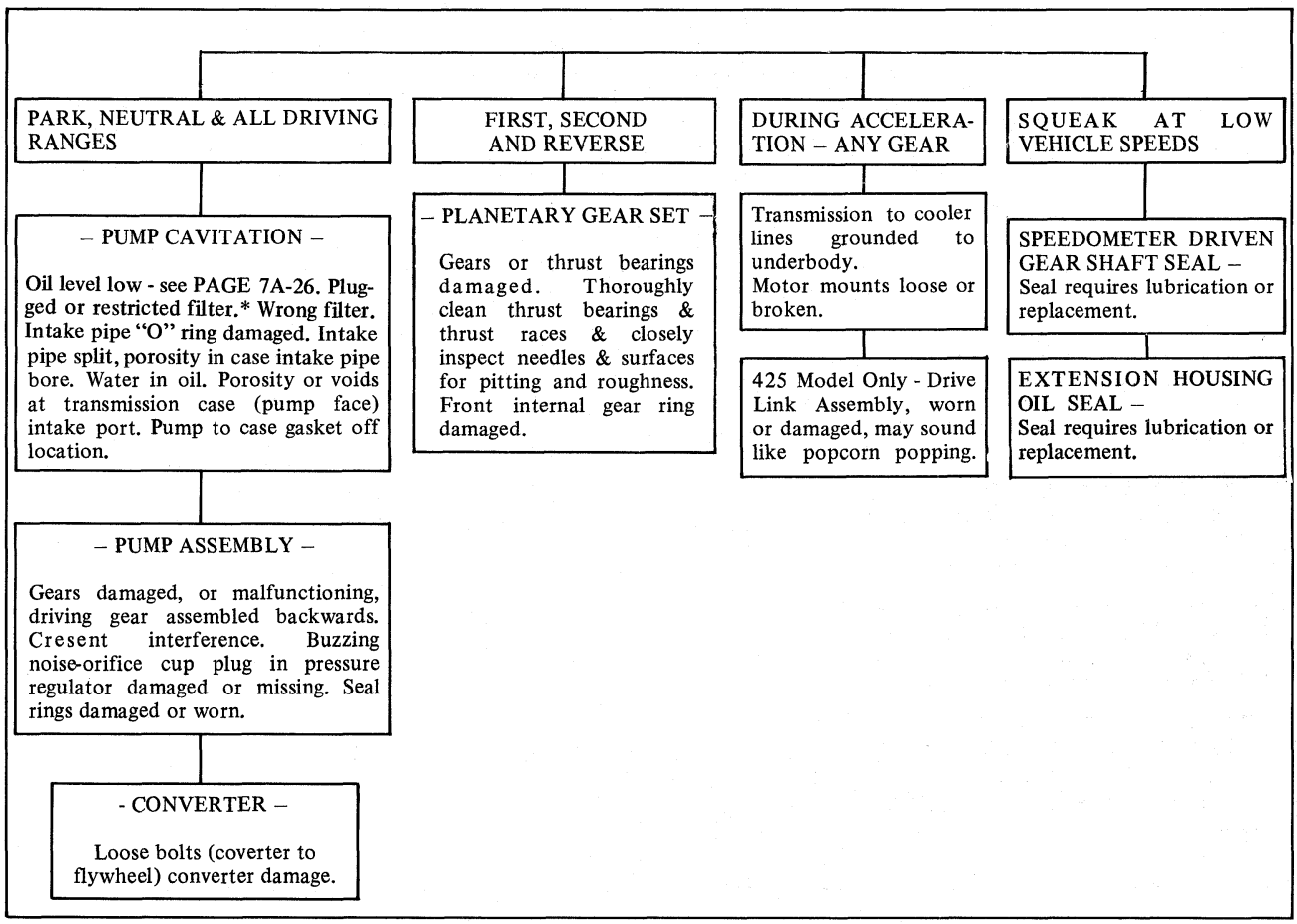


T. No Detent Downshifts



U. Transmission Noisy

NOTE: Before checking transmission for what is believed to be "Transmission Noise," make certain the noise is not from the water pump, generator, air conditioner, power steering. etc. These components can be isolated by removing the proper belt and running the engine no more than two minutes at one time.



*There is no approved service procedure for checking or cleaning the filter. If the filter is suspected of being plugged or restricted, it must be replaced.

DIRECT CLUTCH ASSEMBLY (FIG. 7-2)

a. Type AA-AB-AD-AE-AL (C-Cars)

Clutch	No. of Flat Steel Clutch Plates	No. of Waved Steel Clutch Plates
Forward Clutch	*4	1
Direct Clutch	*4	1
Intermediate Clutch	2	1

*Steel Plate Thickness - .0915"

Clutch	No. of Clutch Composition Plates	No. of Piston Release Springs
Forward Clutch	5	16
Direct Clutch	5	14
Intermediate Clutch	3	3

b. Type AC-AH Clutch Parts (Seville)

Clutch	No. of Flat Steel Clutch Plates	No. of Waved Steel Clutch Plates
Forward Clutch	*3	1
Direct Clutch	**4	
Intermediate Clutch	2	1

*Steel Plate Thickness - .0775"
**Steel Plate Thickness - .0915"

Clutch	No. of Clutch Composition Plates	No. of Piston Release Springs
Forward Clutch	4	16
Direct Clutch	4	14
Intermediate Clutch	3	3

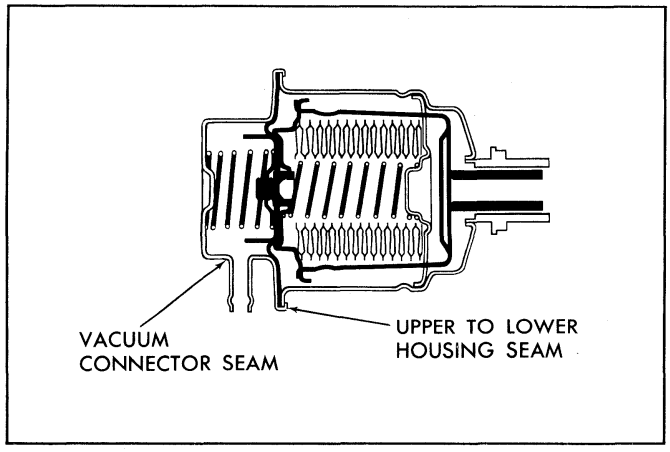


Fig. 7A-4 Vacuum Modulator Cutaway View

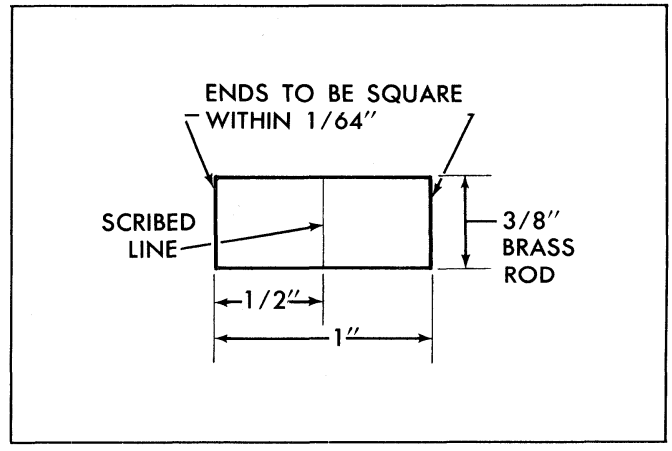


Fig. 7A-5 Vacuum Modulator Test Gage

3. Direct Clutch.

A. Restricted orifice in vacuum line to modulator (poor vacuum response.)

B. Check ball in direct clutch piston damaged, stuck or missing.

C. Leaking Modulator bellows. Part v.

D. Center support bolt loose. (Bolt may be tight in support but not holding support tight to case).

E. Center support oil rings or grooves damaged or missing.

F. Clutch piston seals damaged or missing.

G. Front and rear servo pistons and seals damaged.

H. Manual valve bent and center land not cleaned up.

I. Case valve body face not flat or porosity between channels.

J. Intermediate roller clutch installed backwards.

K. 3-2 valve, 3-2 spring or 3-2 spacer pin installed in wrong location in 3-2 valve bore.

NOTE: If direct clutch plates and front band are burned, check manual linkage. See Page 7A-8.

v. Vacuum Modulator Assembly (Fig. 7A-4)

The following procedure is recommended for checking Turbo Hydra-matic modulator assemblies in the field before replacement is accomplished.

1. Vacuum Diaphragm Leak Check. Insert a pipe cleaner into the vacuum connector pipe as far as possible and check for the presence of transmission oil. If oil is found, replace the modulator.

CAUTION: *Gasoline or water vapor may settle in the vacuum side of the modulator. If this is found without the presence of oil, the modulator should not be changed.*

2. Atmospheric Leak Check. Using Hand Vacuum Pump, J-23738, apply 20" HG to diaphragm. Modulator should hold vacuum for 10 seconds. If vacuum drops, replace modulator.

3. Bellows Comparison Check. Make a comparison gage, as shown in Fig. 7A-5, and compare the load of a known good Hydra-matic modulator with the assembly in question. Modulator Tension Tester, J-24466 may also be used for this purpose.

a. Install the modulator that is known to be acceptable on either end of the gage.

b. Install the modulator in question on the opposite end of the gage.

c. Holding the modulators in a horizontal position, bring them together, under pressure until either modulator sleeve end just touches the line in the center of the gage. The gap between the opposite modulator sleeve end and the gage line should then be 1/16" or less. If the distance is greater than this amount, the modulator in question should be replaced.

4. Sleeve Alignment Check. Roll the main body of the modulator on a flat surface and observe the sleeve for concentricity to the can. If the sleeve is concentric and the plunger is free, the modulator is acceptable.

Once the modulator assembly passes all of the above tests, it is an acceptable part and should be re-used.

w. Downshift Solenoid Circuit Check (C-Car-Seville)

NOTE: Before checking the downshift solenoid circuitry, make certain that the transmission downshift switch is properly adjusted as described on Page 7A-25.

1. With transmission shift lever in Park, turn ignition switch to "ON" position, but do not start car. Leave ignition switch "ON" throughout checking procedure.

2. Working under hood, slowly advance throttle linkage to wide open position. One click should be heard from transmission.

3. Allow throttle to return to closed position. One click should be heard from transmission.

4. If system performed as described above, downshift circuit is operating properly. If system does not perform as described above, proceed to step 5.

5. Use test light to check brown wire at connector on side of transmission case. Test light should light with throttle wide open and go out when throttle is released.

a. If system operates as described above, but did not perform properly during steps 1-3, replace solenoid after first checking to see that internal wiring is operational. Solenoid installation is described on Page 7A-67.

b. If light fails to light with throttle in wide open position, the circuit is open. Proceed to step 6.

c. If light lights with throttle closed, the circuit is shorted. Proceed to step 9.

6. On C cars remove air cleaner. Remove orange wire connector location at transmission downshift switch. On Seville remove brown wire connector at transmission downshift switch mounted above accelerator pedal on support. Use test light to check from the bare terminal at switch with throttle wide open.

a. If test light lights, replace brown wire. Recheck system.

b. If test light fails to light, proceed to step 7.

7. Check black striped orange feed wire at transmission downshift switch with test light.

a. If test light lights, replace transmission downshift switch. Recheck system.

b. If test light fails to light, proceed to step 8.

8. Check transmission control fuse in fuse panel.

a. If necessary to replace fuse, recheck system.

b. If fuse is all right, it will be necessary to locate the open in the wiring. Test the circuit continuity from the black-striped orange wire at the downshift switch to the battery.

9. Remove air cleaner on C cars. Remove black-striped orange wire connector at transmission downshift switch. Use test light to check from the bare terminal at switch with throttle closed.

a. If test light fails to light, orange wire is shorted. Correct shorting condition.

b. If test light lights, proceed to step 10.

10. With throttle in closed position, check black striped orange feed wire at transmission downshift switch.

a. If test light fails to light, replace transmission downshift switch. Recheck system.

b. If test light lights, it will be necessary to locate the short in the wiring. Test the circuit from the black striped orange wire at the downshift switch to the battery.

OIL LEAKS

The precautions that must be observed to prevent fluid leaks are as follows:

1. Use new gaskets and O-ring seals whenever there is a disassembly.

2. Use a very small amount of petrolatum to hold gaskets and thrust washers in place during assembly, or to seal gaskets. Never use gasket paste or shellac.

3. Make sure that composition cork and paper gaskets are not wrinkled or creased when installed. Make sure that gaskets have not stretched or shrunk during storage.

4. Make sure the square type O-ring seals are installed squarely and are not twisted during assembly.

5. Make sure that mating surfaces of castings are flat and smooth, free of deep scratches, chips, and burrs.

6. Torque fasteners to proper torque.

When checking for oil leaks, first determine whether leak originates from transmission or engine. The original factory fill fluid in the transmission is formulated with a red aniline dye to assist in locating leaks. Red dye appearing in the leaking oil will give positive identification as to the location of the leak.

If oil leak is found to be in transmission, check for leak in following areas:

a. Front End

It will be necessary to remove lower cover at front of transmission case to determine location of leaks at front end. To correct leaks at front end, it will be necessary to remove transmission from car.

1. Pump oil seal leak - Check pump oil seal to make certain it is correctly installed and not damaged.

When installing a new pump oil seal, page 7A-33, make certain that bore is free from foreign material and that garter spring on seal is correctly positioned. Check finish of converter neck and bearing surface in pump body.

2. Pump assembly-to-case square cut O-ring or gasket damaged.

3. Rubber coated-washers on pump attaching screws damaged or missing.

4. Converter - Inspect converter for indications of leakage. See page 7A-33, for checking procedure.

5. Pump drain back hole not open Fig. 7A-11.

b. Extension Housing

1. Extension housing oil seal not installed properly or damaged.

2. Gasket (extension housing-to-case) improperly installed or damaged.

3. Extension housing-to-case attaching screws not torqued to specifications. Tighten to 23 foot-pounds.

4. Porous or cracked casting.

5. Propeller shaft front slip yoke scratched or corroded.

6. O-ring on output shaft, improperly installed or damaged.

c. Transmission Case

1. Speedometer driven gear housing retainer attaching screw loose. Tighten to 18 foot-pounds.

2. Speedometer driven gear housing O-ring or lip seal damaged.

3. Governor cover attaching screws not tight. Tighten screws to 18 foot-pounds.

4. Damaged governor gasket.

5. Electrical connector O-ring damaged.

6. Parking pawl shaft cup plug not properly installed.

7. Manual shaft seal damaged.

8. Vacuum modulator damaged.

9. Vacuum modulator retainer screw loose. Tighten to 18 foot-pounds.

10. Vacuum modulator diaphragm damaged.

NOTE: A ruptured diaphragm would allow transmission oil to be drawn into intake manifold and vacuum line. Usually the exhaust will be excessively smoky due to transmission oil added to the combustion. Oil lever of transmission will also be low with no visible external leak.

11. Bottom pan gasket damaged.

12. Bottom pan attaching screws loose. Tighten to 12 foot-pounds.

13. Line pressure plug not tight. Tighten to no more than 10 foot-pounds.

14. Porous or cracked casting.

15. Vent pipe.

a. Transmission over-filled.

b. Water in oil.

c. Pump to case gasket mispositioned.

d. Foreign material between pump and case, or between pump cover and body.

e. Case - Porous pump face improperly machined.

f. Pump - Shy of stock, porous. Breather hole in pump cover plugged, Fig. 7A-12.

g. Cut O-ring or intake or grommet on filter assembly.

d. Oil Cooler Pipe Connections

1. Outside oil cooler pipe connections improperly installed or damaged. Also connectors in radiator and transmission.

2. Oil cooler pipe connections not tight. Tighten to 20 foot-pounds.

3. Flare on oil cooler pipes damaged at radiator or transmission.

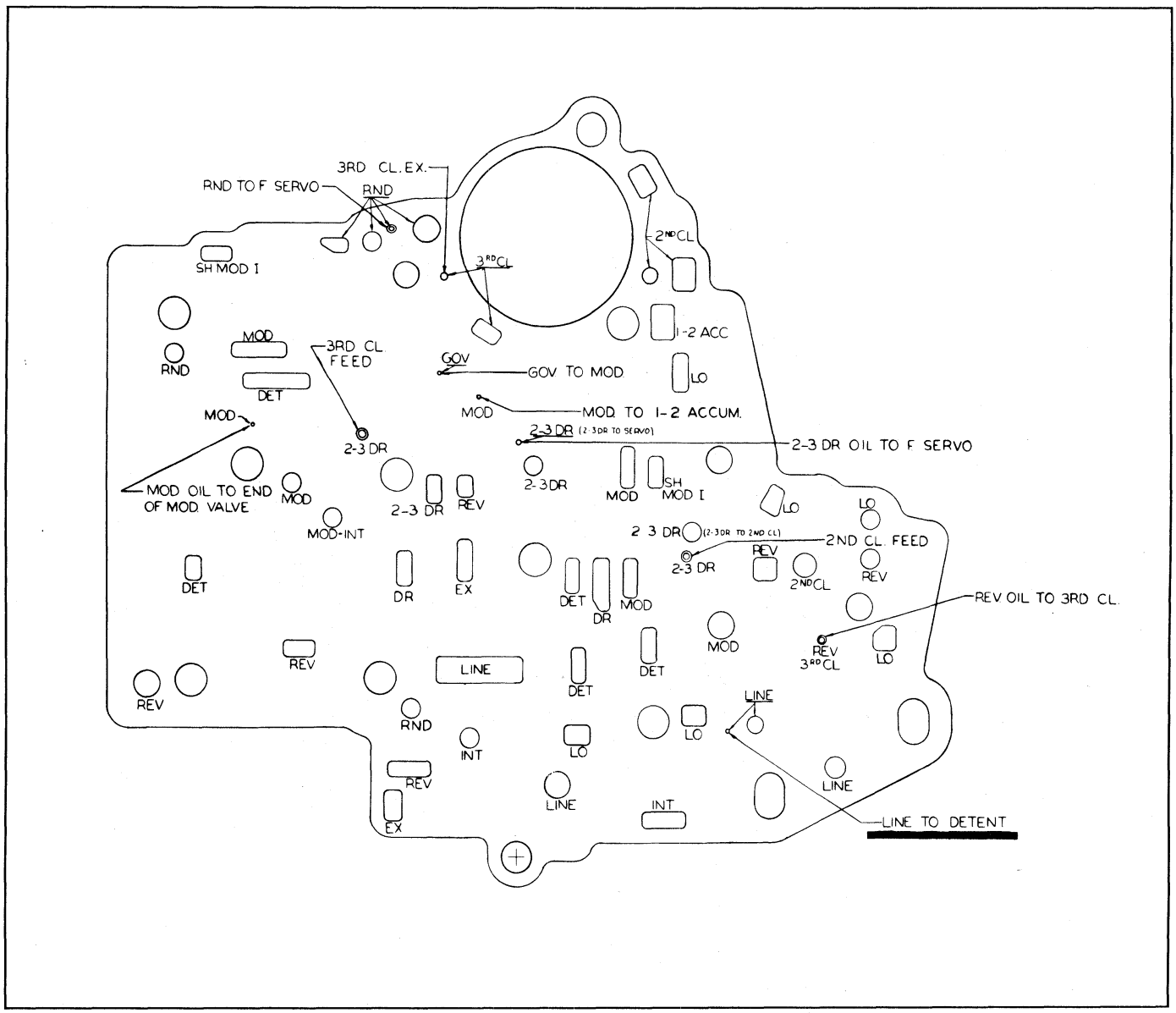


Fig. 7A-6 Spacer for Control Valve Assembly (Typical)

e. Leaking Out Filler Pipe

1. O-ring damaged or improperly installed on pipe.
2. Filler pipe not fully seated in case.

f. Blowing Out Filler Pipe

1. Transmission over-filled.
2. Plugged vent cap.
3. Plugged vent hole in pump.
4. Damaged pump gasket.
5. Engine overheating.

g. Internal Leaks

It will be necessary to remove bottom pan to determine location of internal leaks.

1. Governor pipes damaged.
2. Rear servo cover attaching screws not tight. Tighten to 18 foot-pounds.
3. Rear servo cover gasket damaged.
4. Control valve assembly spacer plate-to-case gasket damaged.
5. Control valve assembly attaching screws loose. Tighten to 8 foot-pounds.
6. Solenoid gasket damaged.
7. Solenoid attaching screws loose. Tighten to 10 foot-pounds.
8. Intake pipe O-ring or filter grommet damaged causing a foaming condition.
9. Rear servo square cut O-ring improperly installed or damaged.

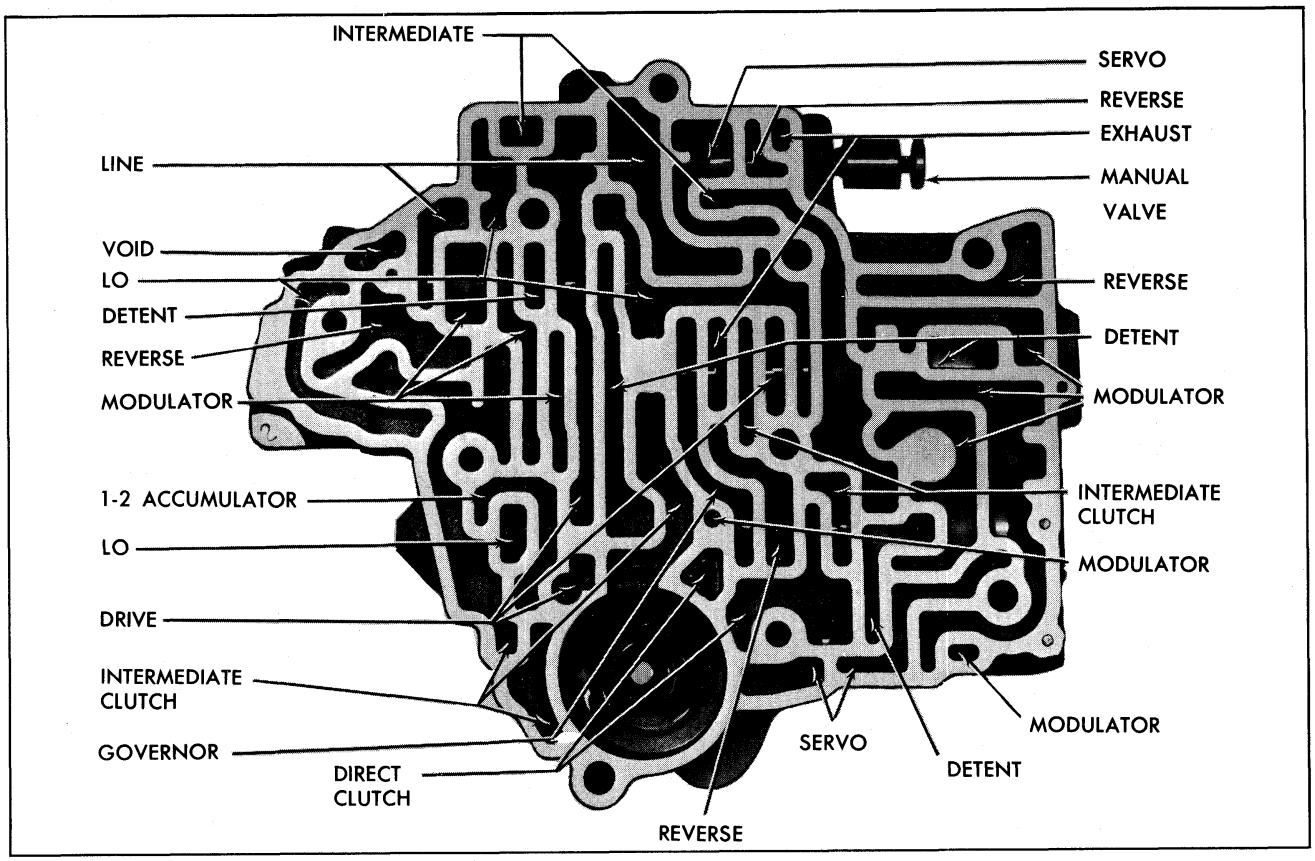


Fig. 7A-7 Control Valve Body Oil Passages

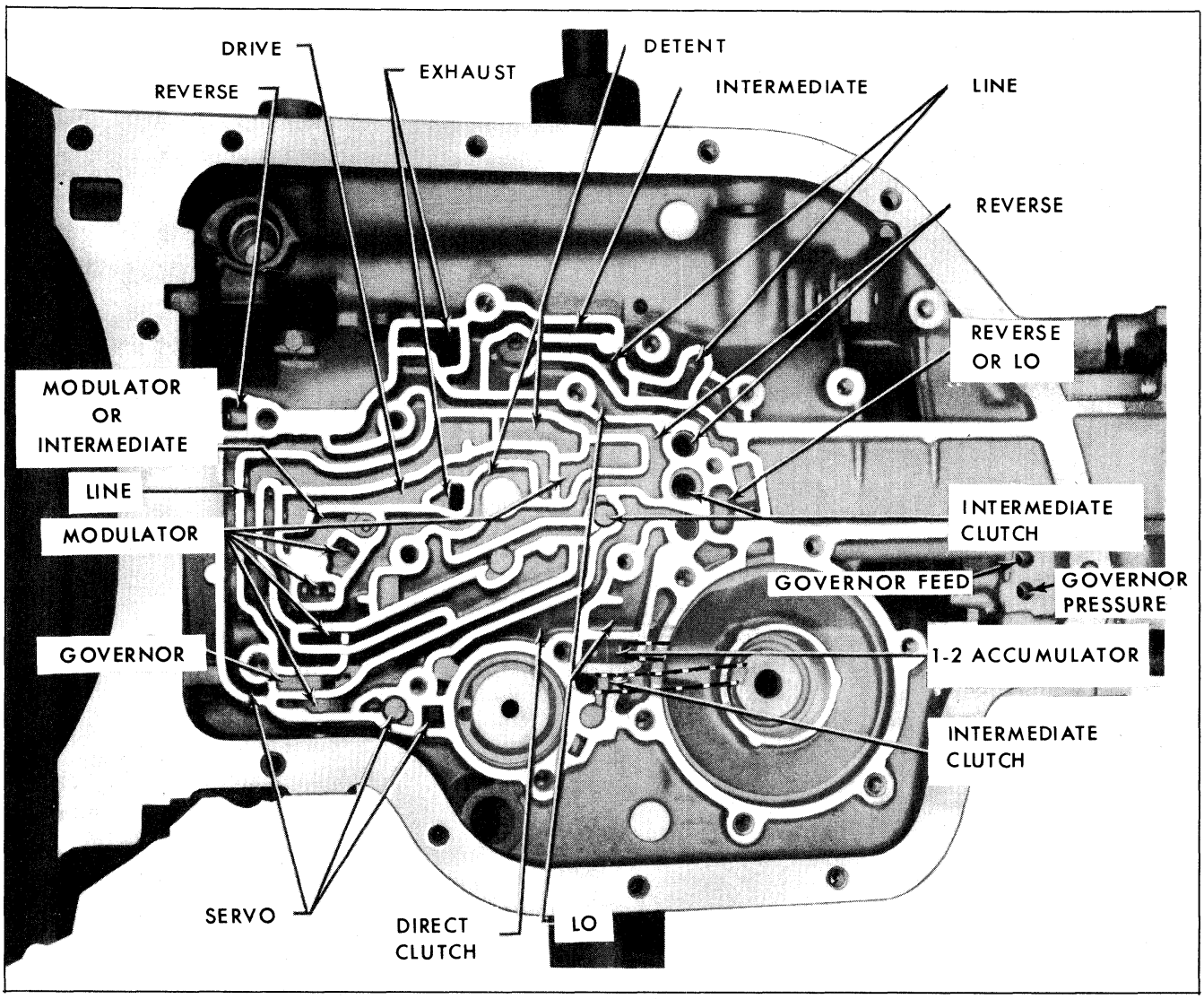


Fig. 7A-8 Transmission Case Oil Passages (Bottom View)

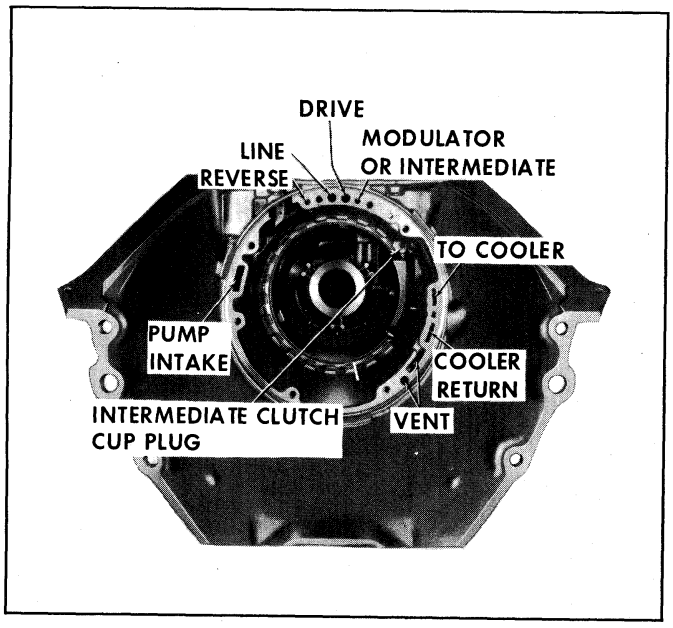


Fig. 7A-9 Transmission Case Oil Passages

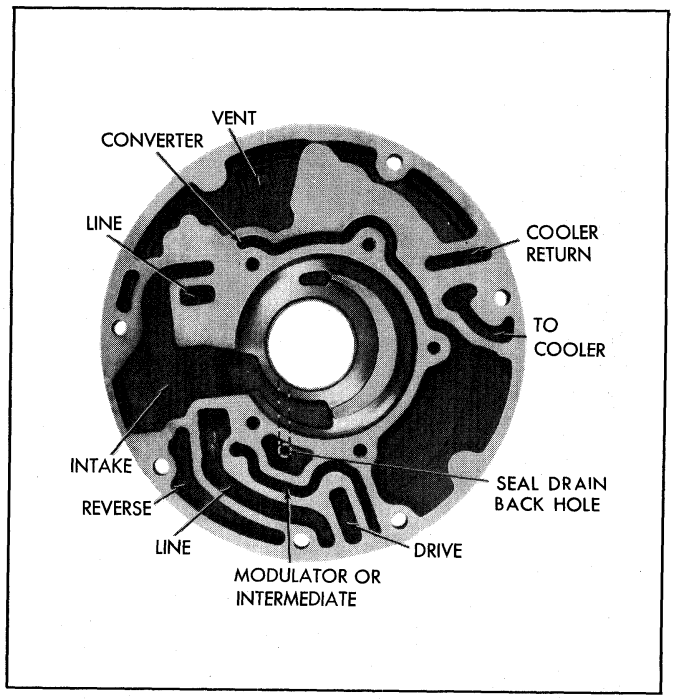


Fig. 7A-11 Pump Body Oil Passages

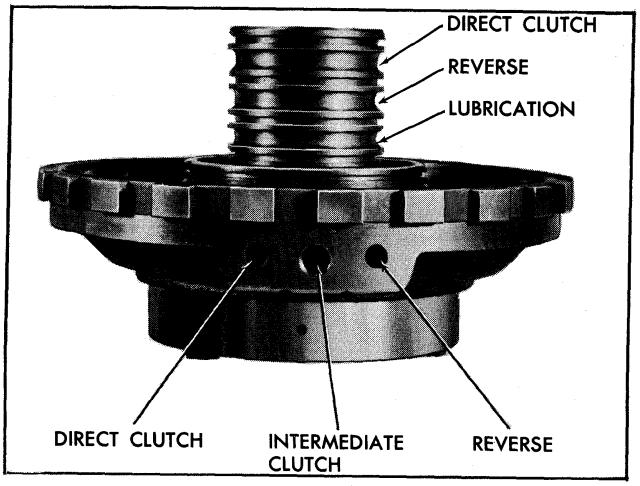


Fig. 7A-10 Center Support Oil Passages

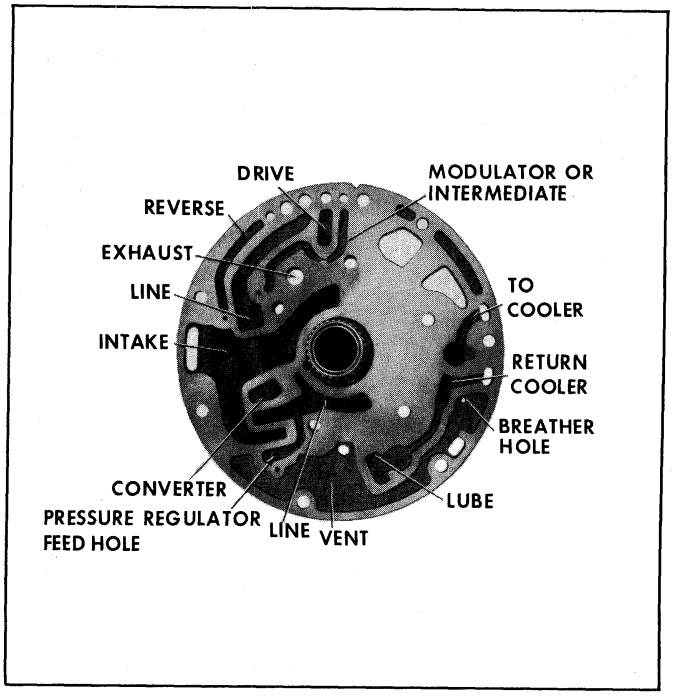


Fig. 7A-12 Pump Cover Oil Passages

ON-CAR SERVICE

MANUAL LINKAGE ADJUSTMENT (C-CARS) (FIG. 7A-13)

1. Loosen adjusting screw on steering column shift rod to trunnion assembly swivel.

2. Working under car, pull trunnion lever up to position transmission shift valve in Park, then pull lever down to the third (Neutral) step. Make sure lever is centered in this detent position.

3. Position selector lever in Neutral detent in steering column.

4. Tighten adjusting screw.

5. Check operation of selector lever by performing the following steps:

a. Lift lever and move to neutral **detent.** (This is the detent in the transmission). Release the lever and check to make sure that the lever fits into neutral notch in steering column.

b. Move lever to Drive detent. There should be a slight travel of the lever beyond this detent until the drive stop in the steering column is reached.

c. Move lever to Reverse detent and check as in (b.) above.

WARNING: WHENEVER LINKAGE IS READJUSTED, CHECK FOR PROPER OPERATION OF SEAT BELT WARNING SWITCH, PARKING BRAKE RELEASE BACK-UP LIGHTS AND COLUMN LOCK IN PARK. REFER TO SECTION 8 FOR PROPER METHOD OF CHECKING FUNCTION OF SEAT BELT WARNING SWITCH.

Manual Linkage Adjustments (Seville) (Fig. 7A-15)

1. Loosen adjusting screw.

2. Working under car, pull trunnion lever up to position transmission shift valve in Park, then pull lever down to the third (Neutral) step. Make sure lever is centered in this detent position.

3. Position selector lever in Neutral detent in steering column.

4. Tighten adjusting screw.

5. Check operation of selector lever by performing the following steps: a. Lift lever and move to neutral detent. (This is the detent in the transmission.) Release the lever and check to make sure that the lever fits into neutral notch in steering column.

b. Move lever to Drive detent. There should be a slight travel of the lever beyond this detent until the drive stop in the steering column is reached.

c. Move lever to Reverse detent and check as in b. above.

Transmission Downshift Switch (C-Car)

a. Removal

1. Remove air cleaner.

2. Disconnect wire connectors.

3. Remove 2 screws that secure switch to switch bracket and remove downshift switch, Fig. 7A-14.

b. Installation

1. Hold switch in on-car position and rotate switch actuating shaft clockwise until it stops. Install lever on shaft with notch on inside and lever in straight-up position.

2. Insert shaft into hole on throttle adapter plate.

3. Insert two mounting screws through switch mounting to mounting bracket and lightly tighten.

4. Adjust switch as described on Page 7A-25.

5. Connect wires to terminals on switch.

6. Replace air cleaner.

c. Adjustment

1. Remove carburetor air cleaner.

2. Make certain that carburetor is adjusted to specification and that throttle linkage is at low speed idle setting.

3. Loosen two mounting screws and insert a #42 (.094") wire gage size drill into the calibrating hole below lower wire terminal, Fig. 7A-14. Adjust position of switch so that lever just touches the carburetor adapter plate arm (stud on 6L).

With this adjustment the downshift switch should make contact above 60° throttle.

4. With switch positioned, tighten mounting screws and remove #42 (.094") gage from calibrating hole through switch.

5. Repeat step 3, if necessary.

6. Install air cleaner.

Transmission Downshift Switch (Seville)

a. Removal

NOTE: Down shift switch is located above accelerator pedal.

1. Disconnect electrical lead from left side of switch.

2. Remove two bolts securing switch to mounting bracket and remove switch, Fig. 7A-16.

b. Installation

1. Position switch on mounting bracket and lightly secure.

2. Connect electrical lead on left side of switch.

3. Adjust switch as described in Step C.

c. Adjustment

1. Loosen two mounting screws and insert a #42 (.094") wire gage size drill into calibrating hole below wire terminal.

2. Adjust position of switch so that lever just touches accelerator relay rod.

NOTE: Rod should be in closed position.

3. With this adjustment the downshift switch should make contact above 60° throttle.

4. With switch positioned, tighten mounting screws and remove #42 (.094") gage from calibrating hole thru switch.

Checking and Adding Fluid

NOTE: When checking fluid level the oil temperature and having the car on a level surface are particularly important. Careful attention to the following procedures is necessary in order to determine the actual fluid level.

a. Turbo Hydra-Matic Oil Recommendations

Whenever fluid is added, use only DEXRON ® - II type transmission fluid, or fluids of equivalent quality that have been especially formulated and tested for use in the Turbo Hydra-matic transmission.

The transmission dipstick and filler tube is located under the hood at the right rear top of the engine.

Under normal driving conditions, the transmission filter and fluid should be changed every 100,000 miles. If the car is driven extensively in heavy city traffic during hot weather, or is used to pull a trailer, change fluid every 50,000 miles. Operators of cars in commercial use (such as taxi-cab or limousine service) where the engine idles for long periods, should change fluid every 50,000 miles.

In any case of a major transmission malfunction, the filter assembly must be replaced. In addition, the oil cooler and cooler lines should be flushed, before adding new fluid.

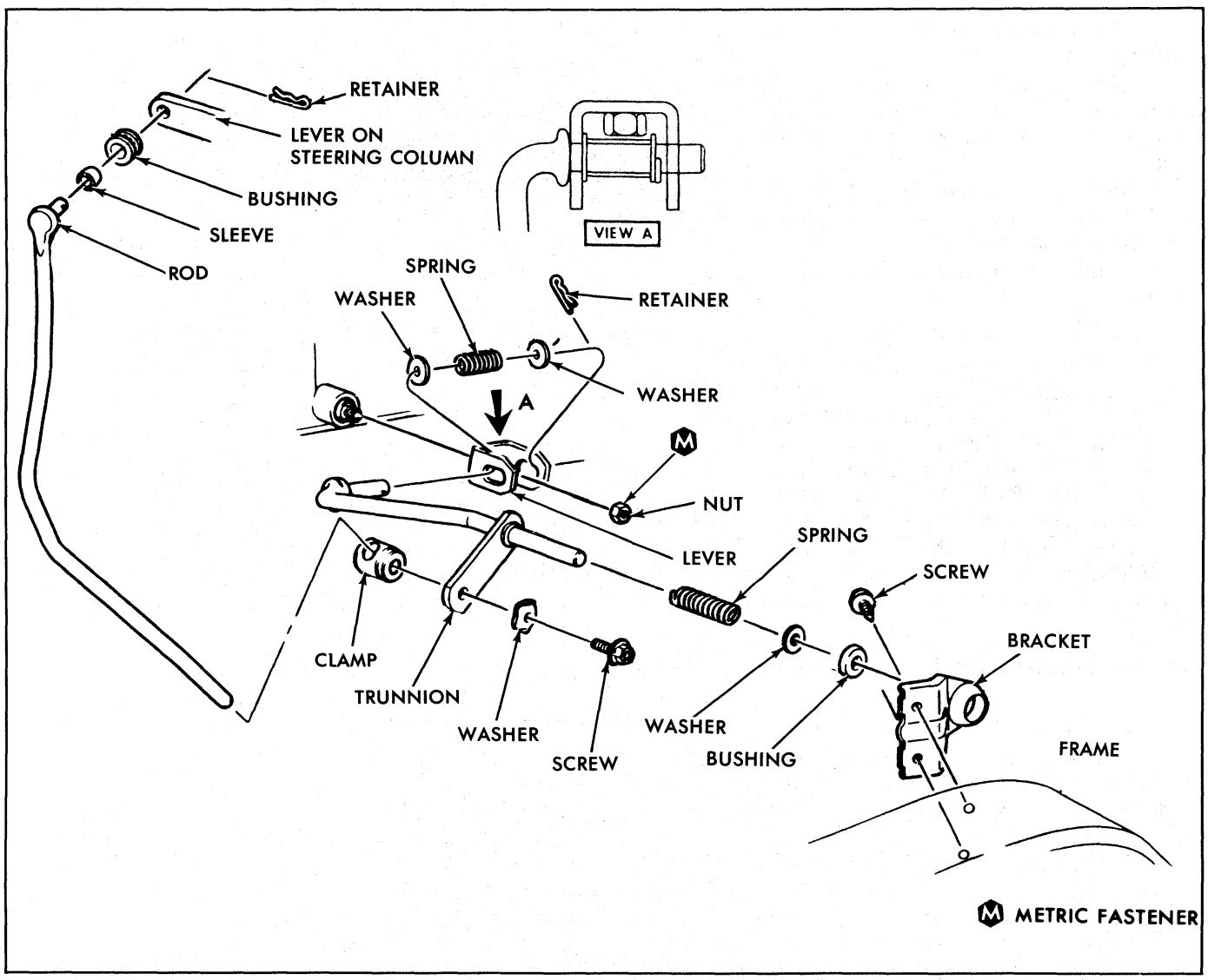


Fig. 7A-13 Transmission Linkage - C-Car

b. Checking and Adding Fluid (Fig. 7A-17)

Automatic transmissions are frequently overfilled because the fluid level is checked when the fluid is cold and the dipstick indicates fluid should be added. However, the low reading is normal since the level will rise as the fluid temperature increases. A level change of over 3/4 inch will occur as fluid temperature rises from 60° to 180° (Celsius 16 to 82).

Overfilling can cause foaming and loss of fluid through the vent. Slippage and transmission failure can result.

Fluid level too low can cause slipping, particularly, when the transmission is cold or the car is on a hill.

Check the transmission fluid level with the engine running, the shift lever in Park, and the car level.

NOTE: If the vehicle has recently been operated for an extended period at high speed or in city traffic in hot weather or the vehicle is being used to pull a trailer, an accurate fluid level cannot be determined until the fluid has cooled down - usually about 30 minutes after the vehicle has been parked.

Remove the dipstick and touch the transmission end of the dipstick cautiously to find out if the fluid is cool, warm or hot, Fig. 7A-17.

Wipe it clean and re-insert until cap seats. Remove dipstick and note reading.

If the fluid feels cool, about room temperature (65° to 85°F)(Celsius 18 to 19) the level should be 1/8 to 3/8 inch below the ADD mark.

If it feels warm the level should be close to the ADD mark (either above or below).

If it feels hot (cannot be held comfortably) the level should be between the ADD and FULL marks.

NOTE: DO NOT OVERFILL. It takes only one pint to raise level from ADD to FULL with a hot transmission.

c. Draining Bottom Pan and Replacing Intake Pipe and Filter Assembly

1. Remove dipstick from filler tube and insert a length of hose secured to a suction gun down the filler tube. Remove 2 quarts of transmission fluid so that bottom pan will not overflow when removed.

2. Raise car on hoist or place on jack stands and provide container to collect draining oil.

3. Remove bottom pan and gasket. Discard gasket.

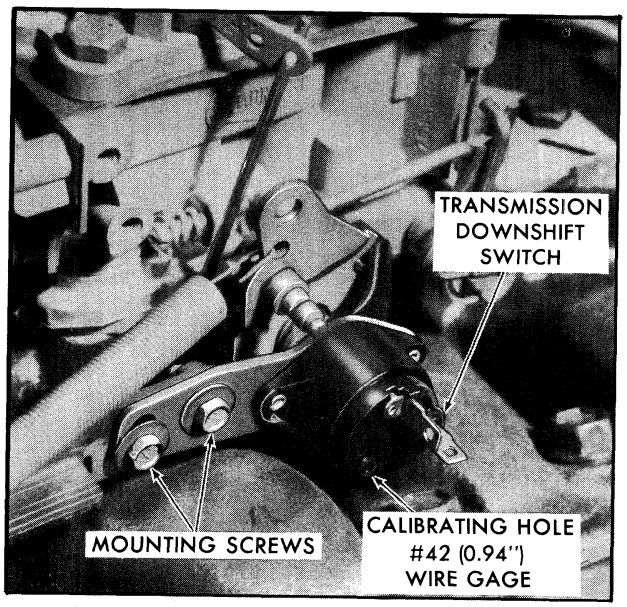


Fig. 7A-14 Downshift Switch - C-Car

4. Drain fluid from bottom pan. Clean pan with solvent and dry thoroughly with clean compressed air.

5. Remove filter retainer bolt.

6. Remove intake pipe and filter assembly. Remove and discard intake pipe O-ring and filter.

7. Install new intake pipe O-ring onto pipe and install intake pipe into filter assembly.

8. Install intake pipe and filter assembly into case bore.

9. Install filter retainer bolt.

10. Install new gasket on bottom pan and install bottom pan. Tighten bottom pan attaching screws to 12 foot-pounds.

11. Lower car and add 4 quarts of transmission fluid through filler tube when replacing intake pipe O-ring seal and filter assembly. When draining bottom pan only add 2 quarts of transmission fluid.

12. Operate engine at 800 rpm for approximately 1-1/2 minutes with selector lever in park "P" position.

13. Reduce engine speed to slow idle and check fluid level. Add fluid, if necessary, to bring to proper level, Fig. 7A-17.

d. Adding Fluid to Fill Dry Transmission and Converter Assembly

The fluid capacity of the Turbo Hydra-matic transmission and converter assembly is approximately 25 pints but correct level is determined by mark on dipstick rather than by amount added. It is important that proper level be maintained. In cases of transmission overhaul, when a complete fill is required, including converter, proceed as follows:

1. Add 8 quarts of transmission fluid through filler tube.

2. Operate engine at 800 rpm for approximately 1-1/2 minutes with selector lever in park "P" position.

3. Reduce engine speed to slow idle.

4. Check fluid level and add additional fluid, if necessary, to bring to proper level, Fig. 7A-17.

Towing Instructions

Refer to the General Motors Passenger Car and Light Truck Towing Instructions Manual.

Units That Can Be Removed With Transmission in Car

The following units can be removed from the transmission without removing transmission from car.

While the detailed procedure for removing each of the units, other than the extension housing and oil seal, and pressure regulator valve, is not outlined separately, the procedures covered under the transmission disassembly and assembly notes will apply.

a. Extension Housing

Removal - Page 7A-28
Installation - Page 7A-28
Oil Seal Replacement - Page 7A-27

b. Pressure Regulator Valve

Removal - Page 7A-29
Installation - Page 7A-29

c. Vacuum Modulator and Valve

Removal - Page 7A-34
Installation - Page 7A-69

d. Governor Assembly

Removal - Page 7A-34
Disassembly - Page 7A-41
Installation - Page 7A-69

e. Speedometer Driven Gear Assembly

Removal - Page 7A-34
Disassembly - Page 7A-43
Installation - Page 7A-69

f. Intake Pipe and Filter Assembly and Bottom Pan

Removal - Page 7A-34
Installation - Page 7A-69 or 7A-26

g. Control Valve Assembly, Governor Pipes, and Detent Spring and Roller Assembly

Removal - Page 7A-34
Disassembly - Page 7A-43
Installation - Page 7A-68

h. Rear Servo Assembly

Removal - Page 7A-35
Disassembly - Page 7A-46
Installation - Page 7A-68

i. Downshift Solenoid, Solenoid Connector, Control Valve Spacer and Gaskets, Check Balls, and Front Servo Assembly

Removal - Page 7A-36
Front Servo Disassembly - Page 7A-46
Installation - Page 7A-67

j. Detent Lever, Manual Shaft, and Parking Linkage

Removal - Page 7A-37
Installation - Page 7A-66

Extension Housing Oil Seal Replacement (Transmission in Car)

1. Raise car on hoist or place on jack stands. Inspect leak to determine if cause is O-ring or housing seal.

2. Remove propeller shaft assembly as described on page 4A-4.

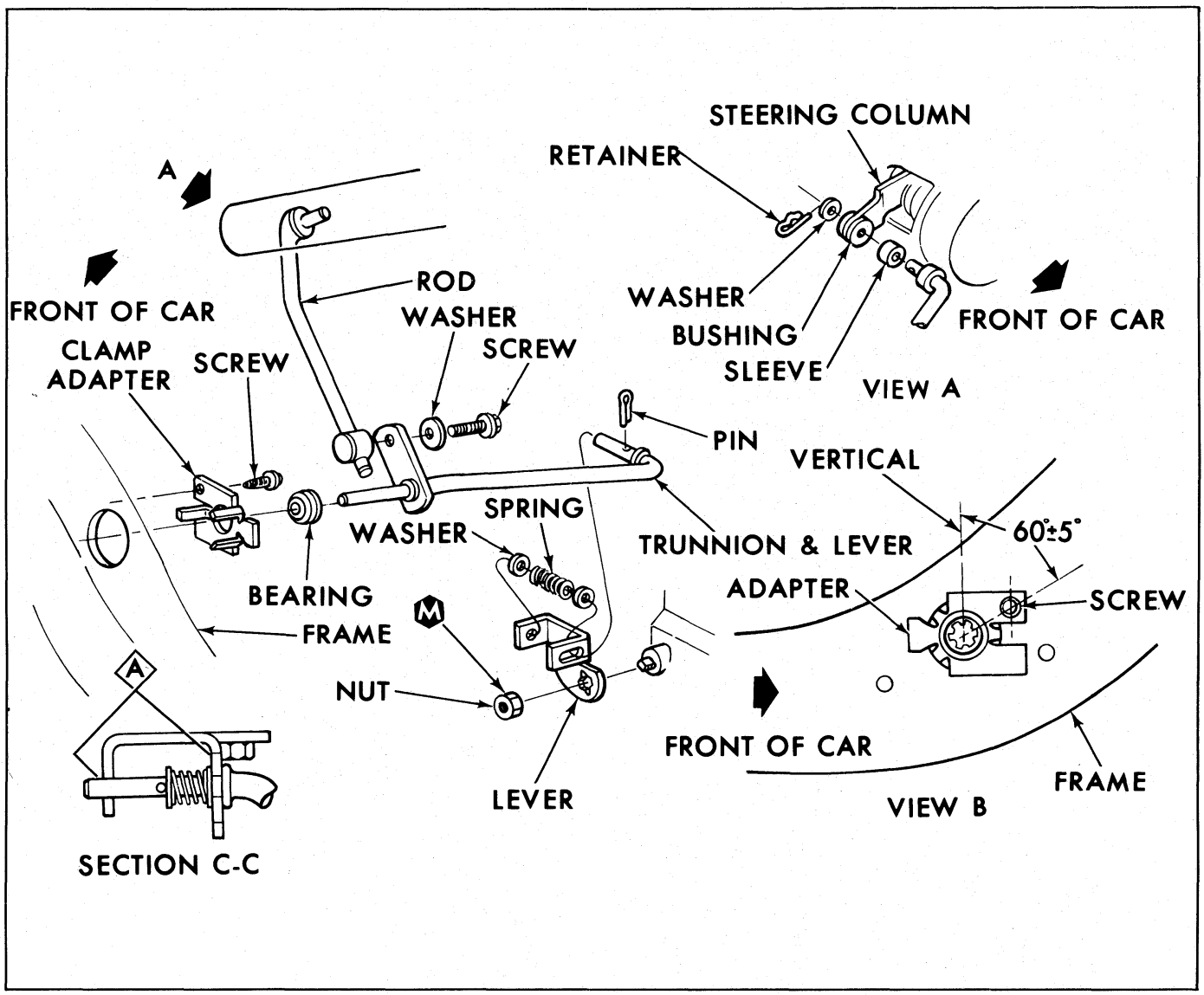


Fig. 7A-15 Transmission Linkage - Seville

3. Use hammer to drive chisel under lip of oil seal and pry seal out of housing, Fig. 7A-18.

4. Install new extension housing oil seals onto Oil Seal Installer, J-21359.

5. Apply sealer supplied with new seal to outside of seal and install seal in extension housing using Oil Seal Installer, J-21359, Fig. 7A-19.

6. Install propeller shaft assembly as described on in Section 4B.

7. Lower car to floor and add fluid to transmission as required.

Extension Housing Removal and Installation (Transmission in Car)

a. Removal

1. Raise car on hoist or place on jack stands. Provide container to catch oil.

2. Remove propeller shaft assembly as described on in Section 4A-5.

3. Remove rear engine mount to extension housing attaching screws.

4. Place jack under bottom oil pan. Use a block of wood to prevent damage to pan and raise transmission to lift extension housing off rear engine mount.

5. Remove six extension housing attaching screws and slide extension housing rearward and downward to remove from car. Make certain that output shaft splines do not come in contact with extension housing oil seal, as splines could damage seal lip.

6. Remove and discard O-ring from output shaft.

b. Installation

1. Install gasket on extension housing.

2. Install new O-ring on output shaft and grease O-ring and splines with specified lubricant.

3. Carefully install extension housing over output shaft and against transmission case. Do not permit output shaft to contact oil seal as splines could damage seal lip.

4. Install six extension housing to case attaching screws, tightening screws 5. Lower transmission onto rear engine mount.

6. Install two rear engine mount to extension housing screws. Tighten screws to 55 foot-pounds.

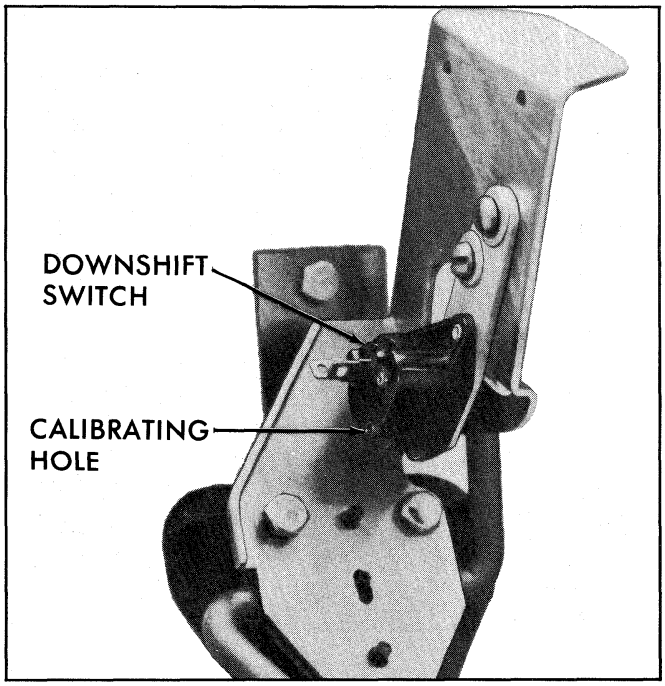


Fig. 7A-16 Adjusting Downshift Switch - Seville

7. Remove jack from bottom of oil pan.

8. Install propeller shaft assembly as described on in Section 4A-5.

9. Lower car to floor and add fluid to transmission as required.

Pressure Regulator Valve Removal and Installation (Transmission in Car)

a. Removal

CAUTION: *The solid type pressure regulator valve does not contain oil holes and an orifice cup plug like the previous type pressure regulator valve. The solid style valve must only be used in the pump cover with the squared off pressure regulator boss, (pressure boost bushing end). See Fig. 7A-21. The previous pressure regulator valve with the oil holes and orifice cup plug will be used to service either type pump cover.*

1. Raise car on hoist or place on jack stands. Provide container to catch oil.

2. Remove bottom pan and gasket. Drain oil.

3. Remove the filter retaining bolt and lift out pump intake pipe and filter assembly.

4. Remove and discard intake pipe O-ring and bottom pan gasket.

5. Using a screwdriver, steel rod or Tool J-24684 compress regulator boost valve bushing against pressure regulator spring, Fig. 7A-20.

WARNING: PRESSURE REGULATOR SPRING IS TIGHTLY COMPRESSED AND WILL FORCE VALVE BUSHING OUT OF BORE WHEN SNAP RING IS REMOVED IF VALVE BUSHING IS NOT HELD SECURELY.

6. Continue to exert pressure on valve bushing and remove snap ring, using Snap Ring Pliers, J-5403 (#21). Gradually release pressure on valve bushing until all spring force is exhausted.

7. Carefully remove regulator boost valve bushing and valve, and pressure regulator spring. Be careful not to drop parts, as they will fall out if they are not held.

8. Remove pressure regulator valve and spring retainer. Remove spacers if present. Be careful not to drop pressure regulator valve when removing it from bore.

b. Installation

1. Install spring retainer on pressure regulator spring. Also install spacers if previously removed.

2. Install pressure regulator valve on spring, stem end first.

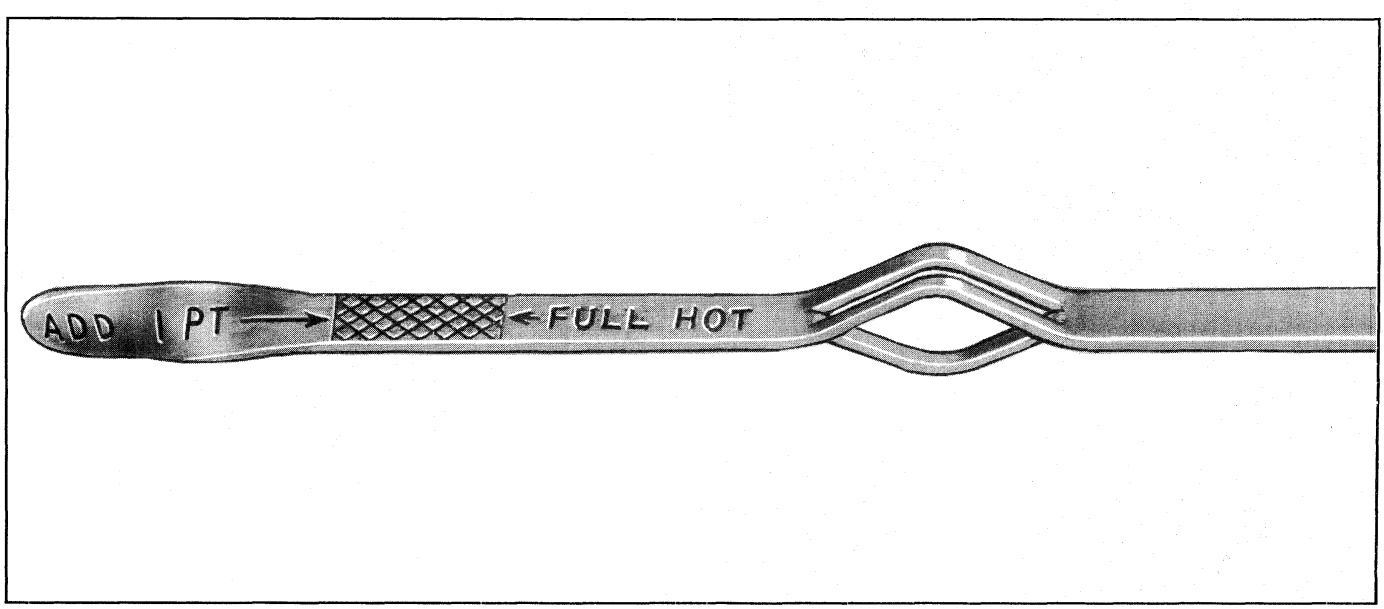


Fig. 7A-17 Transmission Oil Level - C-Car - Seville

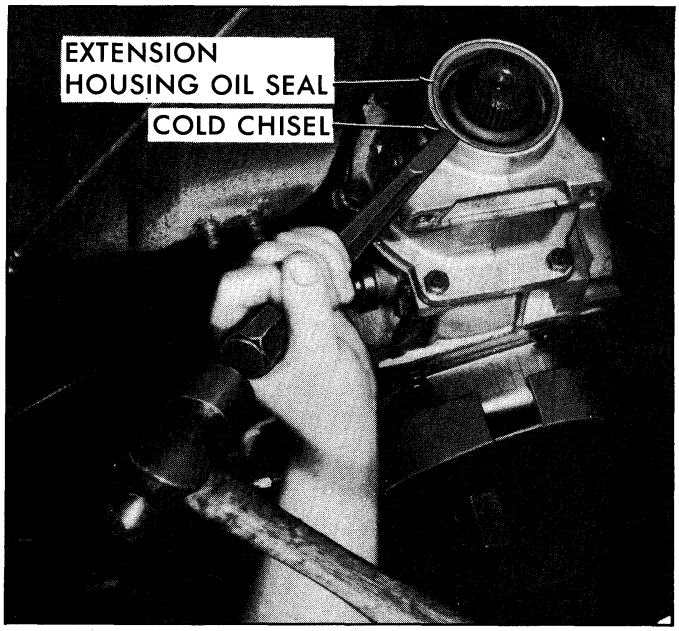


Fig. 7A-18 Removing Extension Housing Oil Seal

3. Install boost valve into bushing, stem end out, and stack parts so that pressure regulator spring is against valve bushing.

4. Install complete assembly into pressure regulator valve bore, being careful not to drop parts during installation.

5. Using a screwdriver, steel rod or tool J-24684 compress regulator boost valve bushing against pressure regulator spring until it is beyond snap ring groove, and install snap ring using Snap Ring Pliers, J-5403 (#21), Fig. 7A-20.

NOTE: To facilitate installation of snap ring, encircle it around screwdriver or steel rod, compress tangs with snap ring pliers, and slide snap ring upward into ring groove in valve bore.

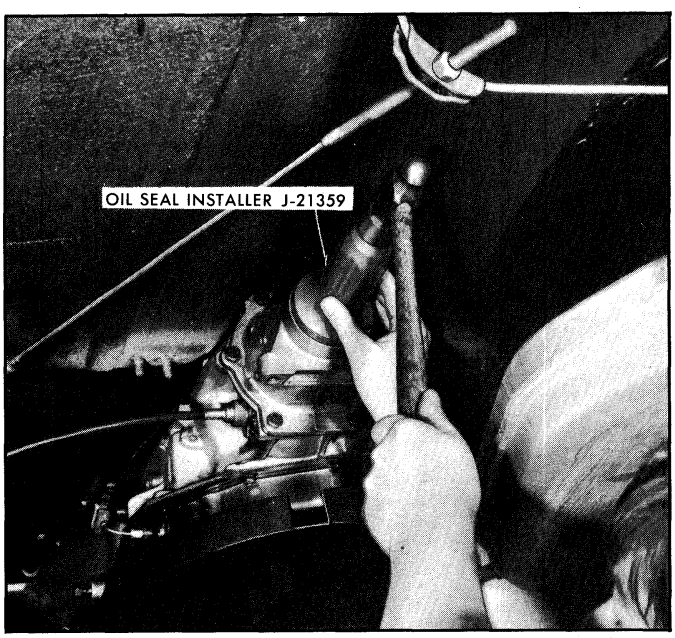


Fig. 7A-19 Installing Extension Housing Oil Seal

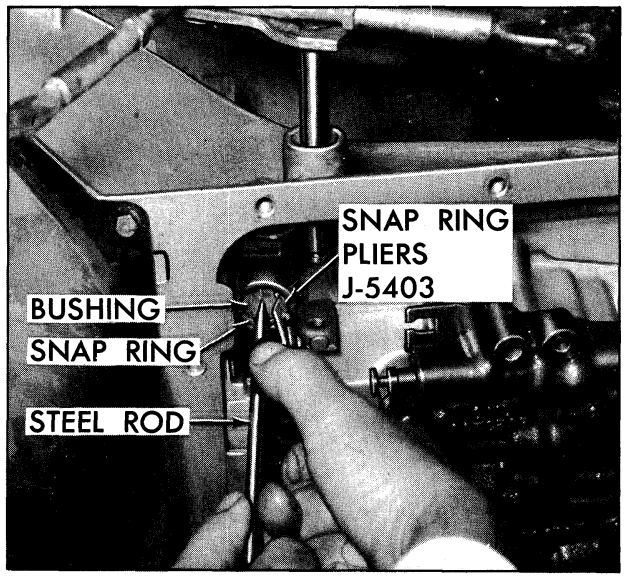


Fig. 7A-20 Removing and Installing Pressure Regulator Valve

6. Install new intake pipe O-ring onto intake pipe and install intake pipe and filter assembly into transmission case bore, retaining filter with retainer bolt.

7. Install new gasket on bottom pan and install bottom pan.

8. Install thirteen bottom pan attaching screws. Tighten screws to 12 foot-pounds.

9. Lower car to floor and add fluid to transmission as required.

Transmission Removal and Installation (C-Car - Seville)

a. Removal

1. Disconnect negative battery cable.
2. Raise car on hoist.
3. Disconnect transmission linkage by removing one nut from shaft on left side of transmission.

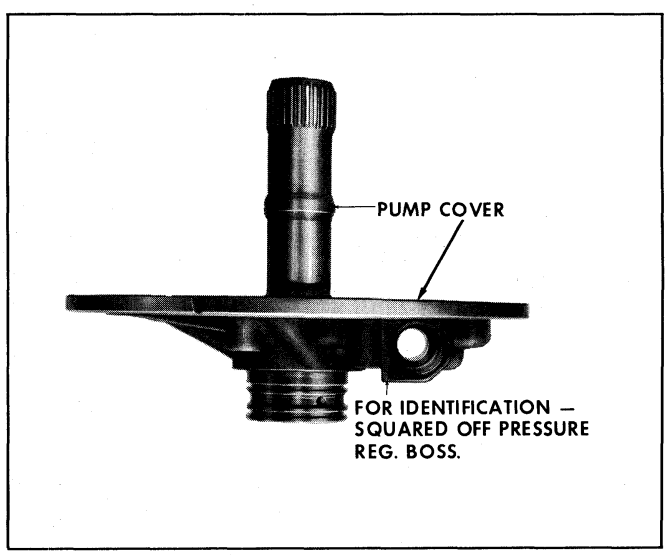


Fig. 7A-21 Solid Type Pressure Regulator Valve

Remove speedometer drive cable.

NOTE: On Seville disconnect solenoid connector at case.

5. Disconnect oil cooler pipes at transmission using an open end wrench to hold fitting and a tubing wrench or a crowfoot adapter to remove tube nut. Cap pipes and plug connector holes in transmission. Position oil cooler pipes out of way.

6. Disconnect vacuum pipe hose from vacuum modulator and position vacuum pipe out of way.

7. Remove two screws that hold starter motor to engine block. Remove starter motor bracket and slide starter forward.

8. Remove propeller shaft as described on page 4A-5.

9. Remove lower flywheel housing cover.

10. Remove three converter to flywheel attaching bolts.

CAUTION: *This is done by inserting a heavy screwdriver in open slot under one of the weld nuts on the converter, and rotating converter and flywheel until bolts can be reached for removal. Do not pry on flywheel ring gear or transmission case to rotate converter, as flywheel or case might be damaged. A bolt in the end of the crankshaft balancer can also be used to rotate the flywheel.*

11. Place jack or other suitable device under rear of engine.

NOTE: On Seville perform steps 12 & 13.

12. Remove lateral strut-rod from engine rear mount and crossmember as described on Page 7A-32.

13. Remove two nuts from tunnel strap and remove strap, Fig. 7A-23.

14. Remove two rear engine mount to extension housing screws.

15. Position transmission jack under transmission and raise it just enough to take the load off rear engine support and remove shim.

16. Remove four bolts, two each side, from rear engine support and swivel support out of position. Allow support to hang by parking brake cable.

17. Disconnect exhaust pipe from exhaust manifold and remove rear engine support crossmember.

18. Remove six transmission case to engine attaching screws. It may be necessary to lower engine and transmission slightly to gain access to upper attaching screws.

19. Move transmission toward rear of car, disengaging transmission case from locating dowels on engine, install Converter Holding Clamp, J-21366, on front of transmission case, Fig. 7A-22 and lower transmission from car.

CAUTION: *Converter holding clamp must be used when removing transmission, otherwise converter can fall out when transmission is removed.*

20. Remove Converter Holding Clamp from transmission case and remove converter.

CAUTION: *Converter with oil weighs approximately 50 pounds. Be careful not to drop or damage converter when removing it.*

b. Installation

1. Install converter on turbine shaft making certain that converter drive hub is fully engaged with pump gear tangs, and install Converter Holding Clamp, J-21366, on front of transmission case, Fig. 7A-22.

2. Place transmission on transmission jack and carefully raise into position. Remove Converter Holding Clamp.

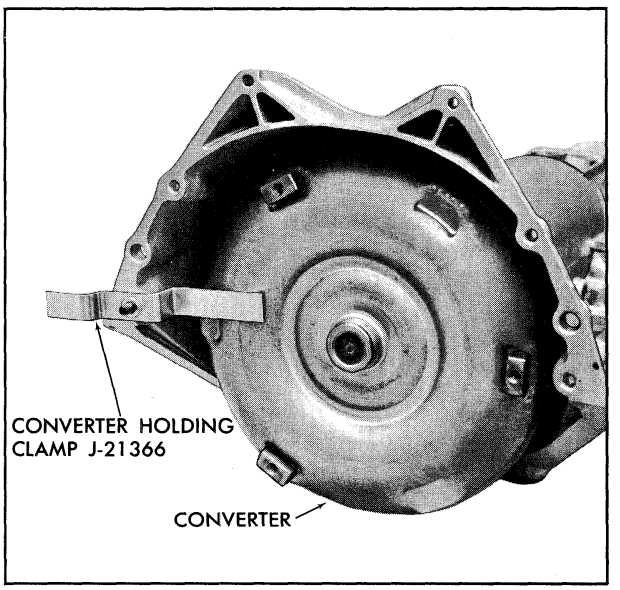


Fig. 7A-22 Installing Converter Holding Clamp

3. Align front of transmission case with engine and dowel holes in transmission case with dowels on engine. Install six transmission case to engine attaching screws, tighten screws to 35 foot-pounds.

CAUTION: *The procedure for attaching the converter to the flywheel as described in Steps 1 through 6 must be strictly followed. Any deviation from this procedure may result in improper installation and damage to flywheel and transmission.*

4. Rotate converter until two of the three weld nuts on converter line up with two bolt holes in flywheel. Make certain converter rotates freely in this position and is not cocked and that pilot in center of converter is properly seated in crankshaft.

5. Install two flywheel to converter attaching bolts through accessible bolt holes in flywheel and tighten finger light. Bolts must not be tightened at this time to assure proper alignment of converter.

6. Insert screwdriver under converter weld nut, rotate converter and install third attaching bolt. Tighten all bolts to 30 foot-pounds.

7. Install lower flywheel housing cover screws tightening screws to 5 foot-pounds.

8. Position starter motor to engine block and install two screws, tightening screws to 46 foot-pounds. Starter harness heat shield and starter ground strap should be installed under outboard screw. Rotate starter harness inside heat shield. Install starter motor front bracket, tightening screws to 12 foot-pounds.

9. Raise engine and transmission above normal height and swivel rear engine support into position. Install two bolts on each side, tighten bolts to 30 foot-pounds.

10. Lower transmission carefully and install two rear engine mount to extension housing screws. Tighten screws to 55 foot-pounds.

11. Install exhaust pipe on exhaust manifold and engage support blade. Tighten screws to 17 foot-pounds.

12. Install four bolts, two each side, on rear engine support crossmember. Tighten bolts to 25 foot-pounds.

NOTE: On Seville perform steps 12 & 13.

13. Install tunnel strap.

14. Install lateral strut-rod as described on page 7A-31.

15. Remove jacks.

16. Install speedometer cable and downshift solenoid electrical harness to transmission case. Connect trackmaster harness if vehicle is so equipped.

17. Install transmission linkage to shaft and secure with one nut.

18. Install vacuum hose on modulator, making sure modulator pipe is fully engaged with modulator.

19. Clean ends of oil cooler pipes with solvent and connect pipes to transmission using an open end wrench to hold fitting and a tubing wrench or a crowfoot adapter to tighten tube nut.

20. Install propeller shaft as described on page 4A-5.

21. Lower car and connect negative battery cable.

22. Add fluid to transmission as required.

23. Check operation of manual linkage. Adjust if necessary as described on page 7A-24 and 7A-25.

Governor Removal and Installation

a. Removal

NOTE: Unit may be removed without removing transmission or bottom pan.

1. Raise car and provide a suitable container to catch transmission fluid.

NOTE: A twin post hoist will allow the front of the car to be lowered slightly and thus avoid spilling transmission fluid.

2. Remove 4 screws securing governor cover to transmission case and remove cover.

3. Remove gasket and discard.

4. Remove governor assembly.

b. Installation

1. Install governor assembly into transmission case.

2. Using a new gasket, position governor cover onto transmission case. Secure with 4 screws and tighten to 18 foot pounds torque.

3. Lower car.

4. Check transmission fluid level as described on Page 7A-25.

Lateral Strut Rod - Seville (Fig. 7A-23)

a. Removal

1. Raise car on hoist.

2. Remove nut, retainer, grommet and spacer from threaded end of strut-rod.

3. Remove nut and grommet from bolt securing strut-rod to transmission mounting bracket.

4. Remove bolt, washer, grommet and spacer, and then remove strut-rod from frame bracket.

b. Installation

1. Install nut, retainer and grommet on end of strut-rod.

2. Insert threaded end of strut-rod through frame bracket and loosely install spacer, second grommet retainer and nut.

3. Install strut-rod on transmission mounting bracket. Install bolt through washer, grommet and spacer securing strut-rod.

4. Install nut on end of bolt, tightening nut to 15-20 ft.lbs.

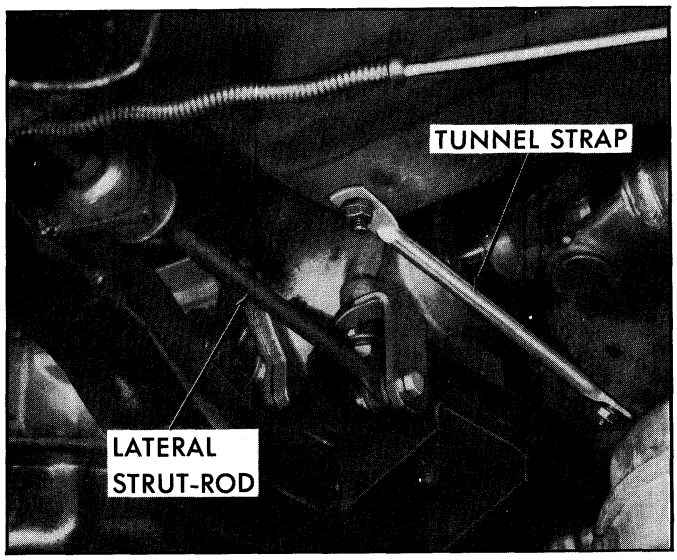


Fig. 7A-23 Lateral Strut Rod - Seville

5. Tighten inboard and outboard nuts on threaded end of strut rod finger tight. In order to provide equal loading on the two grommets, alternately tighten inboard and outboard nuts 1/4 turn until snug. Tighten outboard nut to 65-85 inch lbs.

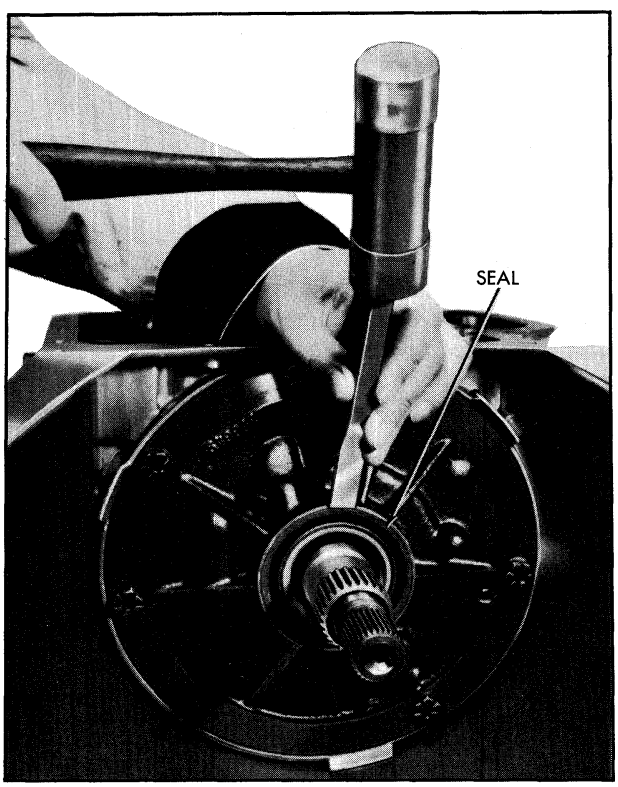


Fig. 7A-24 Removing Pump Oil Seal

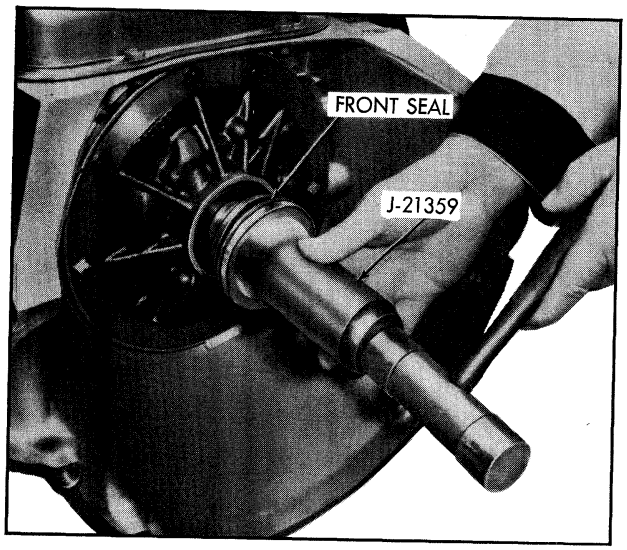


Fig. 7A-25 Installing Pump Oil Seal

Pump Oil Seal Replacement

1. Remove transmission assembly from car as described on page 7A-30.

2. Use hammer to drive chisel under lip of oil seal and pry seal out of pump body, Fig. 7A-24.

3. Before installing new seal, make certain bore is free of foreign material and that garter spring on seal is correctly positioned. Also check finish of converter neck and bearing surface in pump body.

NOTE: Use a non-hardening sealer on outside of seal body before installing seal.

4. Install new seal in pump body using Pump Oil Seal Installer, J-21359, Fig. 7A-25.

5. Install transmission assembly in car as described on Page 7A-31.

UNIT OVERHAUL

Converter

1. Remove transmission from car as described on Page 7A-30. and remove converter from transmission.

2. Perform visual inspection as follows:

a. Inspect converter for visual signs of damage.

b. Inspect for wrong converter.

c. Inspect neck of converter for wear.

d. Inspect pump drive slots for signs of excessive wear.

3. Insert valve, part of Converter Leak Test Fixture, J-21369-01, in neck of converter and back-off large hex nut.

4. Install leak test fixture band crosswise on converter so that slotted plate fits around valve and under nut. Fig. 7A-26. Tighten nut to expand O-ring and secure a good seal.

5. Apply compressed air with a service air hose until approximately 80 to 100 psi air pressure is obtained.

6. Immerse assembly in water, noting any sign of bubbles that would indicate a leak.

7. Depress valve stem to release air pressure in converter and then remove leak test fixture band and valve.

WARNING: ALWAYS RELEASE AIR PRESSURE BEFORE REMOVING VALVE, AS A DEFINITE HAZARD EXISTS SHOULD VALVE BLOW OUT DURING REMOVAL.

8. Thoroughly dry converter and install converter in transmission as follows:

a. Place transmission in Holding Fixture, J-8763-01 and install Holding Fixture in Holding Fixture Base J-3289-21, so that transmission is positioned vertically with pump end up.

b. Carefully position converter on turbine shaft, making certain converter is properly aligned. Long screws or eyebolts can be threaded into the weld nuts on the converter and used as handles.

c. Rotate converter until the shafts are piloted and the converter lugs are indexed in the pump gear.

d. If difficulty is experienced in alignment, tap on outer diameter of converter with plastic-headed hammer, while turning converter.

9. Install transmission as described on Page 7A-31.

NOTE: On the following operations when the transmission is out of car remove converter from

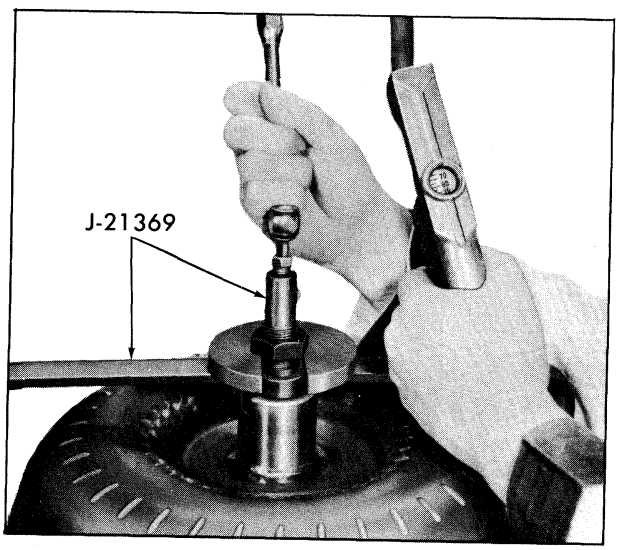


Fig. 7A-26 Leak Checking Converter

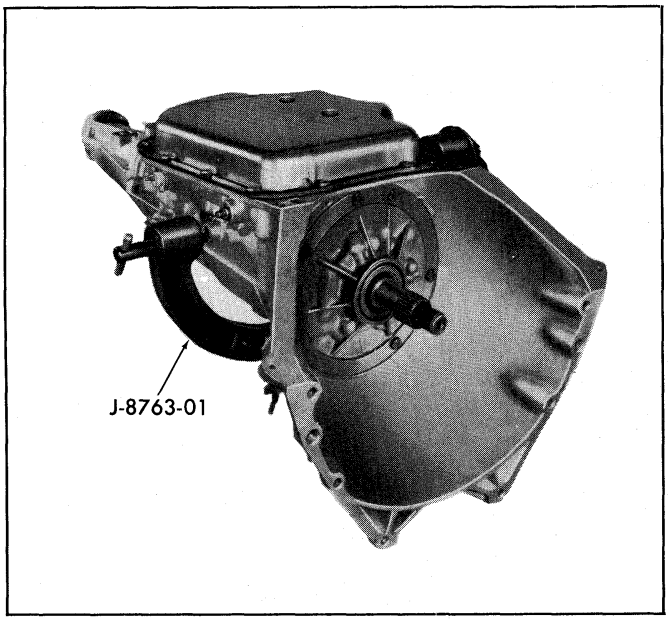


Fig. 7A-27 Transmission in Holding Fixture

transmission and install Holding Fixture, J-8763-02, on transmission so that vacuum modulator will be located on side of Holding Fixture nearest the bench. Install fixture and transmission into Holding Fixture Base, J-3289-21, with bottom pan facing up, Fig. 7A-27 and install lock pin in base. Provide container to catch any oil that may drain from transmission.

Remove Vacuum Modulator and Valve

NOTE: Unit may be removed without removing transmission or bottom pan.

1. Remove vacuum hose from modulator.
2. Remove vacuum modulator attaching screw and retainer from transmission case.
3. Remove modulator assembly and O-ring from case. Discard O-ring.
4. Remove modulator valve from transmission case.

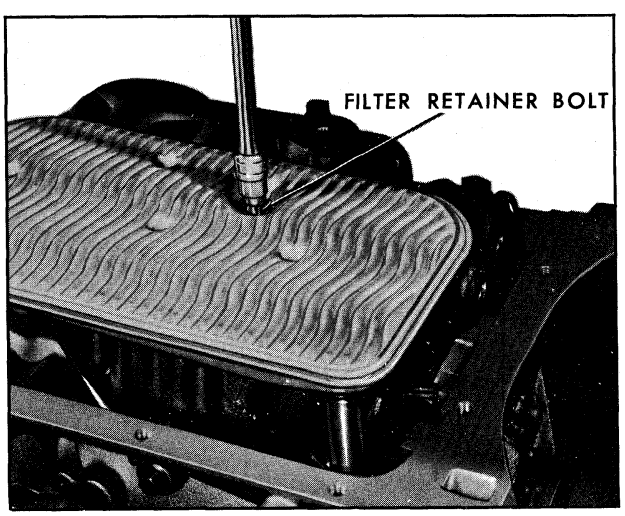


Fig. 7A-28 Removing Filter Retaining Bolt

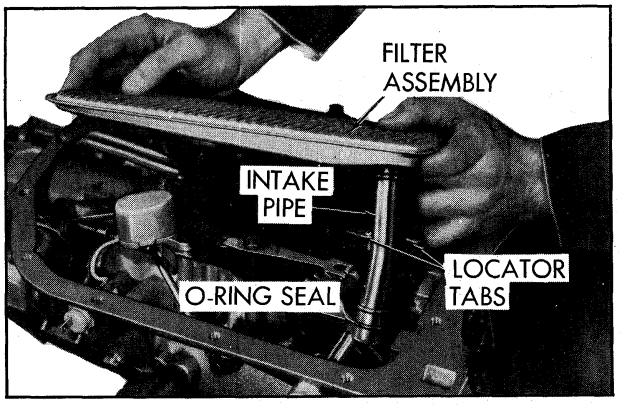


Fig. 7A-29 Removing Intake Pipe and Filter Assembly

Remove Governor Assembly

NOTE: Unit may be removed without removing transmission or bottom pan.

1. Remove four attaching screws, governor cover, and gasket. Discard gasket.
2. Remove two bolts attaching transmission extension housing to cross member.
3. Move rear of transmission sideways enough to allow clearance for governor removal.
4. Remove governor assembly.

Remove Speedometer Driven Gear Assembly

NOTE: Unit may be removed without removing transmission or bottom pan, after removing speedometer cable from driven gear assembly.

1. Remove attaching screw and retainer from left side of case. Apply slight pressure to remove unit and speedometer driven gear.

Remove Intake Pipe and Filter Assembly and Bottom Pan

NOTE: Unit may be removed with transmission in car. In cases of transmission malfunction, filter must be replaced.

1. Remove bottom pan attaching screws.
2. Remove bottom pan and gasket. Discard gasket. Drain oil from pan if transmission is in car.
3. Remove filter retainer bolt, Fig. 7A-28.
4. Lift out pump intake pipe and filter assembly, Fig. 7A-29.
5. Remove intake pipe from filter and discard filter.
6. Remove and discard intake pipe O-ring.

Remove Control Valve Assembly, Governor Pipes, and Detent Spring and Roller Assembly

NOTE: Units may be removed with transmission in car, after removing bottom pan.

1. Remove attaching screw and remove detent spring and roller assembly.
2. Remove ten remaining control valve assembly attaching screws. Do not remove solenoid attaching screws at this time.
3. Remove control valve assembly with the two governor pipes attached, Fig. 7A-30.

CAUTION: *Do not allow manual valve to fall out*

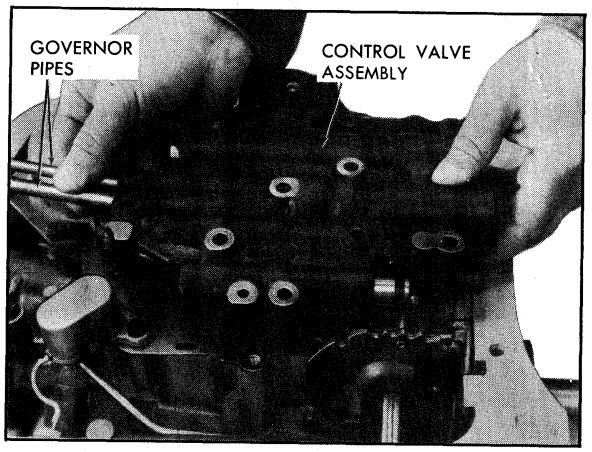


Fig. 7A-30 Removing Control Valve Assembly

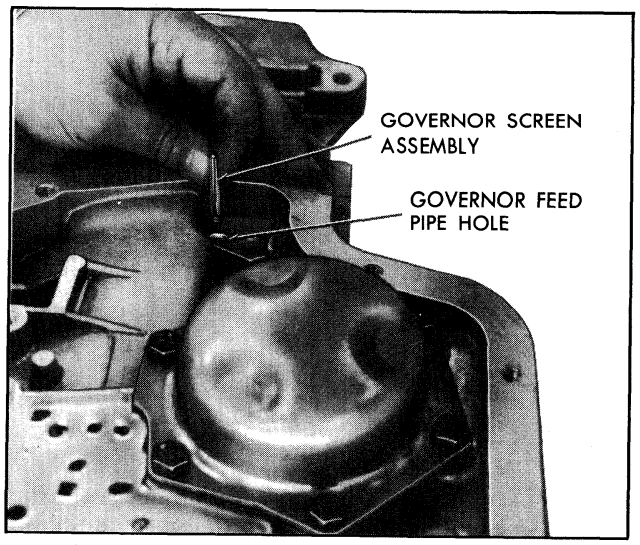


Fig. 7A-31 Removing Governor Screen Assembly

of its bore in control valve assembly. If transmission is in car be careful not to drop front servo group which may drop out as control valve assembly is removed.

4. Remove governor screen assembly from end of governor feed pipe or governor feed pipe hole in case. Fig. 7A-31. Clean screen in clean solvent and air dry.

5. Remove governor pipes from valve body. Governor pipes are interchangeable and need not be identified.

Remove Rear Servo Assembly

NOTE: Unit may be removed with transmission in car after removing bottom pan and allowing fluid to drain. Remove control valve assembly, and governor pipes Page 7A-34.

1. Remove six rear servo cover attaching screws, servo cover, and gasket. Discard gasket.

2. Remove rear servo assembly from transmission case, Fig. 7A-32.

3. Remove servo accumulator spring.

4. Make band apply pin selection check on Page 7A-35 to determine proper size pin to use at time rear servo is assembled.

Band Apply Pin Selection Check

NOTE: Check may be made with transmission in car. Remove bottom pan and allow fluid to drain. Remove control valve assembly, governor pipes and rear servo Page 7A-34.

1. Position Band Apply Pin Selector Gage, J-21370-6, on transmission case over rear servo bore, with hex nut on side of gage facing toward parking brake linkage, and smaller diameter end of Gage Pin, J-21370-5, in servo pin bore, Fig. 7A-33.

2. Secure gage with two 5/16-18 x 1 inch screws, tightening screws to 18 foot-pounds. Make certain that stepped gage pin is free to move up and down in both tool and servo pin bore. Stepped side of pin must face front of transmission case.

Band apply pins are available in three sizes as shown in the following chart:

Identification ring is located on band lug end of pin. Selecting the proper pin is equivalent to adjusting band.

3. To determine proper size pin to use, apply 25 foot-pounds torque on hex nut on side of gage, Fig. 7A-33. This will cause lever on top of gage to depress stepped gage pin into servo pin bore, simulating actual operating conditions. Note relation of steps on gage pin and machined surface on top of gage. Determine proper size pin as follows:

a. If machined surface on top of gage is even with or above upper step on gage pin, long size pin (three rings) is required.

b. If machined surface on top of gage is between upper and lower steps on gage pin, medium size pin (two rings) is required.

c. If machined surface on top of gage is even with or below step on gage pin, short size pin (one ring) is required.

4. If new pin is required, make note of pin size required,

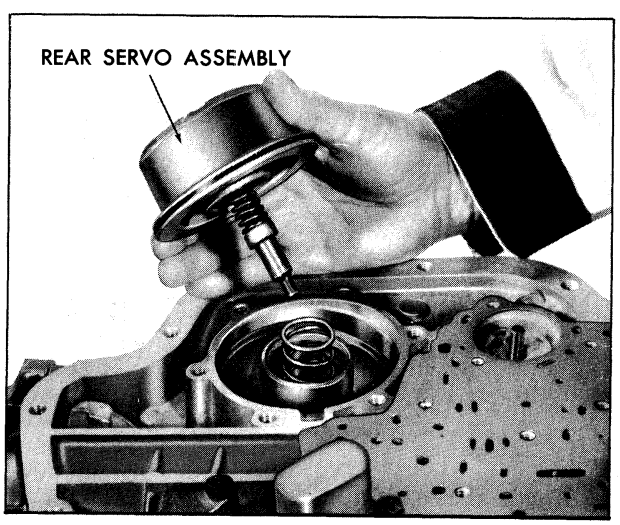


Fig. 7A-32 Removing Rear Servo Assembly

IDENTIFICATION	LENGTH
Three Rings	Long
Two Rings	Medium
One Ring	Short

and remove gage from transmission case.

Remove Detent Solenoid, Solenoid Connector, Control Valve Spacer, Gaskets, Check Balls, and Front Servo Assembly

NOTE: Units may be removed with transmission in car. Remove bottom pan and drain transmission fluid.

To remove control valve spacer, gasket, check balls, and front servo, remove control valve assembly and governor pipes on Page 7A-36.

1. Disconnect detent solenoid wire from electrical connector terminal, see Fig. 7A-34.
2. Compress tabs on case connector and remove connector and O-ring from case. Discard O-ring.
3. Remove two detent solenoid attaching screws and remove solenoid assembly and gasket.
4. Remove control valve spacer plate from case.

NOTE: If operation is being performed on car, lower control valve spacer plate in a level plane so that check balls don't fall out. Then remove check balls from spacer plate.

5. Remove five check balls from cored passages in transmission case.
6. Lift front servo piston, retainer ring, pin, spring retainer, and spring out of transmission case.

Remove Rear Oil Seal and Extension Housing

NOTE: Units may be removed with transmission in car. See Page 7A-30.

1. If required, use hammer to drive chisel under oil seal flange and pry seal out of extension housing.

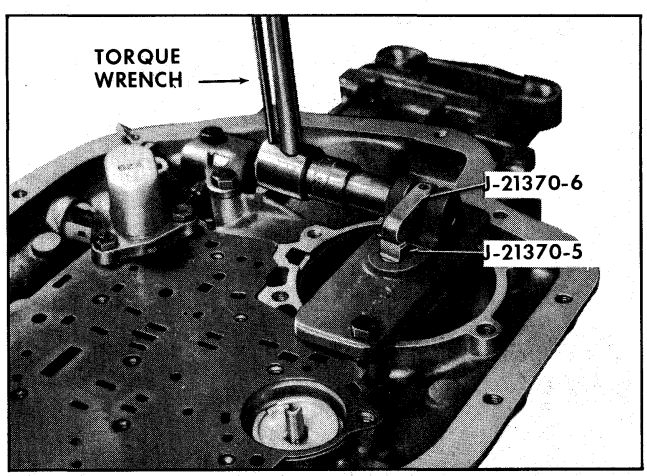


Fig. 7A-33 Band Apply Pin Selection Check

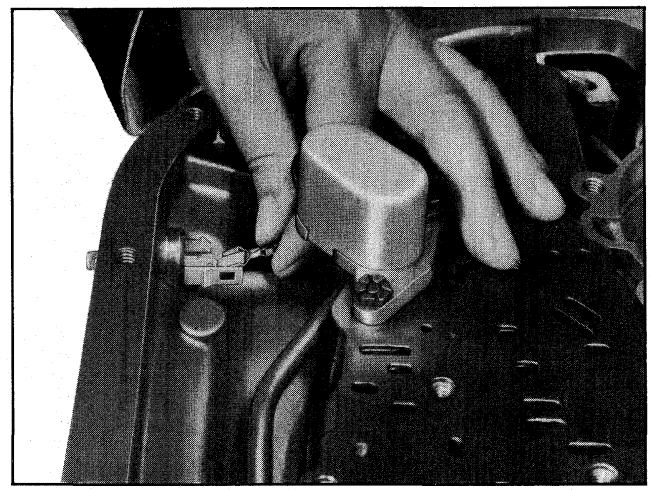


Fig. 7A-34 Removing Wire From Electrical Connector

2. Remove six extension housing attaching screws and remove extension housing.
3. Remove and discard gasket from extension housing.

Front Unit End Play Checking Procedure

NOTE: Transmission must be removed from car as described on Page 7A-30.

1. Remove one oil pump attaching screw and rubber-coated washer at either 10 o'clock or 5 o'clock position.
2. Install Slide Hammer Bolt, J-6125-1, and Adapter, J-6125-2, in screw hole where attaching screw was removed.
3. Mount Dial Indicator, J-8001-02, on slide hammer bolt and index indicator to register with flat surface on end of turbine shaft.
4. Hold output shaft forward while pushing turbine shaft rearward to its stop.

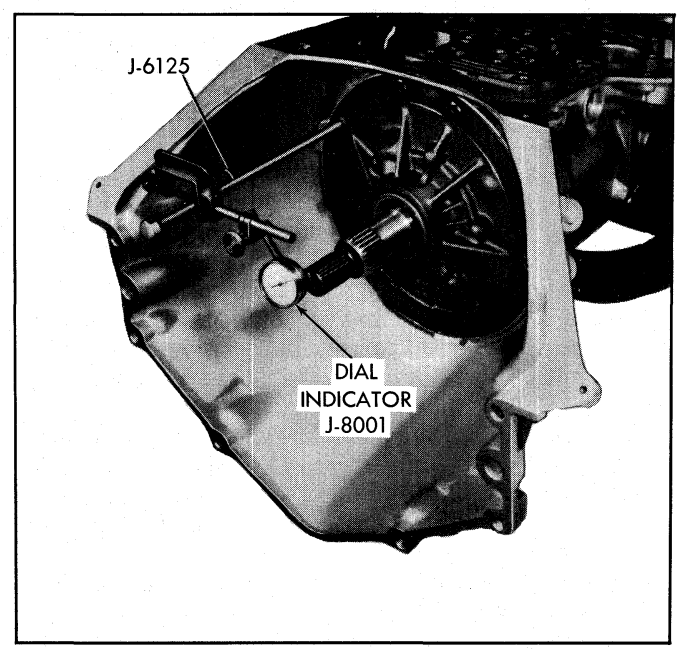


Fig. 7A-35 Front Unit End Play Check

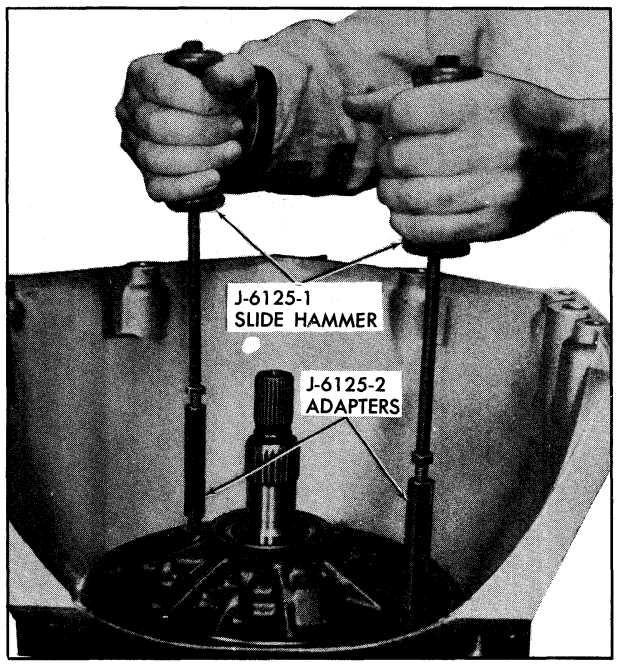


Fig. 7A-36 Removing Pump Assembly

5. Set dial indicator to zero.
6. Pull turbine shaft forward, Fig. 7A-35.

NOTE: Resulting travel or end play for selection of washer for use at time of transmission assembly. End play should be .003 inch - .024 inch. The selective washer controlling this end play is the washer located between pump cover and forward clutch housing. If more or less washer thickness is required to bring end play within specifications, select proper washer from the following chart.

NOTE: An oil-soaked washer may tend to discolor. If necessary, measure washer for thickness.

7. Remove dial indicator. If oil pump is to be removed, do not remove slide hammer assembly at this time.

Remove Oil Pump

NOTE: For removing oil pump only, transmission must be removed from car as described on Page 7A-30.

1. If not done previously, perform the following steps:

a. Remove one oil pump attaching screw and rubber-coated washer at either 10 o'clock or 5 o'clock position.

b. Install Slide Hammer Bolt, J-6125-1, and Adapter, J-6125-2, in screw hole where attaching screw was removed, Fig. 7A-36.

2. Remove other pump attaching screws and washers.

3. Install Slide Hammer Bolt, J-6125-1, and Adapter, J-6125-2, into other threaded hole at 10 o'clock or 5 o'clock position in pump body and drive outward with slide hammers to remove pump assembly from transmission case, Fig. 7A-36.

CAUTION: *Drive outward in unison on both slide hammer assemblies to prevent cocking pump assembly in case.*

4. Remove slide hammer assemblies from pump.
5. Remove and discard pump square cut O-ring and gasket.

Remove Detent Lever, Manual Shaft, and Parking Linkage (Fig. 7A-37)

NOTE: Units may be removed with transmission in car. Drain transmission fluid by removing bottom pan. Remove manual linkage from manual lever and remove detent spring and roller assembly from control valve assembly.

1. Remove pin securing manual shaft to case.

NOTE: If procedure is being performed on car, bend pin to remove it.

2. Loosen locknut securing inside detent lever to manual shaft.
3. Pry or work inside detent lever loose from manual shaft and remove locknut.
4. Remove manual shaft, parking actuator rod and detent lever from case. Inspect manual shaft lip seal as required.
5. Remove parking brake bracket attaching screws and remove bracket.
6. Remove parking pawl return spring.

NOTE: The following steps are to be completed only if one or more of the parts involved require replacement.

7. Remove spring retainer from parking pawl shaft.
8. Remove parking brake pawl shaft cup plug by placing screwdriver between parking pawl shaft and case rib and prying outward, Fig. 7A-38.
9. Remove parking pawl shaft and parking pawl.

Remove Turbine Shaft, Forward Clutch Housing, Direct Clutch Assembly, Sun Gear Shaft, and Front Band

NOTE: Transmission must be removed from car on page 7A-30. Requires removal of oil pump as described on Page 7A-37.

1. Remove turbine shaft and forward clutch assembly from transmission, Fig. 7A-39.
2. Remove forward clutch hub to direct clutch housing thrust washer if it did not come out with forward clutch assembly.
3. Remove direct clutch and intermediate roller assembly, Fig. 7A-40. Sun gear shaft may come out with direct clutch assembly.
4. Remove sun gear shaft if not previously removed. See Fig. 7A-41.
5. Remove front band assembly.

NOTE: Check rear unit end play at this time. Proceed as follows:

Rear Unit End Play Checking Procedure

NOTE: Transmission must be removed from car, as described on page 7A-30. Requires removal of extension housing.

1. Install Speedometer Puller Bolt, J-21797, in one of the bolt holes on end of transmission case.
2. Mount Dial Indicator, J-8001, on Bolt, J-21797, and index indicator to register with flat surface on end of output shaft, Fig. 7A-42.
3. Set dial indicator to zero.
4. Move output shaft in and out. Note resulting travel or end play for selection of washer for use at time of transmission assembly. End play should be .007 inch - .019 inch.

The selective washer controlling this end play is the steel

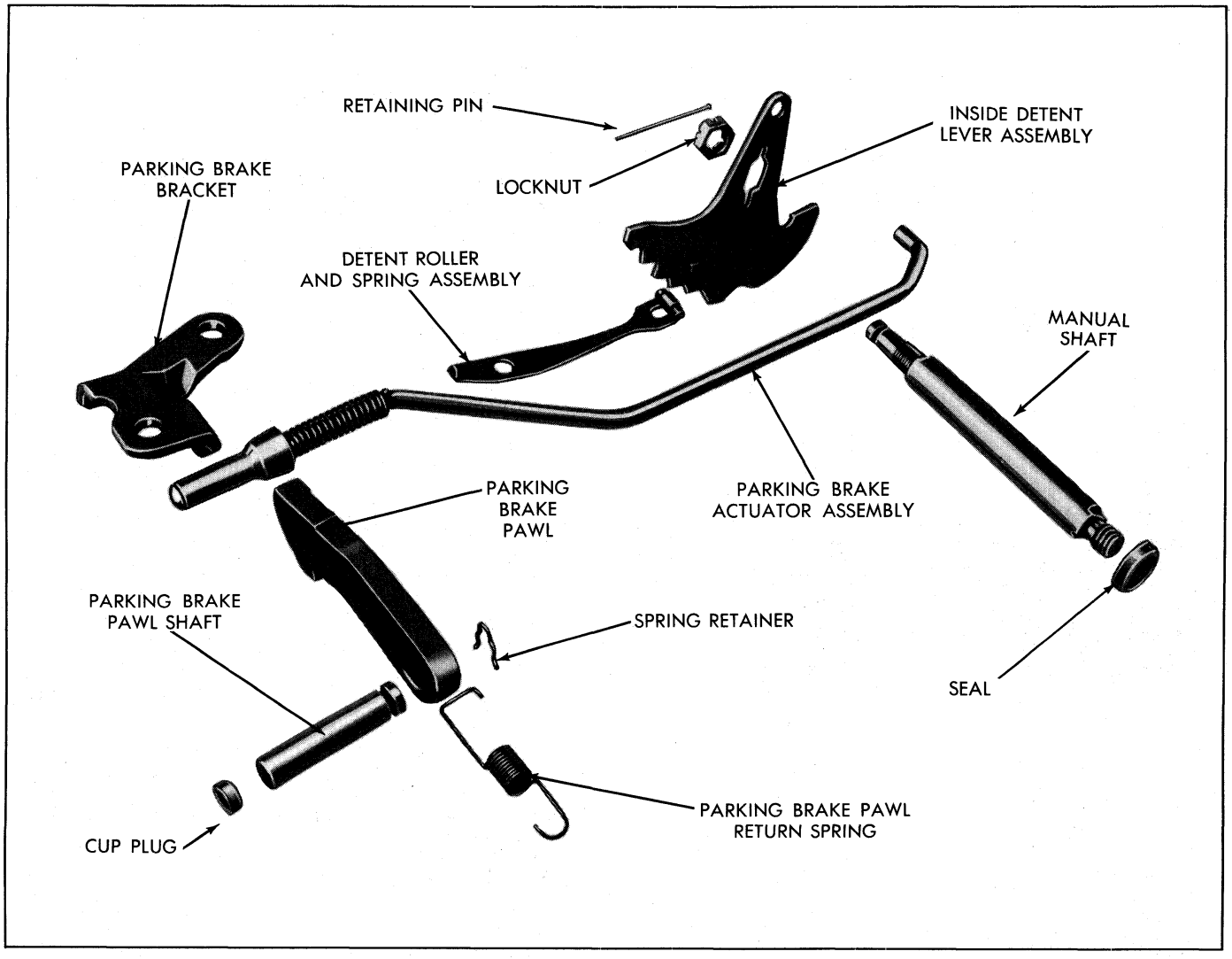


Fig. 7A-37 Manual and Parking Linkage

washer with the three tabs, located between thrust washer and rear face of transmission case. Notches and/or numerals on the tabs serve to identify washer thickness.

If a different washer thickness is required to bring end play within specifications, it can be selected from the following chart. The table will show identification notches numerals or both.

THICKNESS (INCH	COLOR
.060 - .064	Yellow
.071 - .075	Blue
.082 - .086	Red
.093 - .097	Brown
.104 - .108	Green
.115 - .119	Black
.126 - .130	Purple

Remove Remaining Components

NOTE: Transmission must be removed from car as described on Page 7A-30. Requires removal of bottom pan, control valve assembly and governor pipes see Page 7A-43 rear servo assembly see Page 7A-35, control valve spacer two gaskets, check balls and front servo assembly see Page 7A-36, oil pump see Page 7A-37, turbine shaft forward clutch housing, direct clutch assembly, sun gear shaft and front band see Page 7A-37.

1. Remove center support bolt from transmission case using 3/8 inch 12-point thin wall deep socket.
2. Remove intermediate clutch backing plate to case snap ring.
3. Remove intermediate clutch backing plate, and three composition and three steel clutch plates.
4. Using needle nose pliers, or screwdriver, remove center support to case snap ring.
5. Install Tool, J-21795, on end of main shaft so that tangs engage groove in shaft. Tighten screw on tool to secure tool on shaft and prevent movement of roller clutch during removal of gear unit assembly, Fig. 7A-43.
6. Install proper diameter length of pipe over output shaft to be used as a handle and to prevent spline damage to

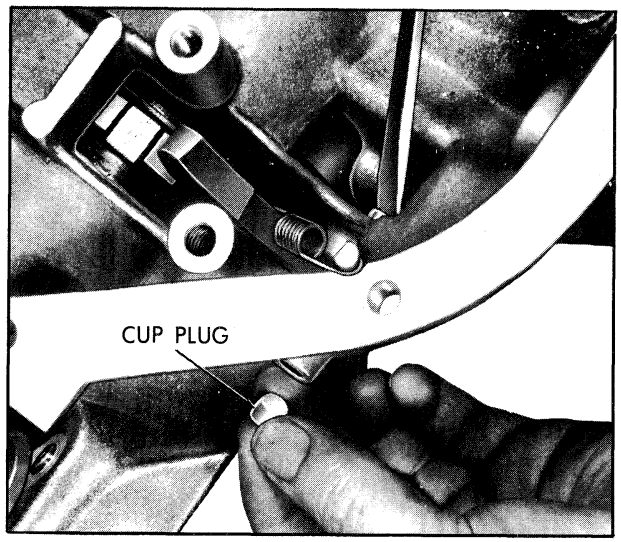


Fig. 7A-38 Removing Cup Plug

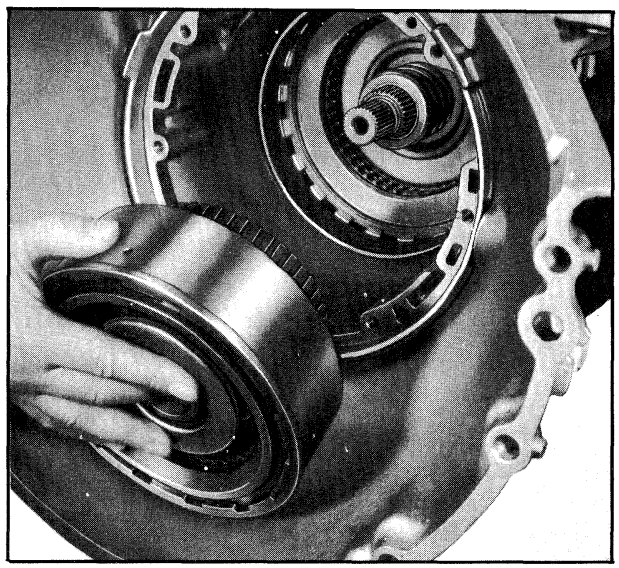


Fig. 7A-40 Removing Direct Clutch and Intermediate Roller Assembly

case bushing when removing gear unit, center support, and reaction carrier.

NOTE: Loosen transmission holding fixture pivot pin slightly, so that gear unit assembly does not bind when it is removed from case.

7. With transmission case in a horizontal position, shift complete assembly toward front of case to facilitate removal of assembly from case. Remove complete gear unit assembly from case.

CAUTION: *Be careful not to drop or bump assembly in transmission case during removal. This could result in damage to output shaft bushing in case as well as to assembly itself.*

8. Remove output shaft to case thrust washer from output shaft or case.

9. Using Adapter, J-21364, in Rear Unit Holding Fixture, J-6116-01, place gear unit assembly in holding fixture with mainshaft pointing upward, Fig. 7A-43. Remove Tool J-21795.

10. Remove rear unit selective washer from transmission case.

11. Remove the center support to case spacer (refer to Fig. 7B-61.)

12. Remove rear band assembly. To facilitate removal, rotate band lugs away from pins and pull band assembly out of transmission case.

13. Remove center support assembly from reaction carrier by lifting straight upward.

14. Remove center support to reaction carrier thrust

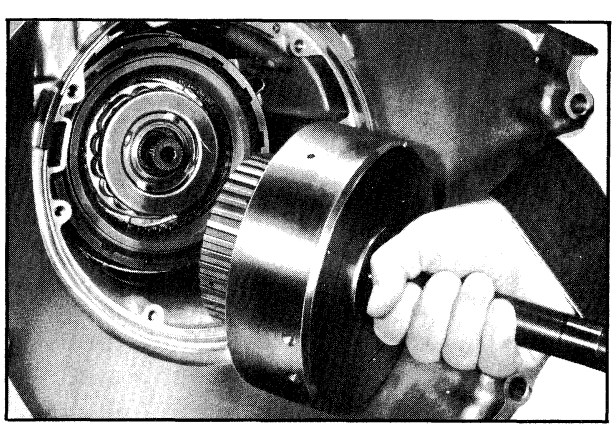


Fig. 7A-39 Removing Forward Clutch Assembly

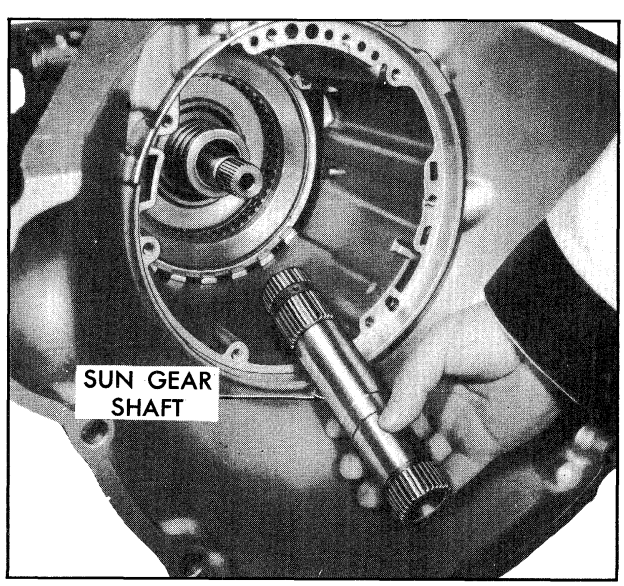


Figure 7A-41 Removing Sun Gear Shaft

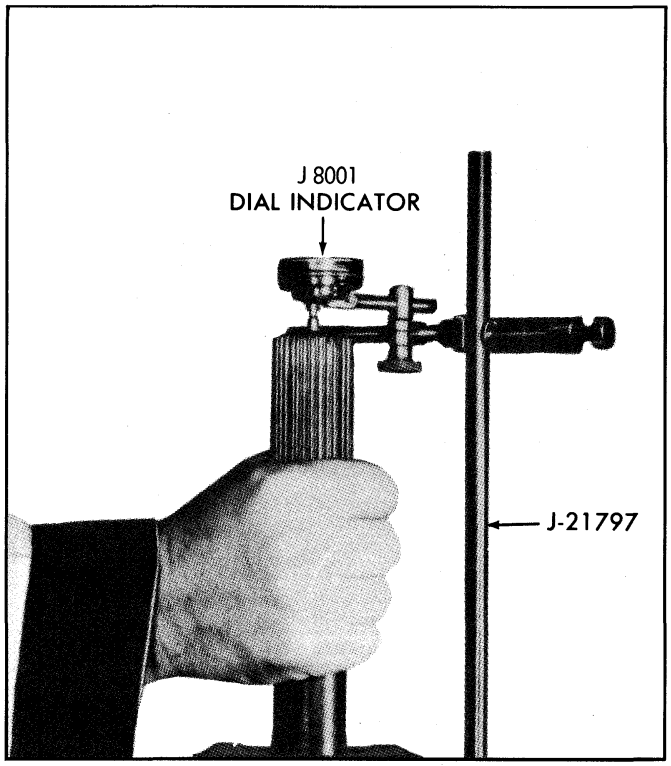


Fig. 7A-42 Checking Rear Unit End Play

washer, Fig. 7A-44.

NOTE: Thrust washer may have stuck to back of center support. If so, remove from center support.

15. Remove reaction carrier and roller clutch assembly from output carrier, Fig. 7A-45, and remove roller clutch assembly from reaction carrier.

TRANSMISSION DISASSEMBLY, CLEANING, INSPECTION AND ASSEMBLY OF INDIVIDUAL UNITS

Inspect each part thoroughly after the transmission and individual units have been disassembled and cleaned, to determine which parts should be replaced. It is very important to distinguish between parts that are simply "worn-in", and those parts worn to the extent that they affect operation of the unit. Only "worn-out", broken or damaged parts should be replaced.

Inspection of Torque Converter

1. Check converter for leaks as described on Page 7A-33.
2. Check converter hub surfaces for signs of scoring or wear.

Inspection of Vacuum Modulator and Valve

1. Inspect vacuum modulator for any signs of bending or distortion.
2. Inspect O-ring seat for damage.
3. Inspect modulator valve for nicks or damage.
4. Check freeness of valve operation in case bore.
5. Check modulator for damaged bellows.

Modulator plunger is under approximately 16 pounds pressure. If bellows is damaged, plunger will have very little pressure. Use procedure outlined in Diagnosis Part V.

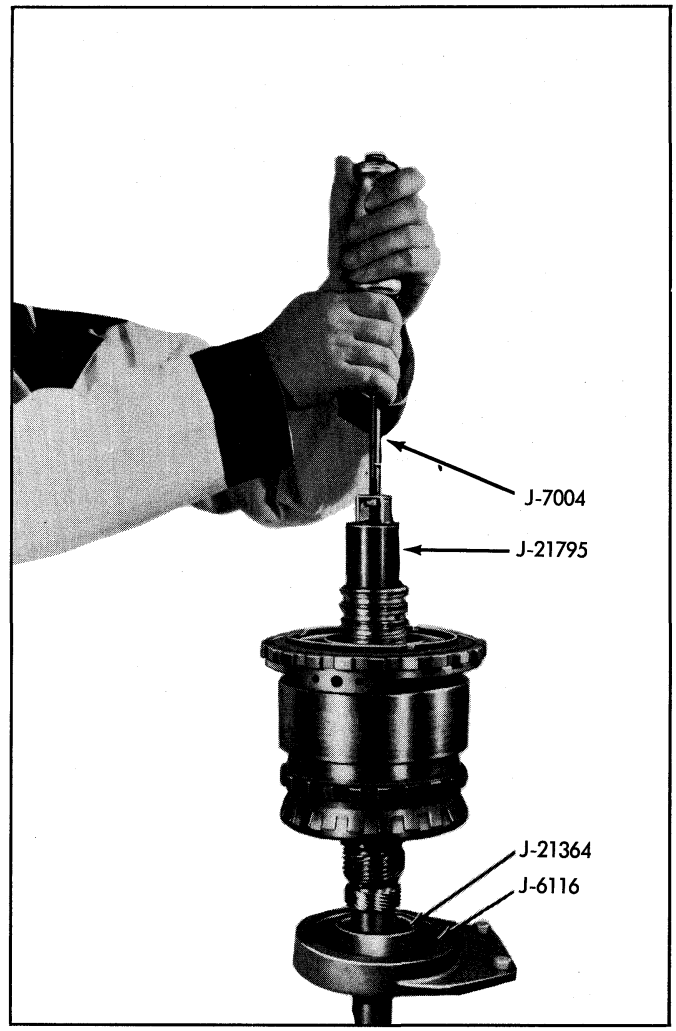


Fig. 7A-43 Gear Unit in Holding Fixture

Inspection of Extension Housing

1. Inspect bushing and rear seal for excessive wear or damage.
2. Inspect gasket mounting face for damage.
3. Inspect housing for cracks or porosity.
4. Be sure rear seal drain back port is not blocked.

THICKNESS (INCH)	IDENTIFICATION NOTCH AND/OR NUMERAL	
.074 - .078	None	1
.082 - .086	On Side of 1 Tab	2
.090 - .094	On Side of 2 Tabs	3
.098 - .102	On End of 1 Tab	4
.106 - .110	On End of 2 Tabs	5
.114 - .118	On End of 3 Tabs	6

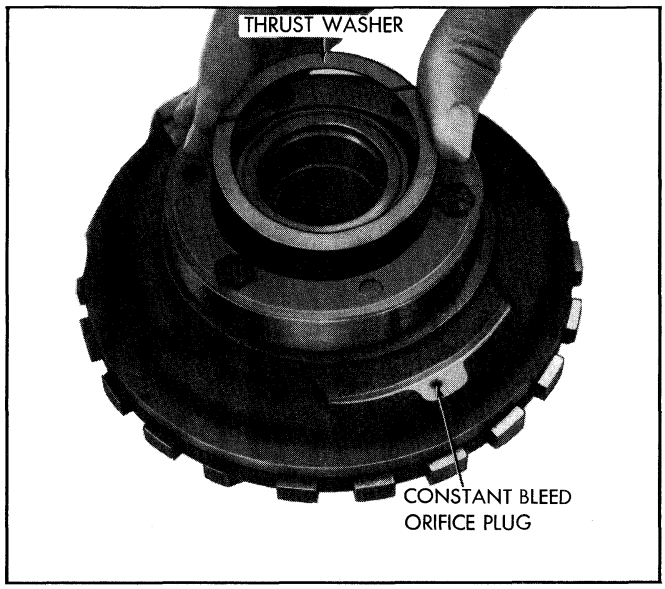


Fig. 7A-44 Removing Center Support to Reaction Carrier Thrust Washer

Inspection of Detent Lever, Manual Shaft, and Parking Linkage

1. Inspect parking actuator rod for cracks, or broken spring retainer lugs.
2. Inspect actuator spring for damage.
3. Inspect actuator for a free fit on actuator rod.
4. Inspect parking pawl for cracks or wear.
5. Inspect manual shaft and lip seal for damage.
6. Inspect inside detent lever for cracks or a loose pin.

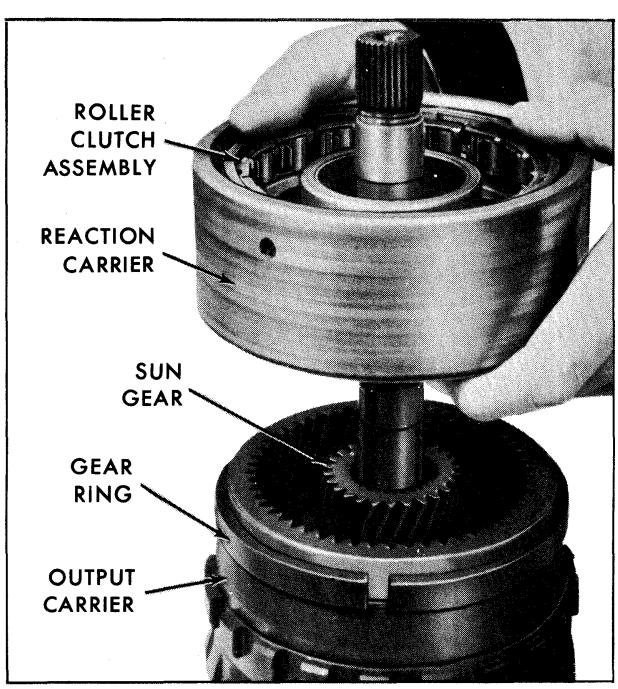


Fig. 7-45 Roller Clutch Assembly

7. Inspect parking pawl return spring for deformed coils or ends.
8. Inspect parking bracket for cracks or wear.
9. Inspect detent spring and roller assembly.

Inspection of Transmission Case

1. Inspect case assembly for cracks, porosity or interconnected passages, Fig. 7A-8 and 7A-9.
2. Check for good retention of band anchor pins.
3. Inspect all threaded holes for thread damage.
4. Inspect intermediate clutch driven plate lugs for damage or brinelling.
5. Inspect snap ring grooves for damage.
6. Inspect governor assembly bore for scratches or scoring.
7. Inspect modulator valve bore for scoring or damage.
8. Inspect cup plug inside case for good staking and sealing, Fig. 7A-9.

CAUTION: *If the case assembly requires replacement, make sure the center support to-case spacer is removed from the old case and reinstalled in the new case.*

NOTE: If the case assembly requires replacement, remove the nameplate from the old case and reinstall it onto the new case, using the truss head nameplate attaching screw that is serviced with the case.

Governor Assembly (Fig. 7A-46)

All components of the governor assembly, with the exception of the driven gear, are a select fit and each assembly is calibrated. The governor, including the driven gear, is serviced as a complete assembly. However, the driven gear can also be serviced separately.

It is necessary to disassemble the governor assembly in order to replace the driven gear. Disassembly may also be necessary due to foreign material causing improper operation. In such cases, proceed as follows:

a. Disassembly

1. Cut off one end of each governor weight pin and remove pins, governor thrust cap, governor weights, and springs. Governor weights are interchangeable from side to side and need not be identified.
2. Remove governor valve from governor sleeve. Be careful not to damage valve.
3. Perform the following inspections and replace governor driven gear if necessary.

b. Inspection

1. Wash all parts in cleaning solvent, air dry and blow out all passages.
2. Inspect governor sleeve for nicks, burrs, scoring and galling.
3. Check governor sleeve for free operation in bore of transmission case.
4. Inspect governor valve for nicks, burrs, scoring or galling.
5. Check governor valve for free operation in bore of governor sleeve.
6. Inspect governor driven gear for nicks, burrs, or damage.
7. Check governor driven gear for looseness on governor sleeve.
8. Inspect governor springs for distortion or damage.
9. Check governor weights for free operation in their retainers.

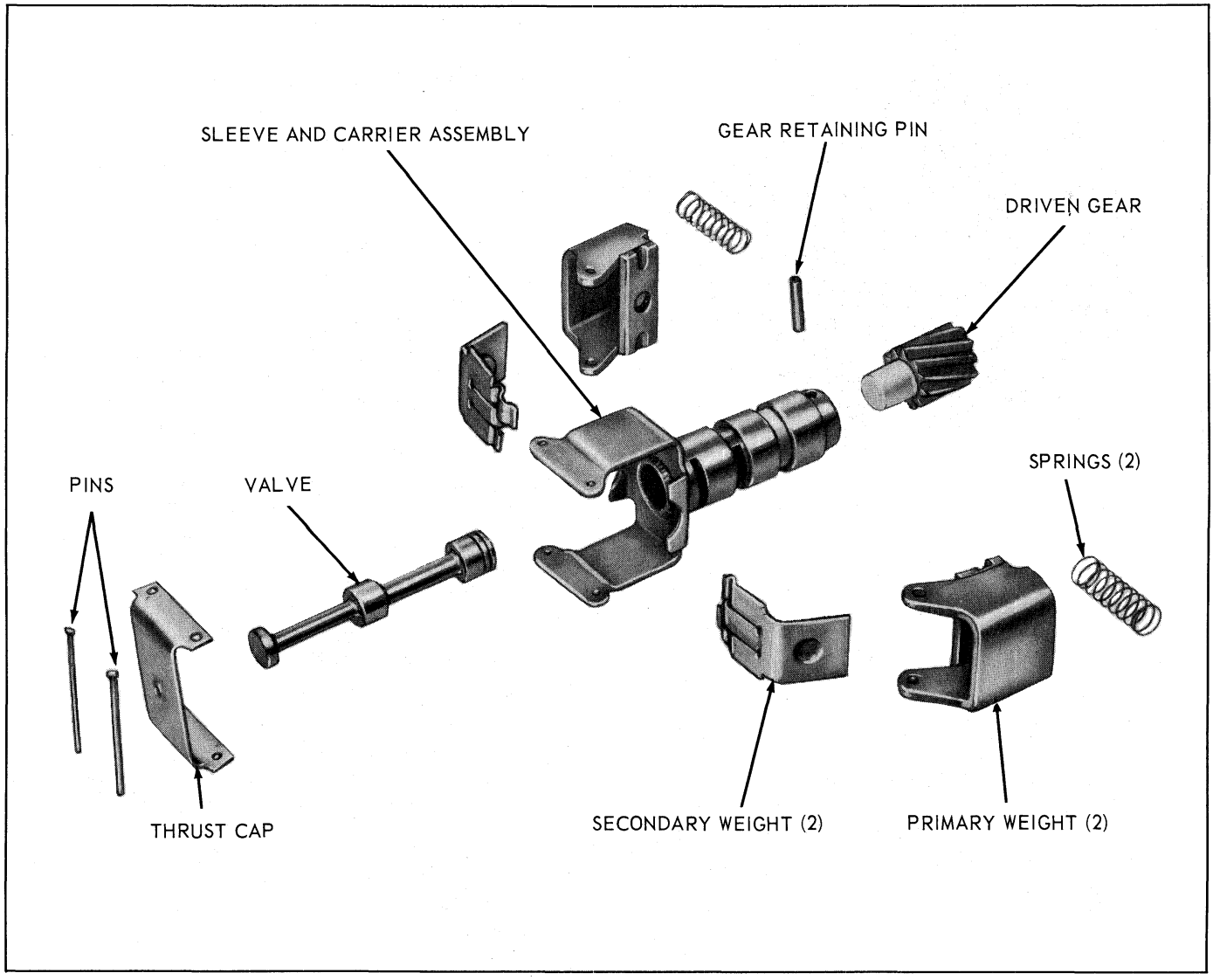


Fig. 7A-46 Governor Assembly - Disassembled View

10. Check valve opening at entry (.020" minimum) with a feeler gage, holding governor as shown with governor weights extended completely outward, Fig. 7A-47.

11. Check valve opening at exhaust (.020" minimum) with a feeler gage, holding governor as shown with governor weights completely inward, Fig. 7A-48.

c. Governor Driven Gear Replacement

To facilitate governor repair in the field, a governor driven gear and replacement pins are available for service use. The service package contains a nylon driven gear, two governor weight retaining pins and one governor gear retainer split pin. Replacement of gear must be performed with care in the following manner:

1. Drive out governor gear retaining split pin using small punch, Fig. 7A-49.

2. Support governor on 3/16 inch plates installed in exhaust slots of governor sleeve, place in arbor press and, with a long punch, press gear out of sleeve.

3. Carefully clean governor sleeve of chips that remain from original gear installation.

4. Support governor on 3/16 inch plates installed in exhaust slots of sleeve, position new gear in sleeve and, with a suitable socket, press gear into sleeve until nearly seated. Carefully remove any chips that may have shaved off gear hub and press gear in until it bottoms on shoulder.

5. A new pin hole must be drilled through sleeve and gear. Locate hole position 90° from existing hole, center punch, and then while supporting governor in press, drill new hole through sleeve and gear using a 1/8 inch drill.

6. Install split retainer pin.

7. Wash governor assembly thoroughly to remove any chips that may have collected.

d. Assembly

1. Install governor valve in bore of governor sleeve.

2. Install governor weights and springs, and thrust cap on governor sleeve.

3. Align pin holes in thrust cap, governor weight assemblies, and governor sleeve, and install new pins. Crimp both ends of pins to prevent them from falling out.

4. Check governor weight assemblies for free operation on pins and valve for freeness in sleeve bore.

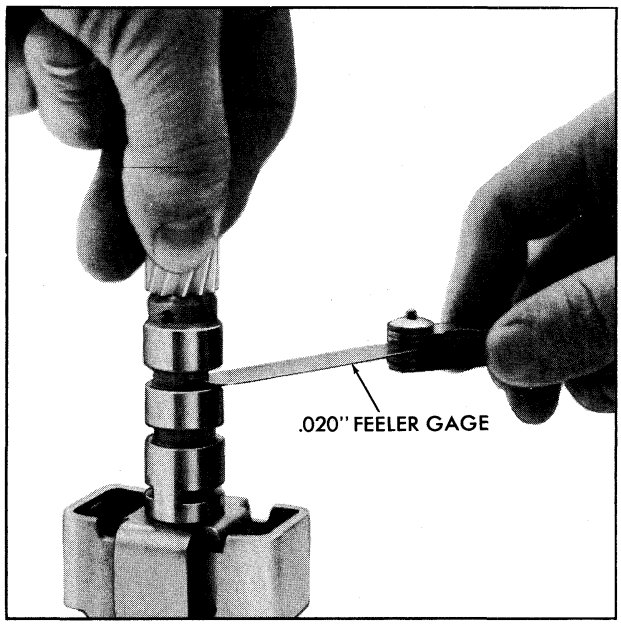


Fig. 7A-47 Checking Valve Opening - Weights Extended

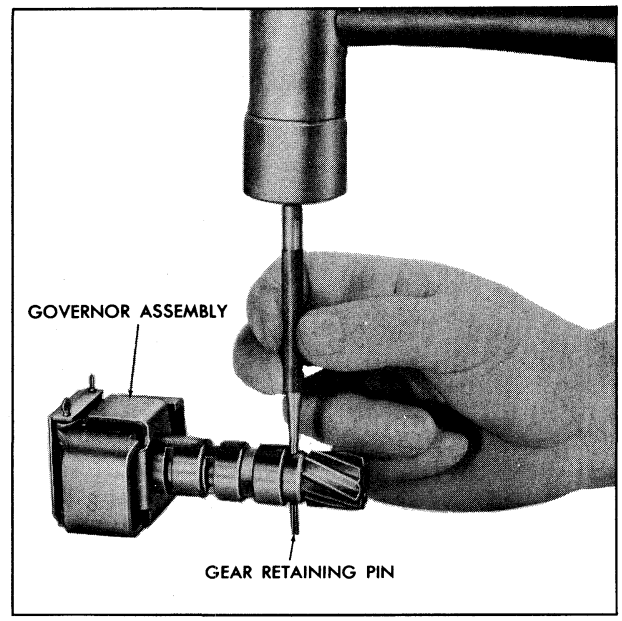


Fig. 7A-49 Removing Governor Driven Gear Retaining Pin

Speedometer Driven Gear Assembly and Transmission Speed Sensor

a. Disassembly

1. Remove speedometer driven gear from sleeve or sensor.

2. Remove O-ring from speedometer driven gear sleeve or sensor.

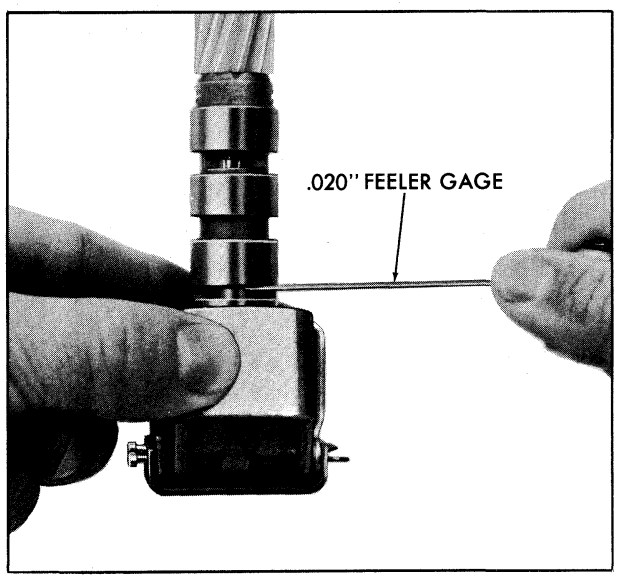


Fig. 7A-48 Checking Valve Opening Weights Inward

3. Remove C-wire ring retaining sleeve to gear lip seal.

4. Remove lip seal.

b. Inspection

1. Inspect gear for damaged teeth or shaft.

2. Inspect sleeve or sensor for scores, damaged threads or cracks.

3. Inspect seals for cuts or damage.

4. Inspect sensor for corrosion on wire terminal.

c. Assembly

1. Install sleeve to gear lip seal.

2. Install C-wire retaining ring.

3. Install O-ring on speedometer driven gear sleeve.

4. Install gear in sleeve.

Control Valve Assembly (Fig. 7A-50)

a. Disassembly

When disassembling control valve assembly make certain that springs are accurately identified so that they can be properly reassembled.

1. Position control valve assembly with gasket surface up and accumulator pocket on bottom.

2. Remove manual valve from upper bore.

3. Install Control Valve Accumulator Piston Installer, J-21885 or J-22269-01, on accumulator piston, compress piston and remove E-ring retainer, Fig. 7A-51.

4. Remove Installer, J-21885 or J-22269-01, and remove accumulator piston and spring.

5. Using pin punch, remove retaining pin from upper right bore, pressing on pin from outer side of valve body. Remove 1-2 modulator bushing, 1-2 regulator valve and spring, 1-2 detent valve and 1-2 shift valve from upper right bore.

NOTE: 1-2 regulator valve and spring may be inside of 1-2 modulator bushing.

6. Using punch, remove retaining pin from center right bore, pressing on pin from outer side of valve body. Remove

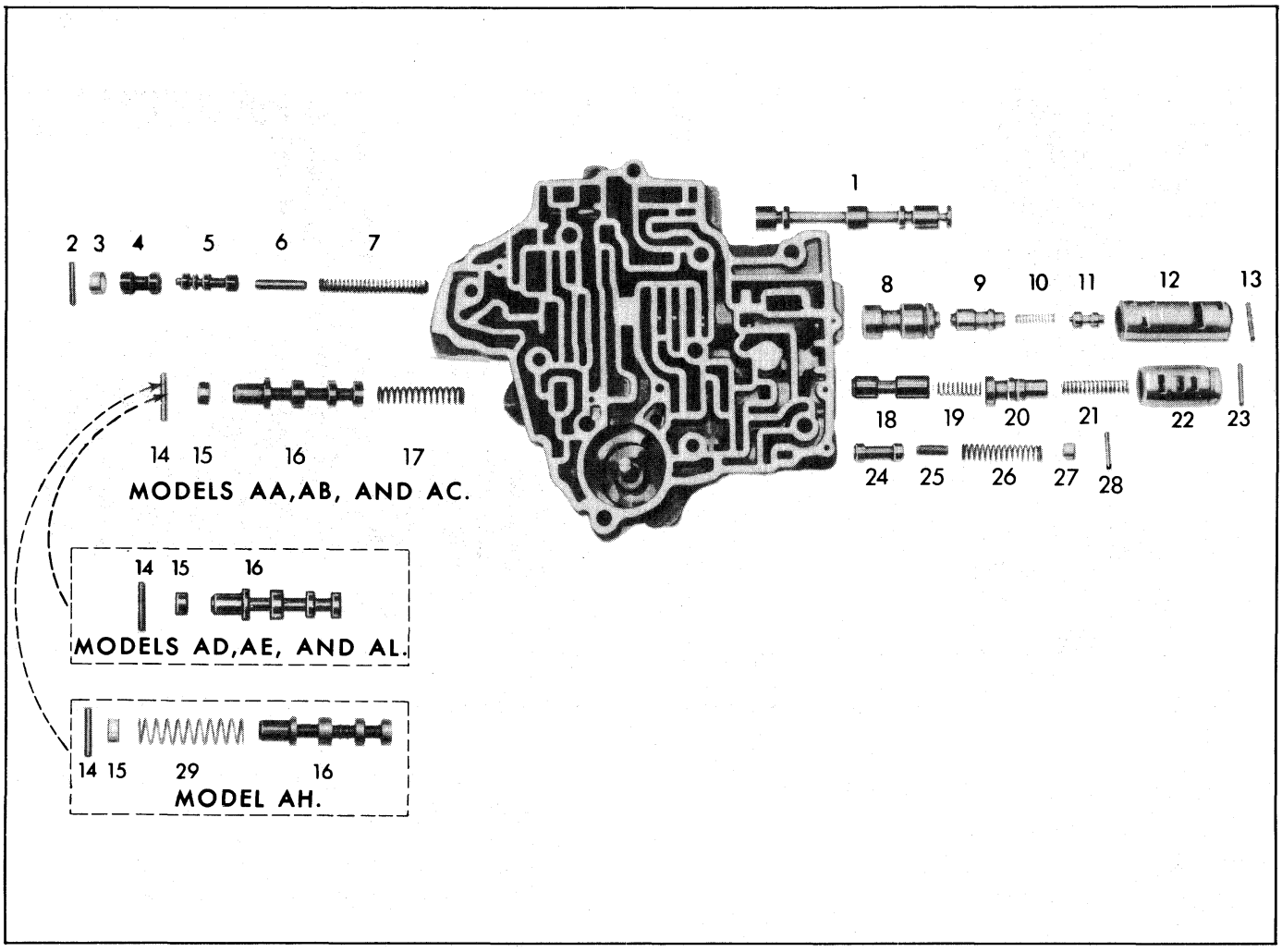


Fig. 7A-50 Control Valve Assembly - Disassembled View

2-3 modulator bushing, 2-3 shift valve spring, 2-3 modulator valve, 3-2 intermediate spring and 2-3 shift valve from center right bore.

NOTE: 2-3 modulator valve will be inside of 2-3 modulator bushing.

7. Using pin punch, remove retaining pin from lower right bore, pressing on pin from outer side of valve body.

CAUTION: *Hold hand over bore when removing retainer pin as 3-2 valve spring may force bore plug out.*

8. Remove bore plug, 3-2 valve spring, spacer and 3-2 valve from lower right bore.

9. Using pin punch, remove retainer pin from upper left bore by pressing on outer side of valve body.

WARNING: HOLD HAND OVER BORE WHEN REMOVING RETAINER PIN AS DETENT REGULATOR VALVE SPRING MAY FORCE OTHER COMPONENTS OUT OF BORE.

10. Remove bore plug, detent valve, detent regulator valve, spacer and detent regulator valve spring from upper left bore.

11. Remove grooved retaining pin from lower left bore by prying out with long nose pliers.

12. a. On all models except AD, AE, AH and AL, remove bore plug, 1-2 accumulator valve and primary spring from lower left bore.

b. On AD, AE and AL models remove bore plug, 1-2 accumulator secondary spring and 1-2 accumulator valve from lower left bore.

c. On AH model, remove bore plug and 1-2 accumulator valve from lower left bore.

NOTE: Do not remove the teflon oil seal ring from the front accumulator piston unless the oil seal ring requires replacement. The service oil seal ring is cast iron, Fig. 7A-53.

CAUTION: *The type of front accumulator piston used in 1971 thru 1976 is not interchangeable with pre-1971 piston.*

1. Wash control valve body, valves, and other parts in clean solvent.

CAUTION: *Do not allow valves to bump together, as this might cause nicks and burrs.*

2. Inspect all valves and bushings carefully to make sure that they are free from dirt and are not damaged in any respect. If burrs are present, they should be removed with a

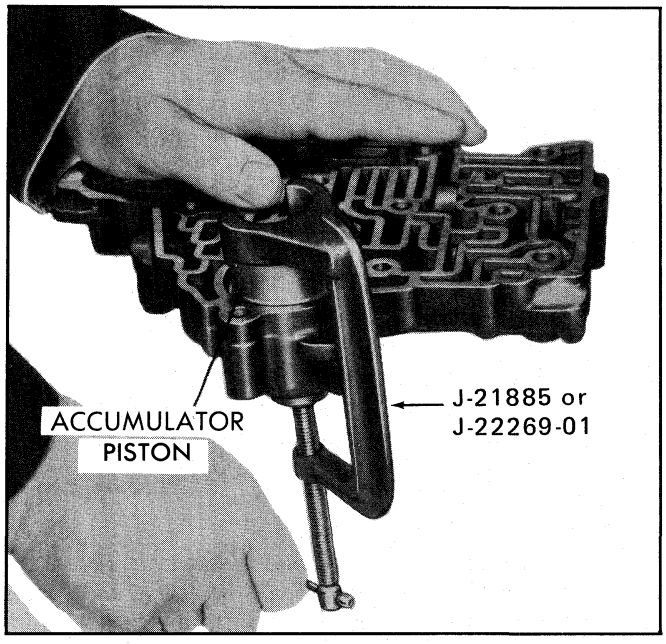


Fig. 7A-51 Removing Front Accumulator Piston

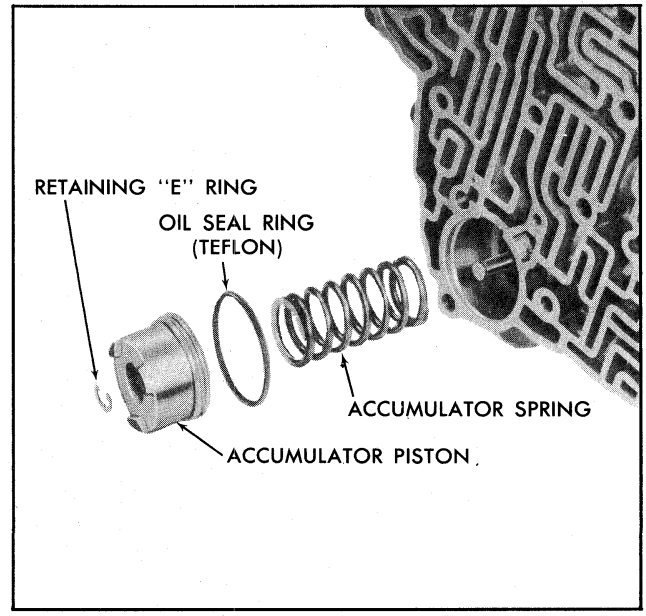


Fig. 7A-53 Front Accumulator Disassembled View

fine stone or fine grade of crocus cloth and light oil. Be careful not to round off shoulders of valves.

3. All valves and bushings should be tested in their individual bores to make certain that free movement can be obtained. All valves should fall freely of their own weight with a slight tapping action on the body. In checking, be careful to prevent valve damage in any way.

4. The manual valve is the only valve that can be serviced separately. If other valves are malfunctioning or damaged beyond repair, a new control valve assembly should be installed.

5. Inspect body for cracks or scored bores.

6. Check all springs for distortion or collapsed coils.

7. Inspect front accumulator piston and oil ring for damage.

NOTE: Refer to Fig. 7A-7 for identification of control valve passages.

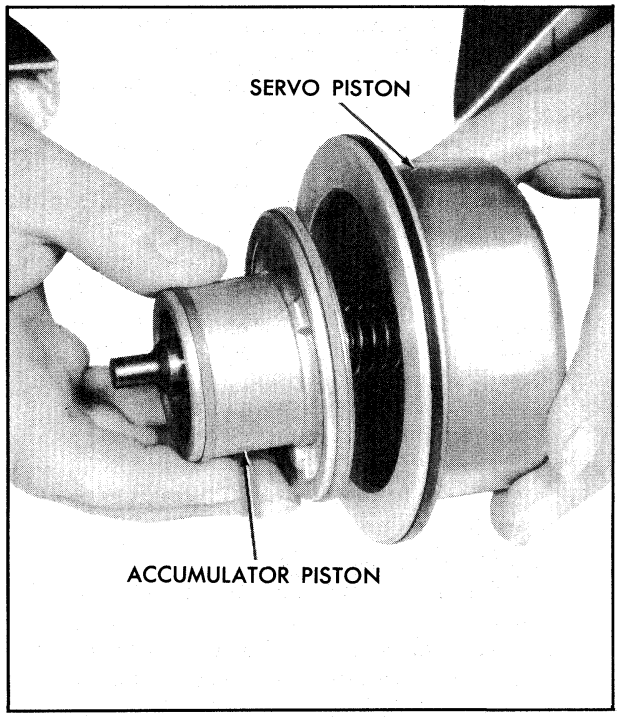


Fig. 7A-52 Disassembling Rear Servo and Accumulator Piston

c. Assembly

1. Position front accumulator spring and piston into valve body.

2. Install Control Valve Accumulator Piston Installer, J-21885, or J-22269-01, on piston. Compress spring and piston, aligning spring and piston with bore, Fig. 7A-51.

CAUTION: *Make certain that piston pin is correctly aligned with hole in piston and that oil seal ring does not catch on lip of bore when installing piston.*

3. Secure piston and spring with E-ring retainer and remove Installer, J-21885 or J-22269-01.

4. Install 1-2 accumulator primary spring into lower left bore Fig. 7A-50.

5. Install 1-2 accumulator secondary valve, stem end out.

6. Install 1-2 accumulator secondary spring, used on AD, AE and AL models only.

NOTE: AH model does not use a 1-2 accumulator valve spring.

7. Install 1-2 accumulator bore plug into the 1-2 accumulator bore.

8. Place control valve body on gasket surface, compress plug and install grooved retaining pin from cast surface side of valve body, with grooved end of pin entering hole last.

9. Tap retaining pin with hammer until pin is flush with cast surface. Return control valve assembly to its original position.

10. Insert spacer inside of detent regulator valve spring and install spring and spacer into upper left bore, making certain spring seats in bottom of bore.

11. Compress detent regulator valve spring and hold with a small screwdriver placed between end of spring and wall on cored side of valve body.

12. Install detent regulator valve, stem end out, and detent valve, small land first, into upper left bore.

13. Insert bore plug, hole out, into upper left bore and, pressing inward on bore plug, remove screwdriver and install retaining pin from cored side of valve body.

14. Install 3-2 valve in bottom right bore.

15. Insert spacer inside of 3-2 valve spring and install spring and spacer in bottom right bore.

16. Compressing 3-2 valve spring, install bore plug, hole end out, and secure with retaining pin from cored side of valve body.

17. Install 3-2 intermediate spring in open end of 2-3 shift valve, and install valve and spring, valve first, into center right bore. Make certain valve seats in bottom of bore.

18. Install 2-3 modulator valve, hole end first, into 2-3 modulator bushing and install both parts in center right bore.

19. Install 2-3 shift valve spring into hole in 2-3 modulator valve, and compressing spring, secure with retaining pin from cored side of control valve.

20. Install 1-2 shift valve, stem end out, in upper right bore, making certain valve seats in bottom of bore.

21. Install 1-2 regulator valve, larger stem first, spring and 1-2 detent valve, hole end first, into 1-2 bushing, and install in upper right bore of control valve body.

22. Compress bushing against spring and secure with retaining pin from cored side of control valve body.

23. Install manual valve with detent pin groove to the right.

Rear Servo Assembly (Fig. 7A-54)

a. Disassembly

1. Remove rear accumulator piston from rear servo piston. See Fig. 7A-52.

2. Remove E-ring retaining rear servo piston to band apply pin.

3. Remove rear servo piston and seal from band apply pin.

4. Remove washer, spring and retainer.

b. Inspection

1. Check freeness of oil seal rings in piston grooves.

NOTE: See Fig. 7A-54. Do not remove the teflon oil seal rings from the rear accumulator piston, unless the oil seal rings require replacement.

If the teflon inner oil seal ring, (small diameter) requires replacement, for service, use the aluminum oil seal ring.

The rear accumulator piston, large diameter ring groove depth, is machined shallower to take the large teflon oil seal ring, if this requires replacement, use only the teflon oil seal ring.)

2. Inspect fit of band apply pin in servo piston.

3. Inspect band apply pin for scores or cracks.

4. Inspect band apply pin for proper size as determined by pin selection check. See Page 7A-35.

c. Assembly

1. Install spring retainer with cup side toward band apply servo pin, spring and washer on servo pin.

2. Install servo piston on pin and secure with E-ring retainer.

3. If removed, install oil seal ring on servo piston.

4. If removed, install outer and inner oil rings on accumulator piston.

5. Install accumulator piston into bore of servo piston.

Front Servo Assembly (Fig. 7A-55)

NOTE: See Figure 7A-55. Do not remove the teflon oil seal ring from the front servo piston unless the oil seal ring requires replacement. The service oil seal ring is aluminum.

CAUTION: *The spring retainer, servo pin, retainer ring and servo piston are identical for 1971 thru 1976 transmissions. These individual parts are not interchangeable with the pre-1971 parts.*

a. Inspection

1. Inspect servo pin for damage.

2. Inspect piston and oil seal ring for damaged oil ring groove, check freedom of ring in groove.

3. Inspect piston for cracks or porosity.

4. Check fit of servo pin in piston.

b. Assembly

1. Reassemble parts of front servo, making sure tapered end of servo pin is pointing through the spring and spring retainer. Make sure the retainer ring is in the servo pin groove.

Oil Pump Assembly

a. Disassembly

1. Using Adapter, J-21364, in Rear Unit Holding Fixture, J-6116, place pump assembly in Holding Fixture with stator shaft pointing downward. Be careful not to damage shaft.

2. Compress regulator boost valve bushing against pressure regulator spring and remove snap ring using Snap Ring Pliers J-5403 (#21), Fig. 7-56.

WARNING: PRESSURE REGULATOR SPRING IS TIGHTLY COMPRESSED

3. Remove regulator boost valve bushing and valve.

4. Remove pressure regulator spring.

5. Remove regulator valve, spring retainer, and spacer or spacers if present.

6. Remove five pump cover attaching screws and remove pump cover from body.

7. Mark drive and driven gears for reassembly in same position and remove from pump body, Fig. 7-57.

NOTE: Installing the gears in the same position as removed, will assure the quietest operation, as the gear teeth will mesh in the established wear pattern.

8. Remove retaining pin and bore plug from end of regulator bore.

9. Remove two oil rings from pump cover.

10. Remove pump to forward clutch housing selective washer.

11. If necessary to replace front oil seal, pry seal from pump body, Fig. 7A-24.

b. Inspection of Pump Body

1. Inspect gear pockets and crescent for scoring, galling or other damage.

2. Place pump gears in pump body and check pump body face to gear face clearance. Clearance should be .0008 inch-.0035 inch, Fig. 7-58.

3. Check face of pump body for scores or nicks.

4. Check oil passages for proper opening and lack of

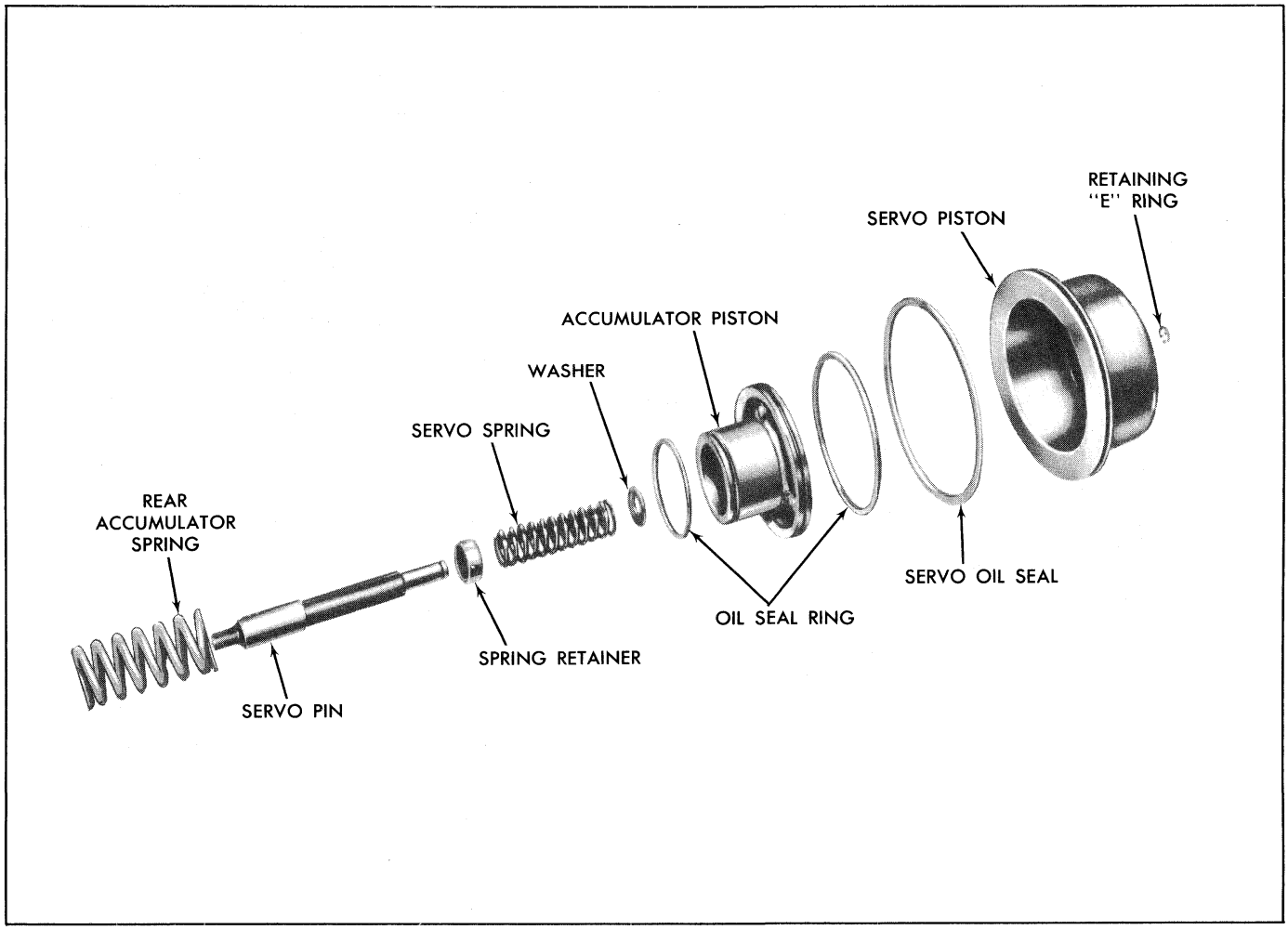


Fig. 7A-54 Rear Servo and Accumulator

porosity.

5. Check for damaged cover bolt attaching threads.
6. Check for overall flatness of pump body face.
7. Check bushing for scores or nicks.

c. Inspection of Pump Cover (Fig. 7-59)

1. Inspect pump cover face for overall flatness.
2. Check for scores or dirt in pressure regulator bore.
3. Make certain all passages are open and not interconnected through porosity.
4. Check for scoring or damage at pump gear face.
5. Inspect stator shaft for damaged splines, or scored bushings.
6. Inspect oil ring grooves for damage or wear.
7. Inspect selective thrust washer face for wear or damage.
8. Inspect oil seal ring on pump body and remove if necessary.
9. Inspect pressure regulator and boost valve for free operation.

NOTE: The solid type pressure regulator valve does not contain oil holes and an orifice cup plug like the previous pressure regulator valve. The solid style valve must only be used in the pump cover with the squared off pressure regulator boss, (Pressure boost bushing end). See Fig. 7A-20. The previous pressure regulator valve with the oil holes and orifice cup plug will be used to service either type pump cover.

10. Inspect pump cover for open 1/8 inch diameter breather hole. See Fig. 7A-12.

d. Assembly

1. Install drive and driven pump gears into pump body with alignment marks up and mated. In this position the pump gear drive tangs will also be up.
2. Install pressure regulator spacer or spacers, if required, spring retainer and spring into pressure regulator bore.
3. Install boost valve into bushing, stem end out, and install both parts into pump cover by compressing bushing against spring.
4. Install retaining snap ring.
5. Install pressure regulator valve from opposite end of bore, stem end first.
6. Install pressure regulator valve bore plug and retaining pin into end of bore.
7. Install previously selected front unit selective thrust washer over pump cover delivery sleeve.

NOTE: Proper washer size was determined at time of front unit end play check. See page 7A-36.

8. Install two oil seal rings, as shown in Fig. 7A-60.
9. Place pump body in Rear Unit Holding Fixture, J-6116, with gasket surface facing up.
10. Lubricate pump gears with transmission fluid and

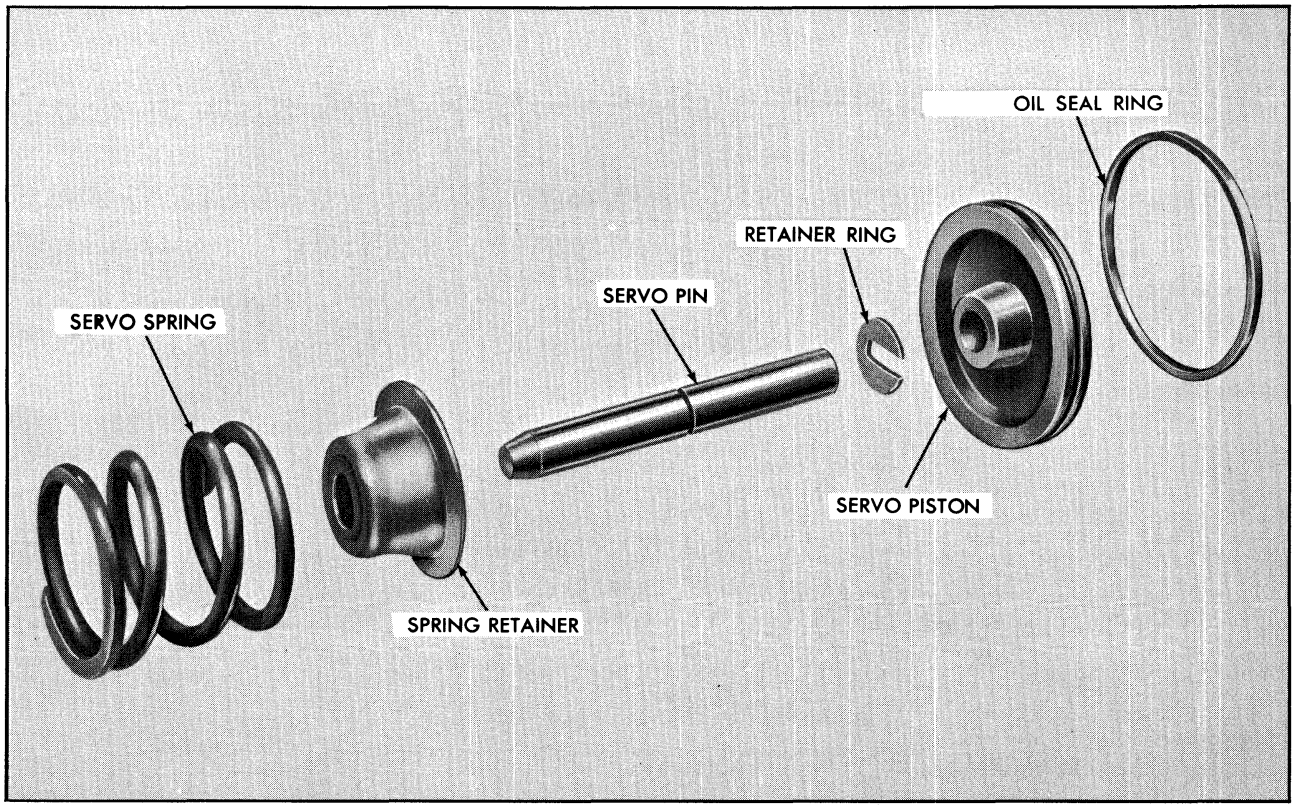


Fig. 7A-55 Front Servo

install pump cover on pump body.

11. Install pump cover attaching screws following screw chart, Fig. 7A-61. Leave screws one turn loose at this time.

12. Install pump body and Cover Alignment Band, J-21368, around pump assembly. Tighten wing nut on alignment band to align pump cover with pump body, Fig. 7A-62.

13. Tighten pump cover attaching screws to 18 foot-pounds and remove alignment band from pump.

14. Install new square cut O-ring on pump.

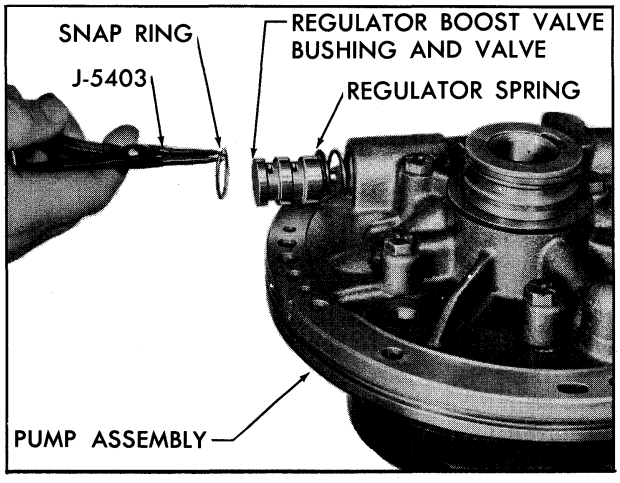


Fig. 7-56 Removing Pressure Regulator Valve Snap Ring

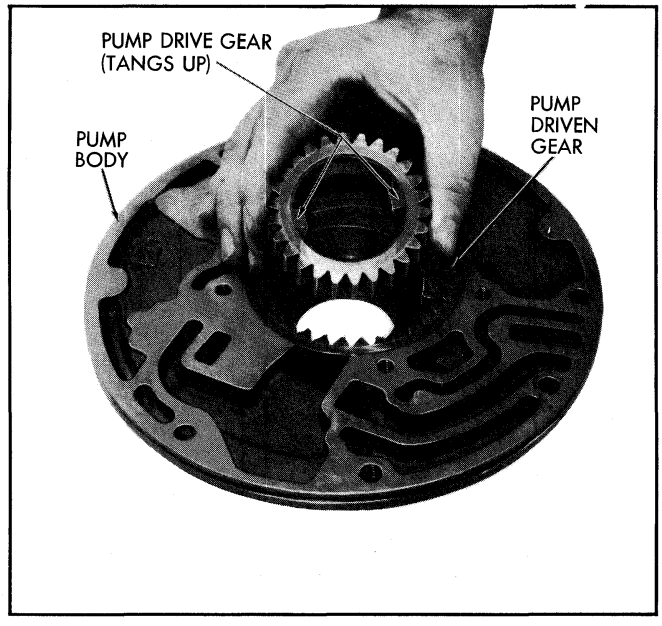


Fig. 7-57 Removing Pump Gears

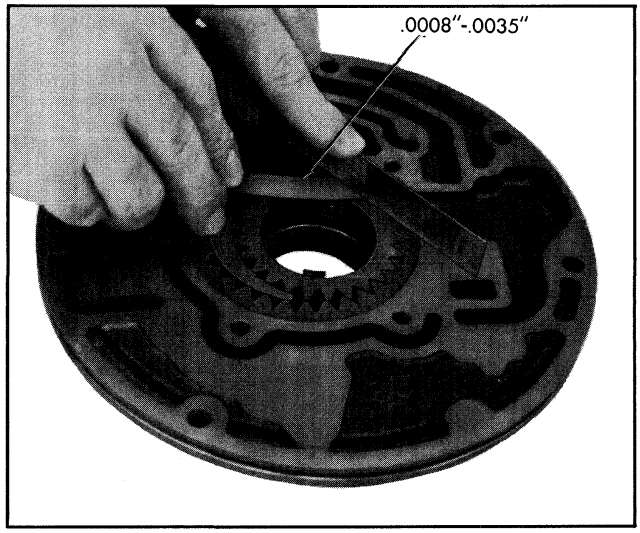


Fig. 7-58 Pump Body Face to Gear Face Clearance

15. If necessary, install new pump oil seal using pump Oil Seal Installer, J-21359, Fig. 7A-25.

Forward Clutch Assembly - Disassembly (Fig. 7-63)

a. Disassembly

1. Using Adapter, J-21364, in Rear Unit Holding Fixture, J-6116-01, place forward clutch assembly in Holding Fixture with turbine shaft pointing downward. Be careful not to damage shaft.

2. Remove forward clutch housing to direct clutch hub snap ring.

3. Remove direct clutch hub.

4. Remove forward clutch hub and one thrust washer from each side of hub, Fig. 7A-63.

5. Remove composition and steel clutch plates as shown on Fig. 7A-63.

6. Place forward clutch assembly in arbor press with turbine shaft pointing downward.

7. Using Clutch Spring Compressor, J-4670-01, and Adapter, J-21664, compress spring retainer with arbor press and remove snap ring using Snap Ring Pliers, J-8059 or J-5586, Fig. 7A-64.

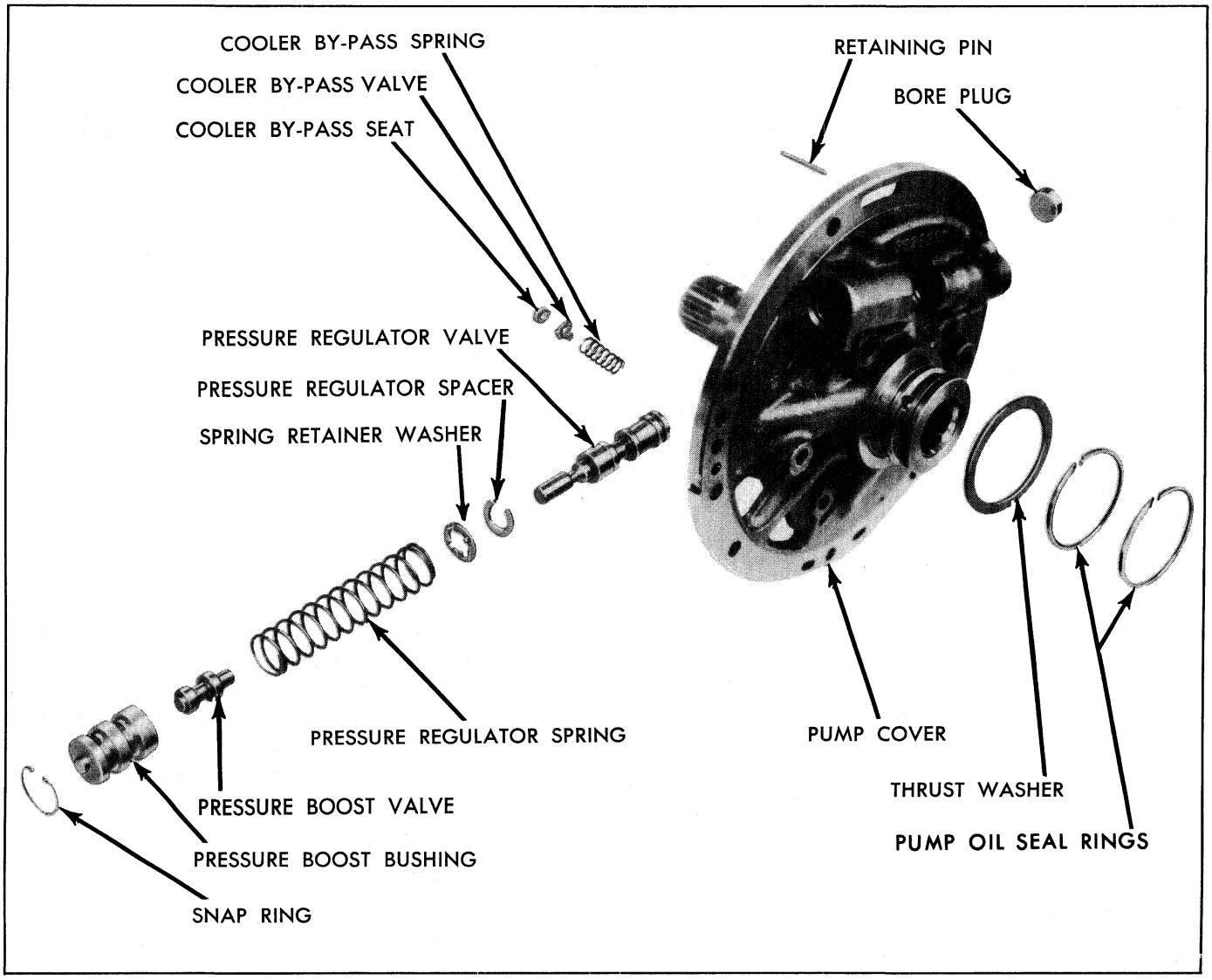


Fig. 7-59 Pump Cover Disassembled View

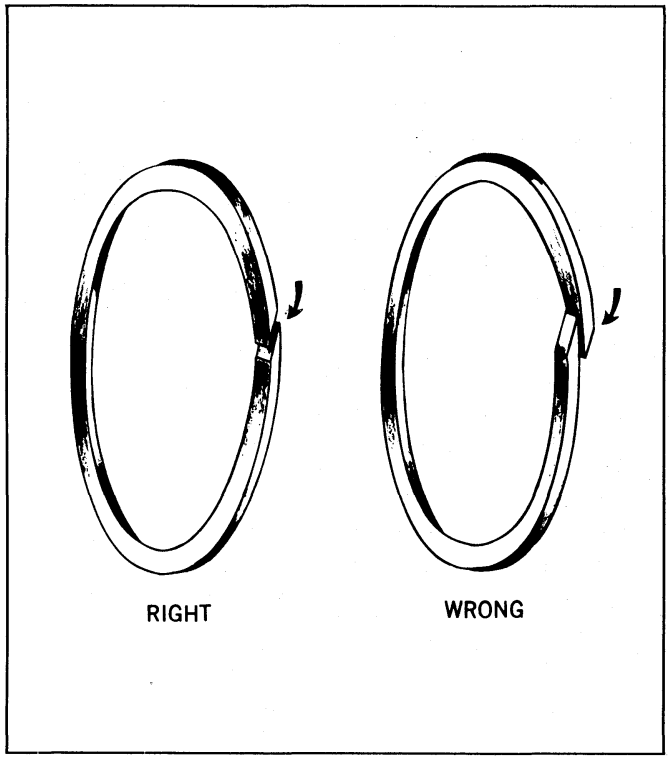


Fig. 7A-60 Teflon Ring Lap Joint

8. Remove tools, spring retainer and 16 clutch release springs. Keep springs separate from direct clutch springs.

9. Remove forward clutch piston from forward clutch housing.

10. Remove inner and outer seals from clutch piston.

11. Remove center piston seal from forward clutch housing.

12. It is not necessary to remove turbine shaft from forward clutch housing unless either shaft or housing is damaged and must be replaced. In such case proceed as follows:

a. Place forward clutch housing in arbor press with turbine shaft pointing downward.

b. Using 3/8 inch drive extension approximately 3 inches long, or similar tool as driver, press turbine shaft out of forward clutch housing.

b. Inspection

1. Inspect composition faced and steel clutch plates for signs of burning, scoring or wear.

2. Inspect sixteen release springs for collapsed coils or signs of distortion.

3. Inspect clutch hubs for worn splines, proper lubrication holes, and thrust faces.

4. Inspect piston for cracks.

5. Inspect clutch housing for wear, scoring, cracks and open oil passages.

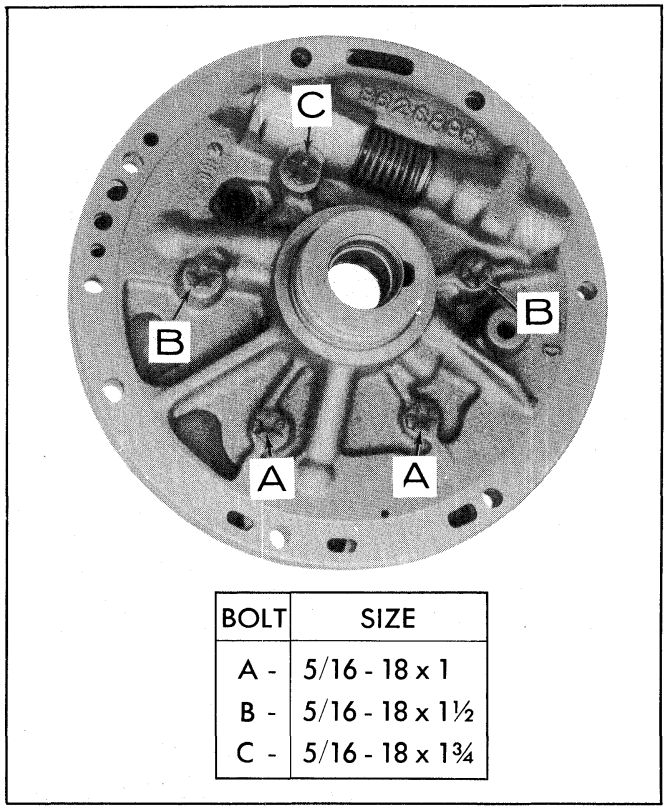
6. Inspect operation of ball check in forward clutch housing.

7. Inspect turbine shaft for open lubrication passages at each end.

8. Inspect turbine shaft splines for damage.

9. Inspect bushing journals for damage.

10. Inspect turbine shaft for cracks or distortion.



BOLT	SIZE
A -	5/16 - 18 x 1
B -	5/16 - 18 x 1½
C -	5/16 - 18 x 1¾

Fig. 7A-61 Pump Cover Attaching Screws

c. Assembly

1. If turbine shaft was previously removed from forward clutch housing proceed as follows:

a. Place forward clutch housing on arbor press with flat side up.

b. Align shorter splined end of turbine shaft with splines in forward clutch housing, and using arbor press, carefully press shaft into housing until shaft bottoms on hub of housing.

CAUTION: *Start shaft into housing and back off on*

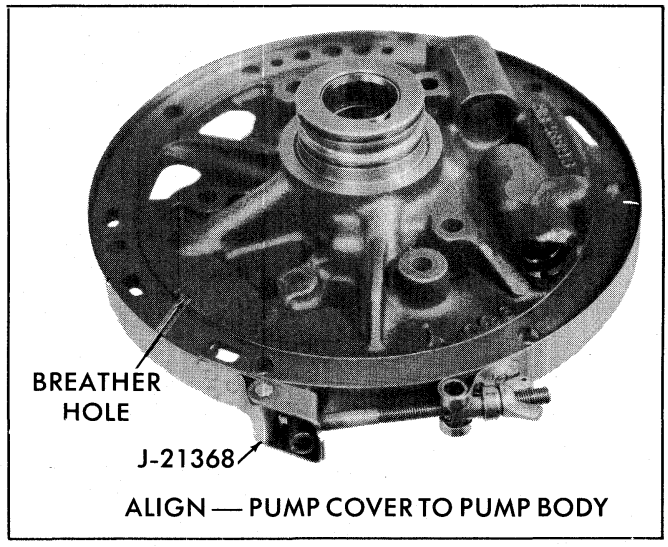


Fig. 7A-62 Aligning Pump Cover and Body

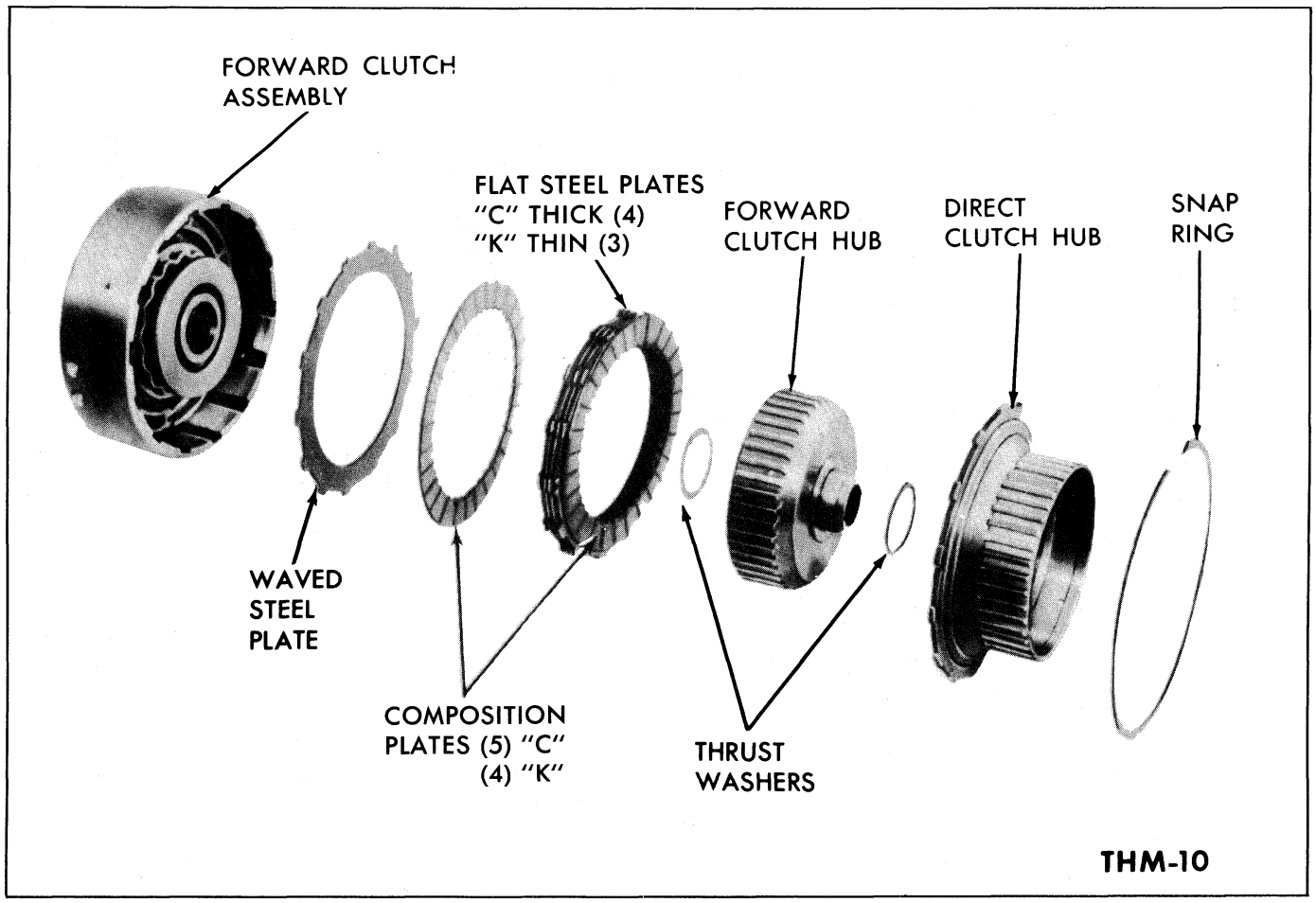


Fig. 7A-63 Forward Clutch Assembly - Disassembled View

arbor press to allow shaft to straighten itself. Repeat this step several times until you are certain shaft is going in straight, otherwise, shaft or housing splines may be damaged.

2. Invert forward clutch housing on arbor press with turbine shaft pointing downward.

3. Lubricate new inner and outer clutch piston seals with transmission fluid. Lubricate seal grooves in forward clutch piston with petrolatum and install seals with lips facing away from spring pockets.

4. Lubricate new center piston seal with transmission fluid. Lubricate seal groove in forward clutch housing with petrolatum and piston seal with transmission fluid. Lubricate seal groove in forward clutch housing with petrolatum and install seal into clutch housing with lip facing up.

5. Place Forward and Direct Clutch Inner Seal Protector, J-21362, over forward clutch hub. Install clutch piston inside Forward and Direct Clutch Piston Installer, J-21409. Insert assembly in forward clutch housing. Fig. 7A-65, and install clutch piston by rotating it slightly in a clockwise direction until seated.

6. Install sixteen clutch release springs into spring pockets in clutch piston.

7. Using Clutch Spring Compressor, J-4670-01, and Adapter, J-21664, compress spring retainer with arbor press, being careful that retainer does not catch in snap ring groove, and install snap ring using Snap Ring Pliers, J-8059 or J-5586, Fig. 7A-64. Remove tools.

CAUTION: *Make certain clutch release springs are not leaning. If necessary, straighten with a small screwdriver.*

8. Remove forward clutch assembly from arbor press and place in Holding Fixture, J-6116-01, with turbine shaft pointing down. Be careful not to damage shaft.

9. Install thrust washer on the outside of forward clutch

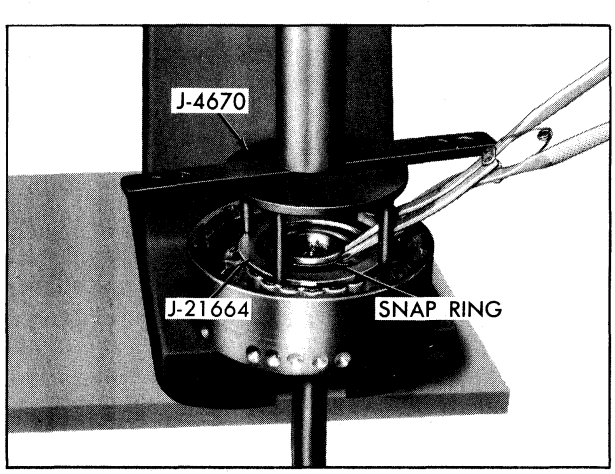


Fig. 7A-64 Removing Forward Clutch Snap Ring

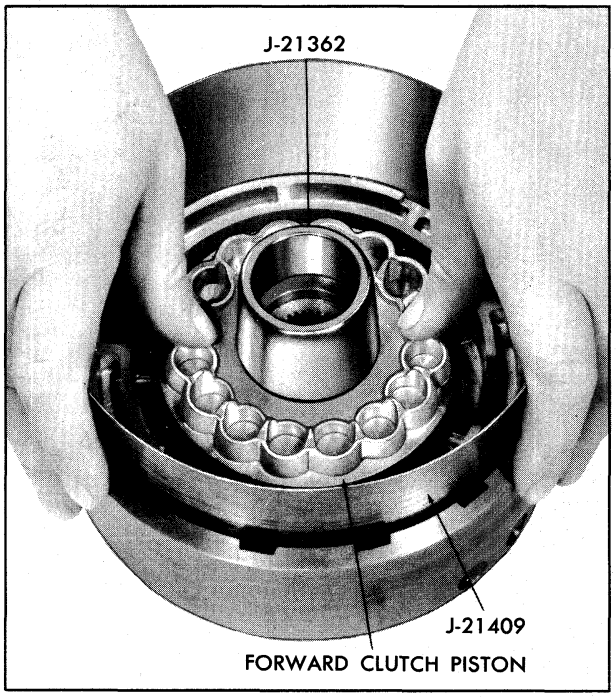


Fig. 7A-65 Installing Forward Clutch Piston

hub. The bronze washer is installed on side of hub facing forward clutch housing.

10. Install forward clutch hub in forward clutch housing.

11. Lubricate and install the flat steel, composition and one waved steel plate for "C" car only with transmission fluid and install clutch plates in forward clutch housing, see Fig. 7A-63. **Start with waved steel plate** and alternate composition and steel plates.

12. Install direct clutch hub in forward clutch housing over clutch plates, and install snap ring.

13. Place forward clutch housing on pump delivery sleeve and air check clutch operation by applying air through forward clutch passage in pump, Fig. 7A-66 to actuate piston and move forward clutch.

Direct Clutch and Intermediate Roller Assembly (Fig. 7A-68)

a. Disassembly

1. Remove roller retainer snap ring, and remove clutch retainer.

2. Remove roller outer race and remove roller assembly. See Fig. 7A-67.

3. Turn unit over and remove direct clutch backing plate to clutch housing snap ring.

4. Remove direct clutch backing plate and composition and steel clutch plates as shown on Fig. 7A-69.

5. Using Clutch Spring Compressor, J-4670, Rear Clutch Spring Compressor, J-6129, or an arbor press, and Adapter J-21664. Fig. 7A-70 compress spring retainer and remove snap ring with Snap Ring Pliers, J-8059 or J-5586.

6. Remove tools, spring retainer and 14 clutch release springs. Keep springs separate from forward clutch springs.

7. Remove direct clutch piston from direct clutch housing.

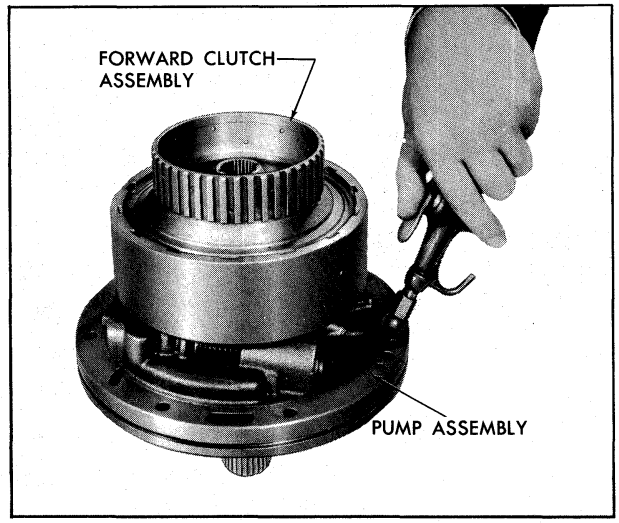


Fig. 7A-66 Air Checking Forward Clutch

8. Remove inner and outer seals from clutch piston.

9. Remove center piston seal from direct clutch housing.

b. Inspection

1. Inspect roller clutch assembly for damaged rollers, cage or springs.

2. Inspect cam and outer race for scratches or wear.

3. Inspect clutch housing for cracks, wear, proper opening of oil passages and wear on clutch plate drive lugs.

4. Inspect composition-faced and steel clutch plates for signs of wear or burning.

5. Inspect backing plate for scratches or other damage.

6. Inspect piston for cracks.

7. Inspect springs for collapsed coils or signs of distortion.

8. Inspect housing for face operation of check ball.

NOTE: The 14 direct clutch release springs are not serviced individually. If one or more of these springs require replacement, discard all of them and install the 16 service direct clutch release springs.

c. Assembly

1. Lubricate new inner and outer clutch piston seals with transmission fluid. Lubricate seal grooves in direct clutch piston and install seals with lips facing away from spring pockets.

2. Lubricate new center seal with transmission fluid. Lubricate seal groove in direct clutch housing and install seal in clutch housing with lip facing up.

3. Place Forward and Direct Clutch Inner Seal Protector, J-21362, over direct clutch hub. Install clutch piston inside Forward and Direct Clutch Piston Installer, J-21409, insert assembly in direct clutch housing, Fig. 7A-71, and install clutch piston by rotating it slightly, in a clockwise direction.

4. Install 14's (16's if service) clutch release springs into spring pockets in clutch piston.

5. Place spring retainer and snap ring over springs.

6. Using Clutch Spring Compressor, J-4670-01, Rear Clutch Spring Compressor, J-6129, or an arbor press, and Adapter, J-21664, Fig. 7A-70, compress spring retainer,

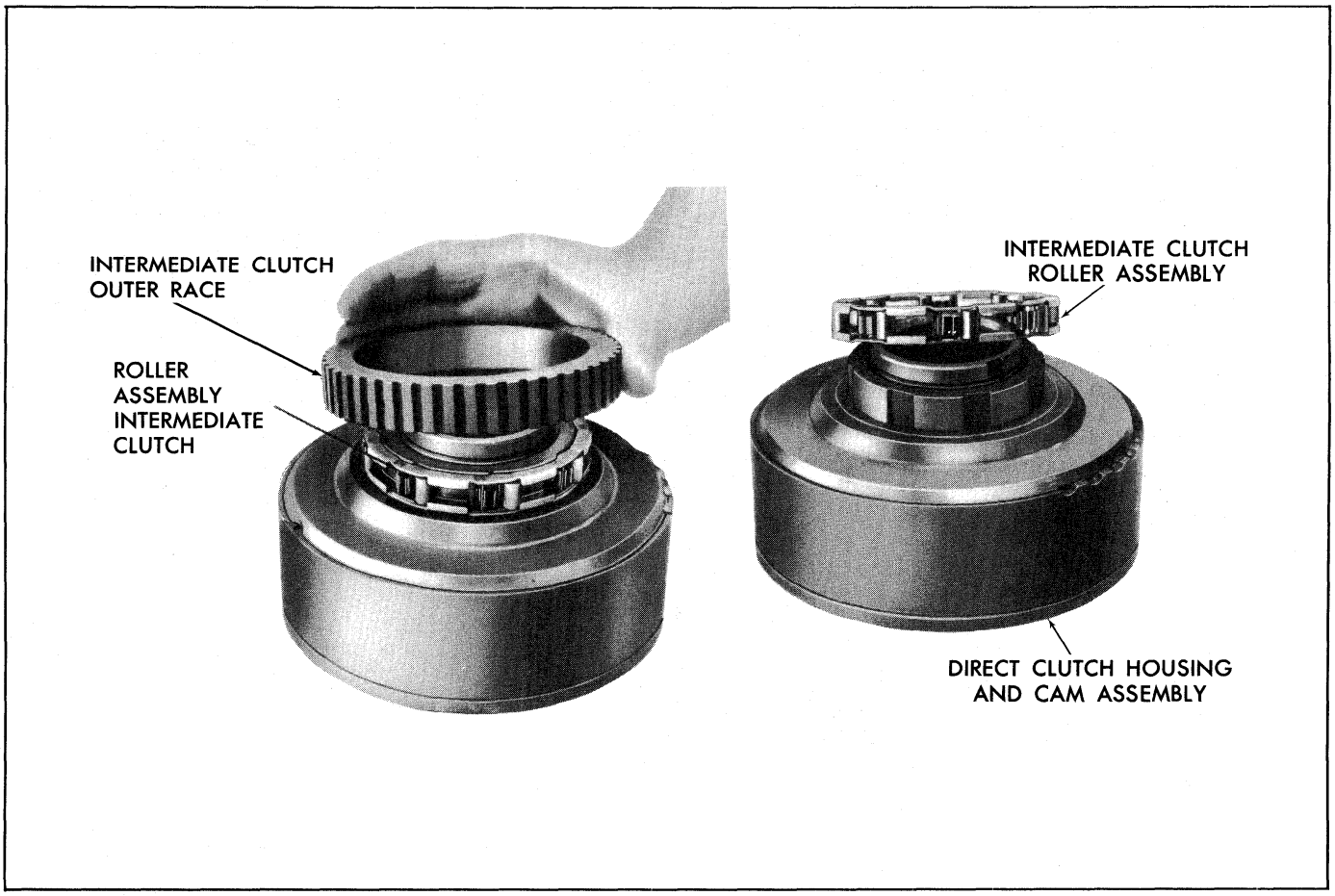


Fig. 7A-67 Removing Roller Outer Race and Assembly

being careful that retainer does not get caught in snap ring groove, and install snap ring with Snap Ring Pliers, J-8059 or J-5586. Remove tools.

NOTE: Make certain clutch release springs are not leaning. If necessary, straighten spring with a small screwdriver.

7. Lubricate and install waved steel plate and composition flat steel plates with transmission fluid and install clutch plates in direct clutch housing, as shown on Fig. 7A-72. Start with waved steel plate and alternate composition faced and flat steel plate.

NOTE: Do not use radially grooved composition plates here.

NOTE: All direct clutch flat steel plates are .0915 in. thick.

8. Install direct clutch backing plate over clutch plates and install backing plate snap ring.

NOTE: Install rollers that may have come out of the roller cage by compressing the energizing spring with forefinger and inserting the roller from the outer side.

Turn unit over and install the roller clutch assembly onto the intermediate clutch inner cam.

Install the intermediate clutch outer race with a clockwise turning motion.

NOTE: When installed, outer race should not turn counterclockwise, Fig. 7A-73.

9. Install roller clutch assembly retainer and snap ring.

10. Place direct clutch assembly on center support and air check operation of direct clutch, Fig. 7A-74.

NOTE: If air is applied through reverse passage, (right oil feed hole) it will escape from direct clutch passage (left oil feed hole). This is considered normal. Apply air through left oil feed hole to actuate piston and move direct clutch plates.)

Center Support and Intermediate Clutch Piston

a. Disassembly (Fig. 7A-75)

1. Remove four oil rings from the center support, Fig. 7A-76.

2. Compress spring retainer and remove snap ring with Snap Ring Pliers, J-8059 or J-5586, Fig. 7A-77.

3. Remove spring retainer and 3 intermediate clutch release springs.

4. Remove spring guide.

5. Remove intermediate clutch piston from center support.

6. Remove inner and outer seals from clutch piston.

NOTE: Do not remove the three screws retaining roller clutch inner race to center support.

b. Inspection

1. Inspect roller clutch inner race for scratches or indentations. Be sure lubrication hole is open.

2. Inspect bushing for scoring, wear or galling.

3. Check oil ring grooves for damage.

4. Air Check oil passages to be sure they are open and not interconnected.

5. Inspect piston sealing surfaces for scratches.

6. Inspect piston seal grooves for nicks or other damages.

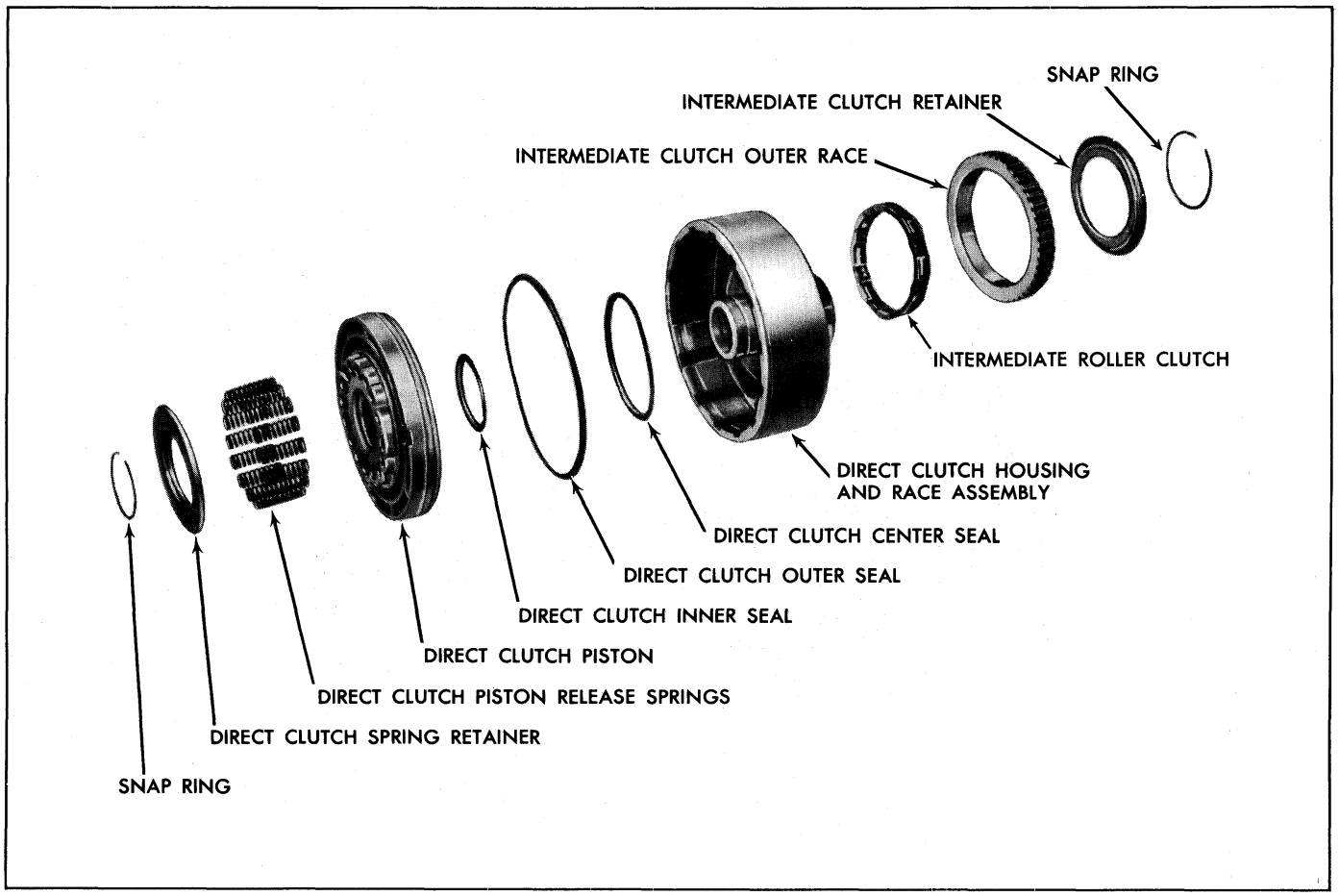


Fig. 7A-68 Direct Clutch and Piston

7. Inspect piston for cracks.

NOTE: Refer to Fig. 7A-10 for identification of oil feed passages and lands.

8. Inspect springs for collapsed coils or signs of distortion.

9. Inspect oil seal rings for damage.

NOTE: All service center support oil seal rings are hook type cast iron.

10. Inspect to see that constant bleed orifice (approx. .020) is open, Fig. 7A-44.

c. Assembly

1. Lubricate new inner and outer clutch piston seals with transmission fluid. Lubricate seal grooves in intermediate clutch piston and install seals with lips facing away from spring guide, Fig. 7A-78.

2. Place Intermediate Clutch Inner Seal Protector, J-21363, over center support hub, Fig. 7A-79, and install intermediate clutch piston, making certain it fully seats in center support. Remove J-21363.

3. Install plastic spring guide, Fig. 7A-80.

4. Install 3 clutch release springs, space equally into holes in spring guide, Fig. 7A-81.

5. Place spring retainer and snap ring over springs.

6. Compress spring retainer, being careful that retainer does not get caught in snap ring groove, and install snap ring with Snap Ring Pliers, J-8059 or J-5586, Fig. 7A-77.

7. Install four oil seal rings on the center support, Fig. 7A-76.

8. Air check operation of intermediate clutch piston. Apply air through center oil feed hole to actuate clutch pistons, Fig. 7A-82.

Gear Unit (Fig. 7A-83)

a. Disassembly of Gear Unit

1. Using Adapter, J-21364, in Rear Unit Holding Fixture, J-6116-01, place gear unit in Holding Fixture with output shaft pointing downward.

2. Remove center support to sun gear races and thrust bearing.

NOTE: Outer race may have stuck to center support when it was removed.

3. Remove sun gear from output carrier assembly.

4. Remove reaction carrier to output carrier thrust washer and front internal gear ring.

5. Invert gear unit in Holding Fixture with main shaft pointing downward.

6. Remove snap ring securing output shaft to output carrier and remove output shaft. Remove O-ring from output shaft and discard.

7. Remove thrust bearing and races from rear internal gear.

8. Lift rear internal gear and main shaft out of output carrier and remove thrust bearing and races from innr face of rear internal gear.

9. Remove snap ring from end of main shaft and remove rear internal gear.

10. Remove output carrier from Holding Fixture.

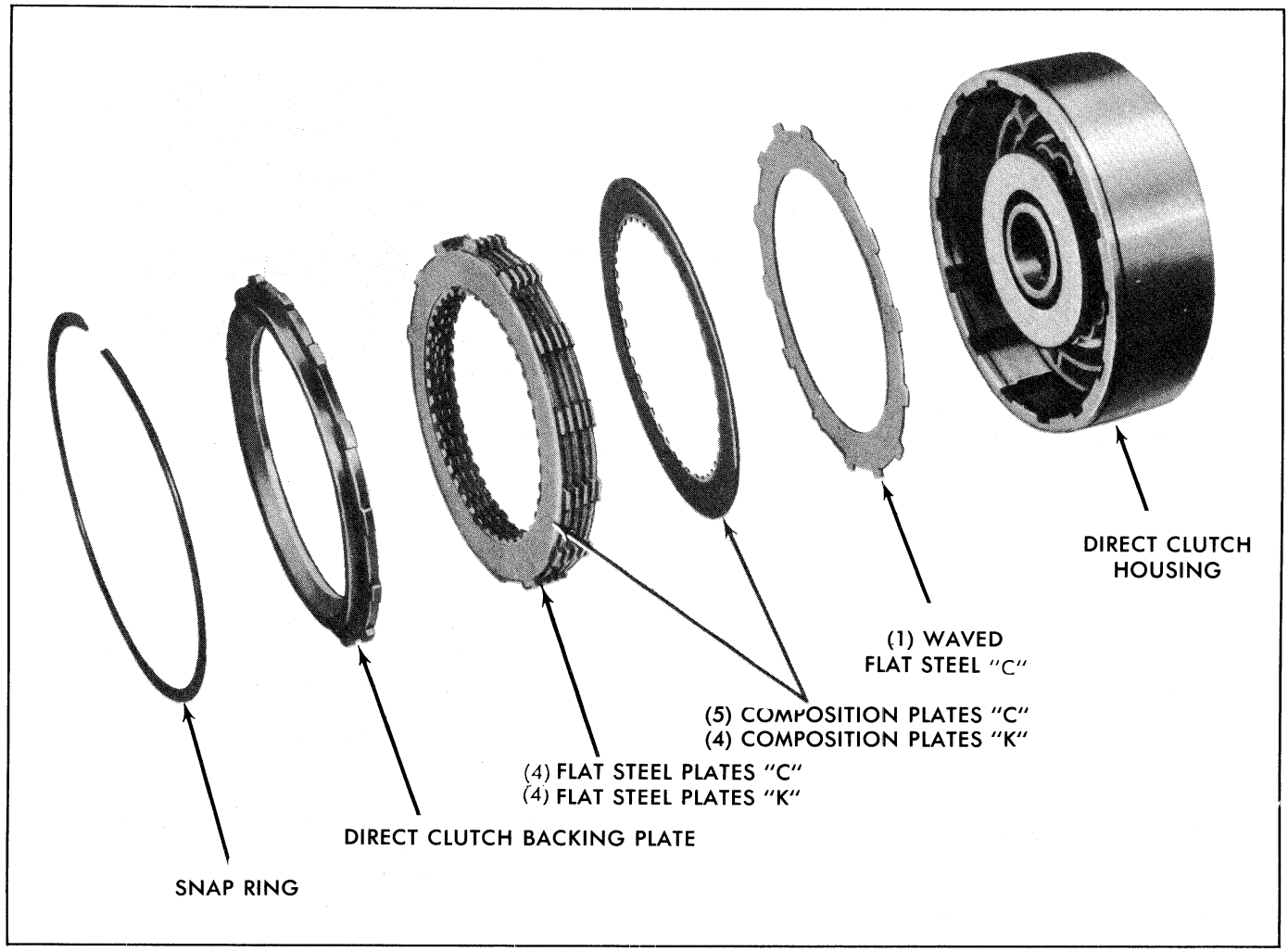


Fig. 7A-69 Direct Clutch - Disassembled View

b. Inspection of Output Shaft

1. Inspect bushing for wear or galling.
2. Inspect bearing and thrust washer surfaces for damage.
3. Inspect governor drive gear for rough or damaged teeth.
4. Inspect splines for damage.
5. Inspect drive lugs for damage.
6. Inspect speedometer drive gear for rough or damaged teeth. If replacement of drive gear is necessary, proceed as follows.

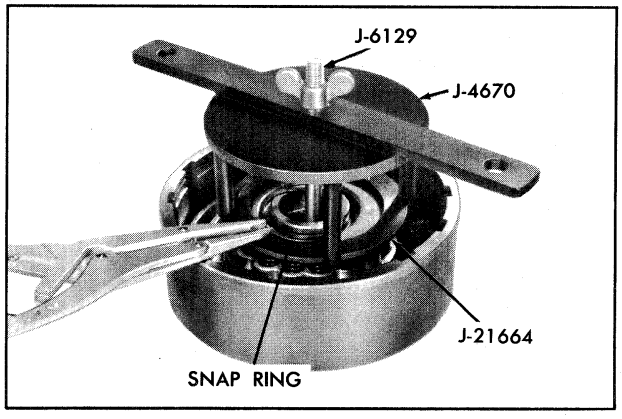


Fig. 7A-70 Removing Direct Clutch Snap Ring

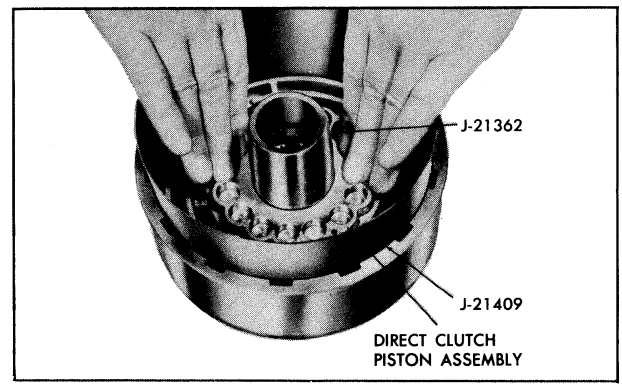


Fig. 7A-71 Installing Direct Clutch Piston

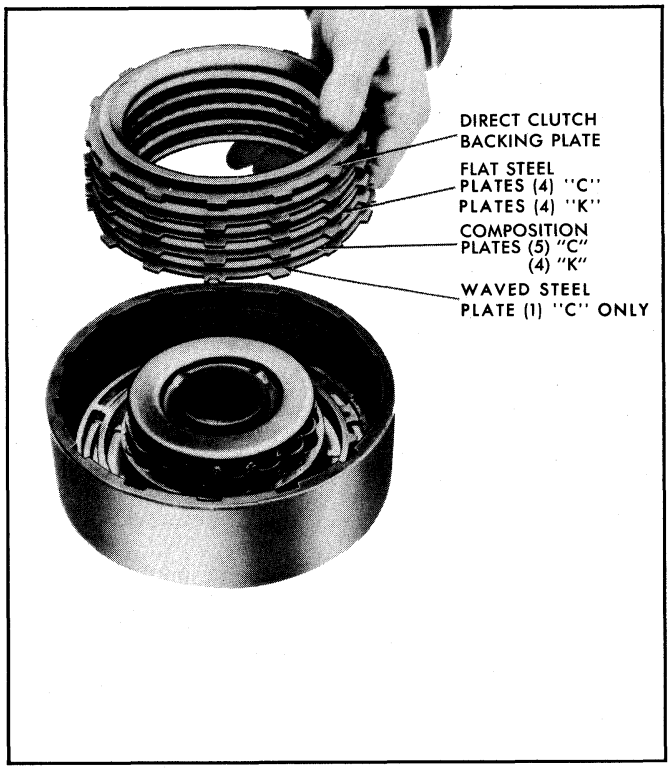


Fig. 7A-72 Installing Direct Clutch Plates

c. Speedometer Drive Gear Replacement

1. Install Speedometer Drive Gear Remover, J-21427, with Pulley Puller, J-8433, and attach on output shaft so that puller bolt indexes with end of shaft and flat face of remover tool is under front face of drive gear.

2. Tighten bolt on Pulley Puller, Fig. 7A-84 until gear is free on shaft. Remove tools and gear from shaft.

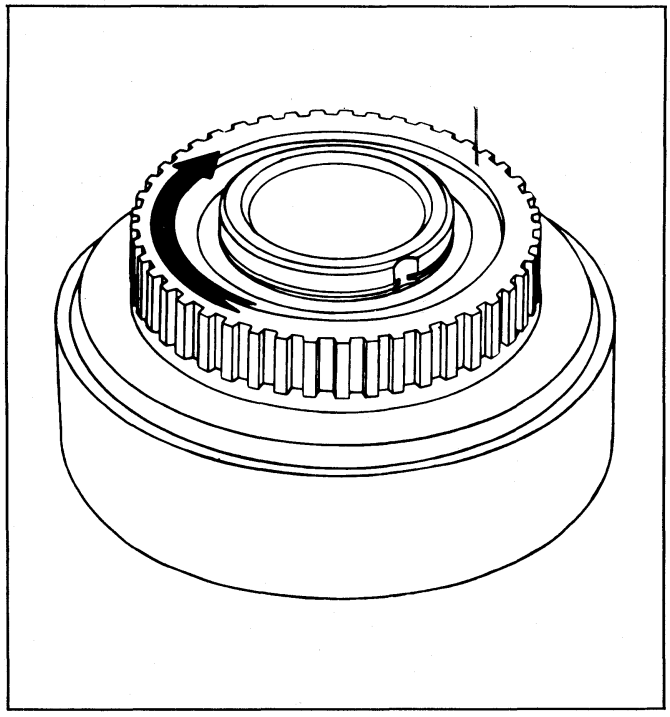


Fig. 7A-73 Roller Clutch Rotation

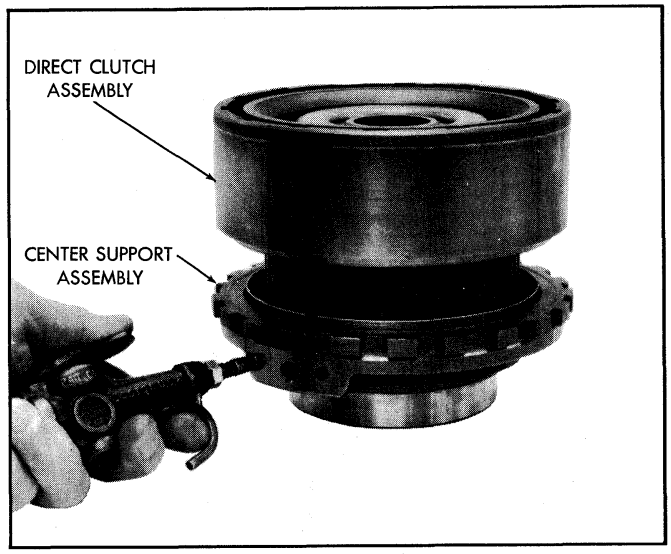


Fig. 7A-74 Air Checking Direct Clutch

3. Support output shaft and install new steel speedometer drive gear using a piece of pipe.

CAUTION: *Use a pipe that closely fits output shaft and does not contact gear teeth. Contact with gear teeth would result in damage to the gear as it is driven into place.*

4. Drive gear onto shaft until distance from rear face of gear to end of output shaft is 5-21/32", Fig. 7A-85.

d. Inspection of Main Shaft

1. Inspect shaft for cracks or distortion.
2. Inspect splines for damage.
3. Inspect ground bushing journals for damage.
4. Inspect snap ring groove for damage.
5. Make sure lubrication holes are open.

e. Inspection of Rear Internal Gear

1. Inspect gear teeth and bearing surfaces for damage or wear.
2. Inspect splines for damage.
3. Inspect gear for cracks.

f. Inspection of Output Carrier Assembly

1. Inspect front internal gear for damaged teeth.
2. Inspect pinion gears for damage, rough bearings or tilt.
3. Check pinion end play. Pinion end play should be .009 inch-.024 inch, Fig. 7A-86.
4. Inspect parking gear lugs for cracks or damage.
5. Inspect output shaft locating splines for damage.
6. Inspect front internal gear ring for flaking or cracks.

g. Inspection of Reaction Carrier Assembly

1. Inspect band surface on reaction carrier for signs of burning or scoring.
2. Inspect roller clutch outer cam for scoring or wear.
3. Inspect thrust washer surfaces for signs of scoring or wear.
4. Inspect bushing for damage. If bushing is damaged, carrier must be replaced.
5. Inspect pinion gears for damage, rough bearings or excessive tilt.
6. Check pinion end play. Pinion end play should be .009

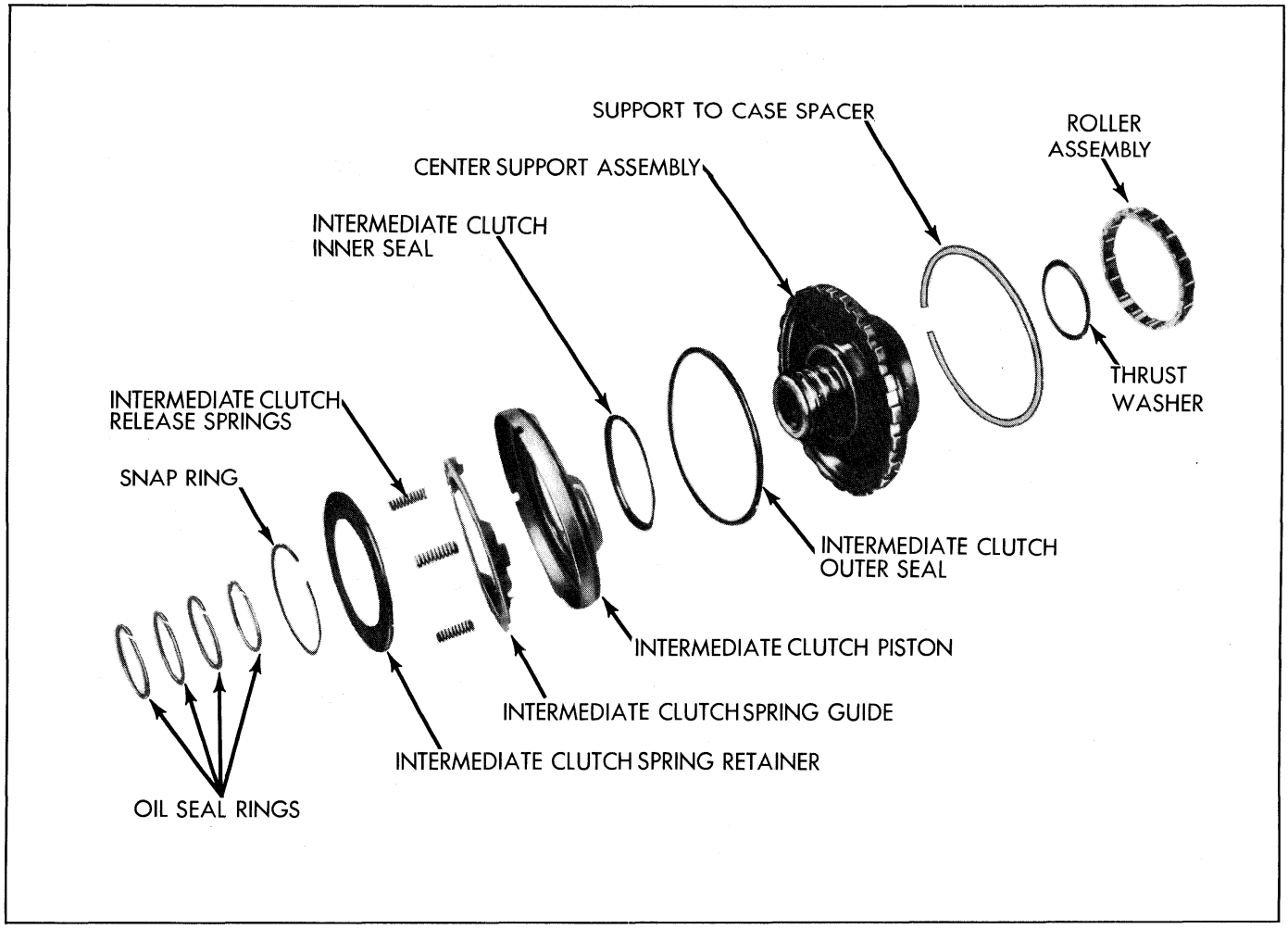


Fig. 7A-75 Center Support Assembly - Disassembled View

inch-.024 inch.

h. Pinion Gear Replacement - Reaction and Output Carrier Assemblies

1. Support carrier assembly on its FRONT face.
2. Using a 1/2 inch diameter drill, remove stake marks from the end of the pinion pin, or pins, to be replaced. This will reduce the possibility of cracking the carrier when pinion pins are pressed out.

CAUTION: *Do not allow drill to remove any stock from the carrier as this will weaken the part and could result in a cracked carrier.*

3. Using a tapered punch, drive or press pinion pins out of carrier.
4. Remove pinion gears, thrust washers, and roller needle bearings.
5. Inspect pinion pocket thrust faces for burrs and remove if present.
6. Install eighteen needle bearings into each pinion gear using petrolatum to hold bearings in place. Use a pinion pin as a guide.
7. Place a bronze and steel thrust washer on each side of pinion gear with steel washers against gear, Fig. 7A-87. Hold washers in place with petrolatum.
8. Place pinion gear assembly in position in carrier and install a pilot shaft through rear face of assembly to hold parts in place.
9. Drive a new pinion pin into place from the front, while rotating pinion gear. Be sure that headed end is flush or below face of carrier.
10. Using a punch and bench vise for an anvil, stake opposite end of pinion pin in three places with a blunt radius chisel, Fig. 7A-88.

CAUTION: *Both ends of pinion pins must lie below face of carrier or interference may occur.*

11. Repeat installation procedure for each pinion gear.

i. Inspection of Roller Clutch Assembly

1. Inspect roller clutch for damaged rollers or springs.
2. Inspect roller clutch cage for damage.

j. Inspection of Sun Gear

1. Inspect gear teeth for damage or wear.
2. Inspect splines for damage.
3. Be sure oil lubrication hole is open.

k. Inspection of Sun Gear Shaft

1. Inspect shaft for cracks or splits.
2. Inspect splines for damage.
3. Inspect bushings for scoring or galling.
4. Inspect ground bushing journals for damage.
5. Be sure oil lubrication hole is open.

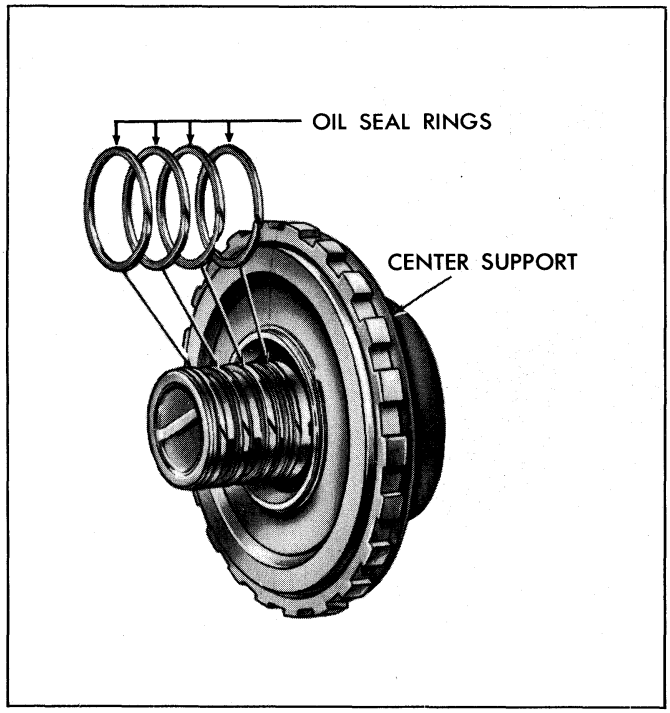


Fig. 7A-76 Center Support Oil Seal Rings

L. Assembly of Complete Gear Unit

1. Install rear internal gear on end of mainshaft that has snap ring groove and install snap ring.

2. Install races and thrust bearing on inner face of rear internal gear, retaining races and bearing with petrolatum. Proceed as follows:

a. Install large diameter race first, with flange facing up, Fig. 7A-89.

b. Install thrust bearing in race.

c. Install small diameter race on bearing with inner flange facing down.

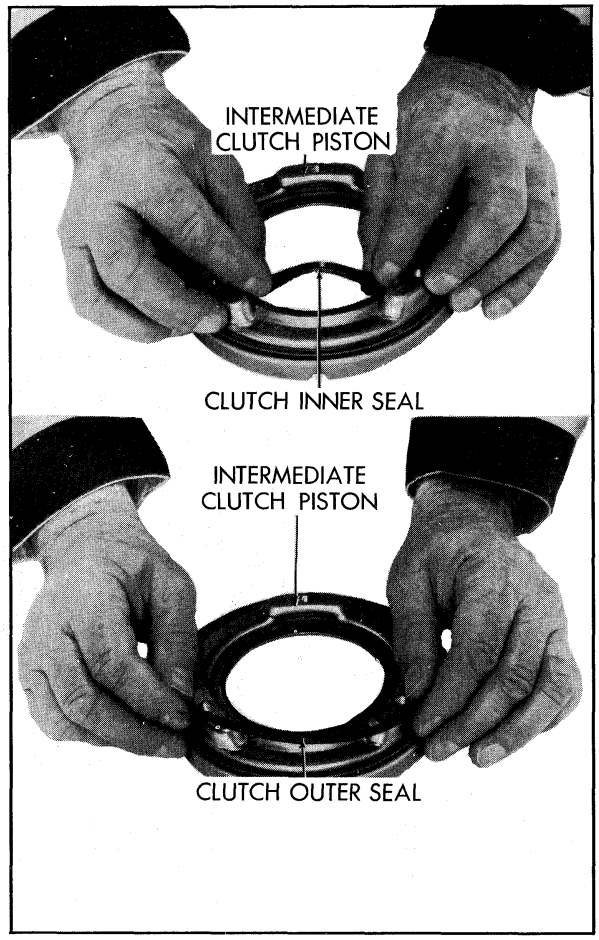


Fig. 7A-78 Installing Intermediate Clutch Piston Seals

3. Lubricate pinion gears in output carrier with transmission fluid and install output carrier on mainshaft so that pinion gears mesh with rear internal gear.

4. Place assembly in Rear Unit Holding Fixture, J-6116-

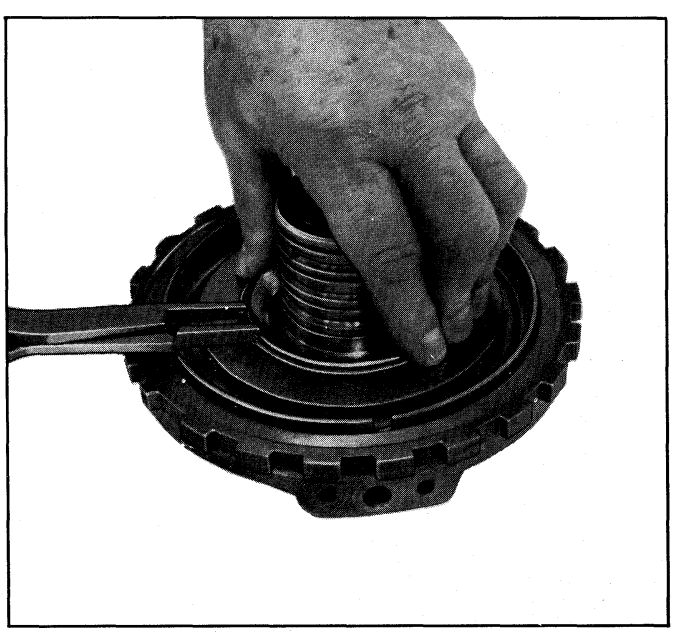


Fig. 7A-77 Removing Intermediate Clutch Snap Ring

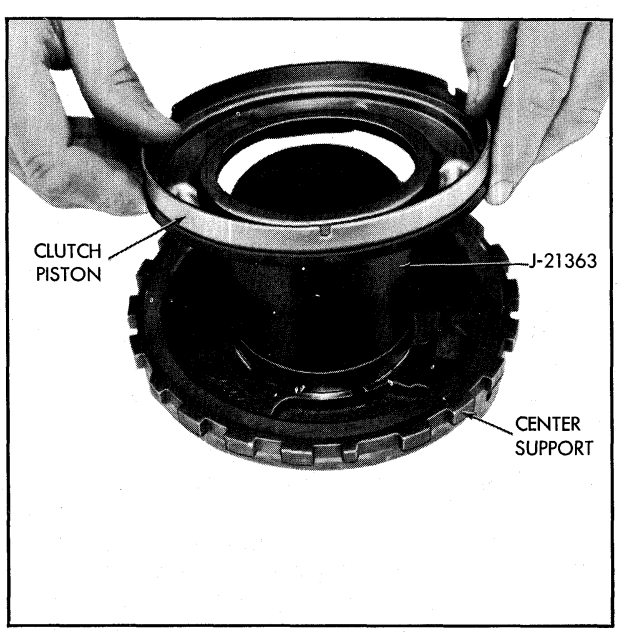


Fig. 7A-79 Installing Intermediate Clutch Piston

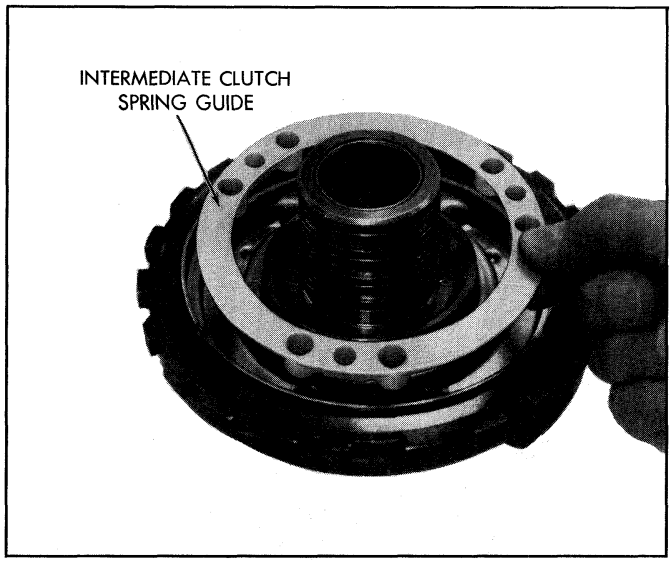


Fig. 7A-80 Installing Spring Guide

01, with mainshaft pointing downward. Be careful not to damage shaft.

5. Install races and thrust bearing on outer face of rear internal gear, retaining races and bearing with petrolatum. Proceed as follows:

a. Install small diameter (flanged I.D.) race first, with flange facing up, Fig. 7A-90.

b. Install thrust bearing in race.

c. Install large diameter (flanged O.D.) race on bearing with flange cupped over bearing.

6. Install output shaft into output carrier and install snap ring. Install new O-ring on output shaft.

7. Invert assembly in Holding Fixture with output shaft pointing downward.

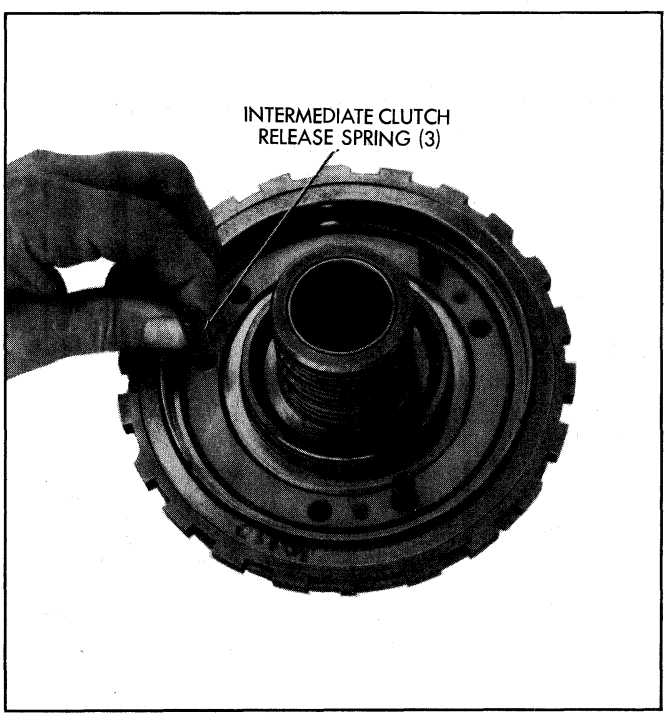


Fig. 7A-81 Installing Clutch Release Spring

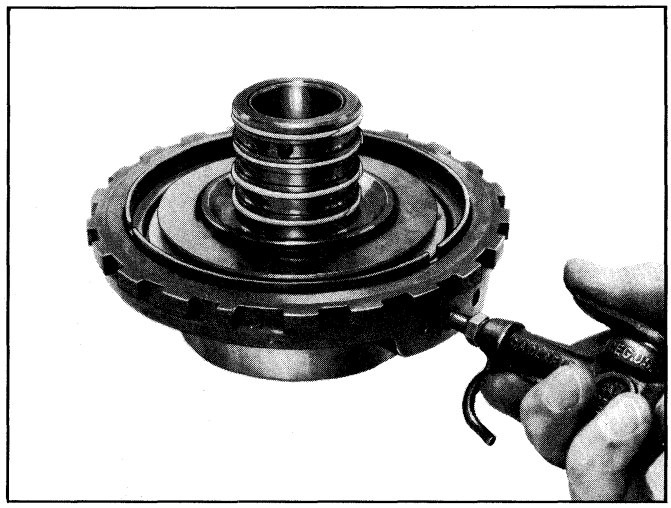


Fig. 7A-82 Air Checking Intermediate Clutch

8. Lubricate tab side of reaction-to-output carrier thrust washer with petrolatum and install thrust washer in output carrier with tabs in tab pockets, Fig. 7A-91.

9. Install sun gear with end having chamfered I.D. facing down.

10. Install sun gear shaft with longer splined end down.

11. Install gear ring over output carrier.

12. Lubricate pinion gears in reaction carrier with transmission fluid and install reaction carrier on output carrier, Fig. 7A-92, so that pinion gears mesh with front internal gear.

NOTE: When a new output carrier and/or reaction carrier is being installed, and if the front internal gear ring prevents assembly of the carriers, replace the front internal gear ring with the service ring. The front internal gear ring is a selective fit at the factory but not in service.

13. Install large diameter O.D. race on sun gear with flange facing up against sun gear shaft.

14. Install thrust bearing on race.

15. Lubricate small diameter race with petrolatum and install race on center support with flange facing toward lower end, Fig. 7A-93.

16. Lubricate reaction carrier to center support thrust washer with petrolatum and install washer in recess in center support, Fig. 7A-44.

17. Install rollers that may have come out of roller clutch cage, by compressing energizing spring with forefinger and inserting roller from outer side, Fig. 7A-94.

NOTE: Make certain that energizing springs are not distorted, and that curved end leaf of springs are positioned against rollers.

18. Install roller clutch assembly in reaction carrier, Fig. 7A-95.

19. Install center support assembly into roller clutch in reaction carrier, Fig. 7A-96.

NOTE: Be sure that center support to reaction carrier thrust washer is in place before installing center support assembly into roller clutch in reaction carrier.

NOTE: With reaction carrier held, center support should turn counterclockwise only.

20. Install Tool J-21365 or J-21795-02, on end of main shaft so that tangs engage groove in shaft. Tighten screw on

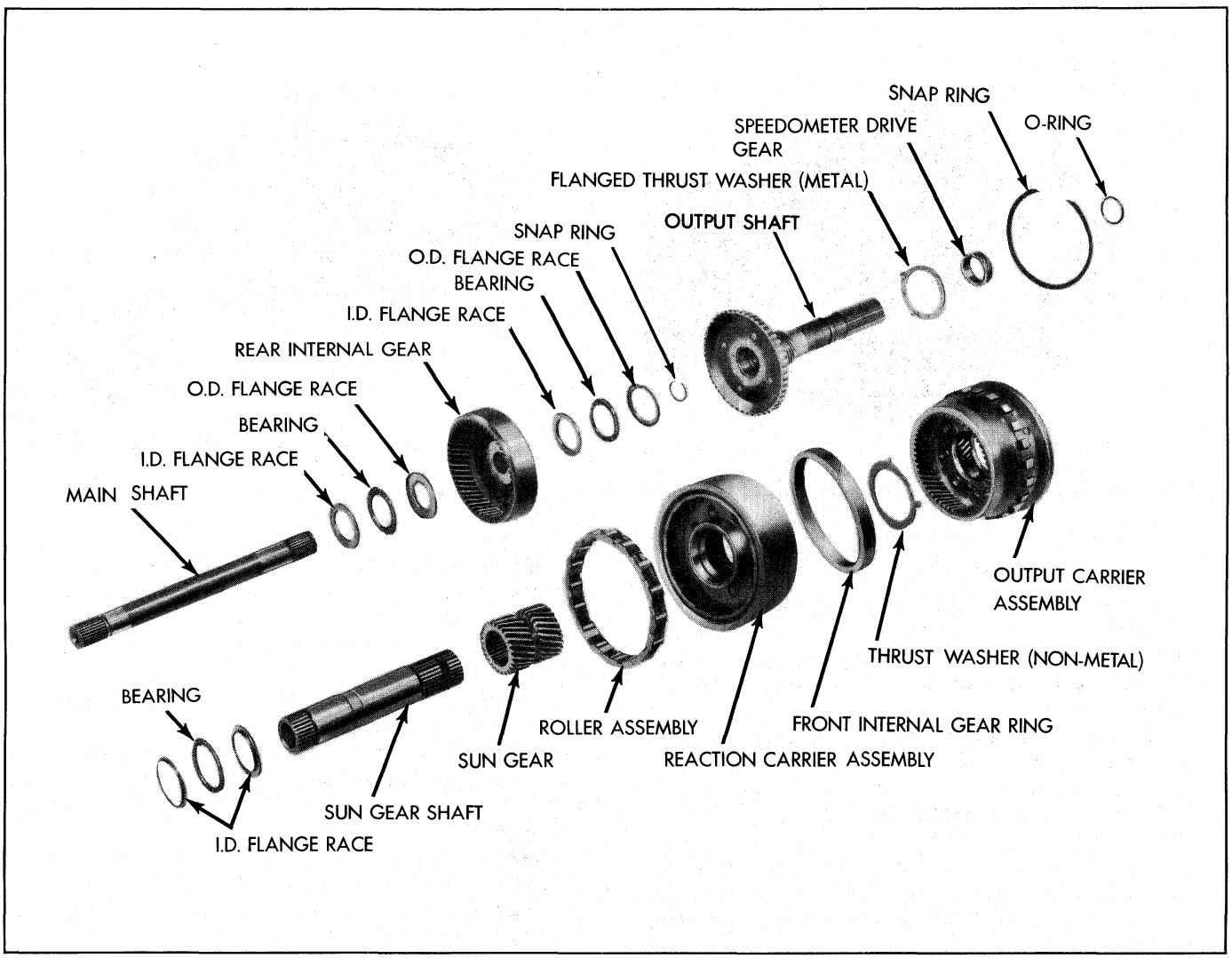


Fig. 7A-83 Gear Unit - Disassembled View

tool to secure tool on shaft and prevent movement of the roller clutch during installation of the gear unit assembly.

21. Remove gear unit from Holding Fixture and lay unit on its side. Install thrust metal washer on rear face of output shaft with bent tabs in tab pockets. Retain thrust washer with petrolatum, Fig. 7A-91.

CAUTION: *This must be a metal washer.*

MAJOR TRANSMISSION COMPONENTS–INSTALLATION

Install Parking Pawl

1. Install parking pawl, tooth toward center of transmission, and install parking pawl shaft, Fig. 7A-97.

2. Install parking pawl shaft retainer clip.

3. Install parking pawl shaft cup plug by driving into the transmission case, using a 3/8 inch diameter rod, until the parking pawl shaft bottoms on the case rib, Fig. 7A-98.

4. Install parking pawl return spring with square end hooked on pawl.

5. Install parking pawl bracket with guides over parking pawl, Fig. 7A-99. Install two attaching screws and tighten screws to 18 foot-pounds.

Install Support to Case Spacer Rear Band and Complete Gear Unit Assembly

1. Inspect rear band for cracks or distortion and band ends for damage at anchor lugs and apply lug. Also inspect lining for cracks, flaking, burning and looseness.

2. Install rear band assembly in transmission case so that band lugs index with anchor pins, Fig. 7A-101.

3. Inspect support to case spacer for burrs or raised edges. If present, remove with a stone or fine sandpaper.

4. Install the support to case spacer against the shoulder at the bottom of case splines and the gap located adjacent to the band anchor pin.

CAUTION: *Do not confuse this spacer (.040" thick and both sides flat) with either the center support to case snap ring (one side beveled) or the backing plate to ease snap ring (.093" thick and both sides flat).*

5. Install previously selected rear unit selective washer into slots provided inside rear of transmission case. Retain washer with petrolatum.

NOTE: Proper washer size was determined at time of rear unit end play check, Page 7A-37.

6. Place transmission case in Holding Fixture in

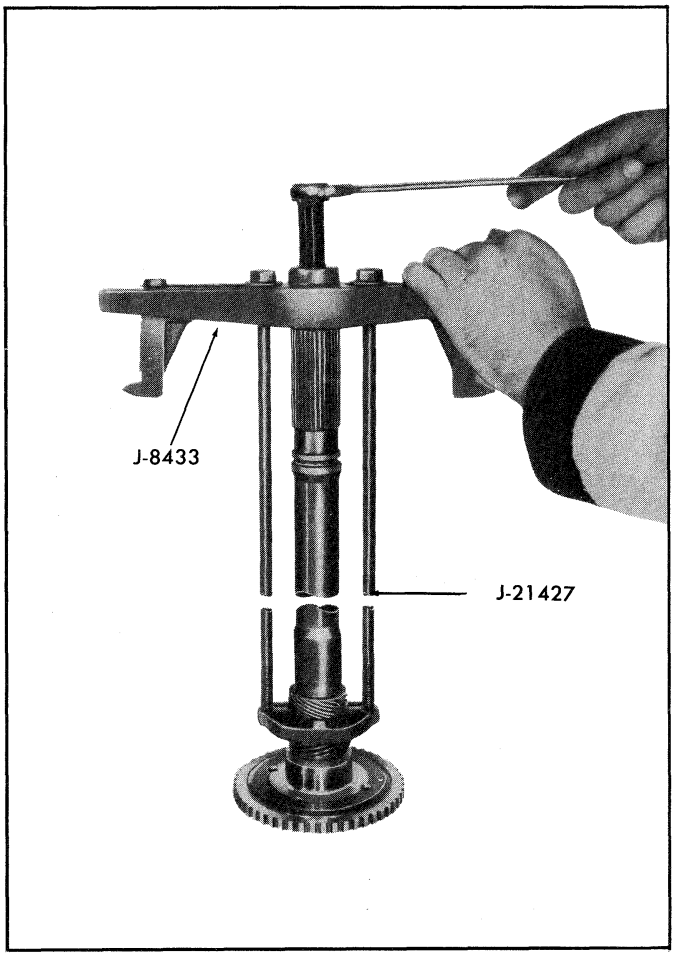


Fig. 7A-84 Removing Steel Speedometer Drive Gear

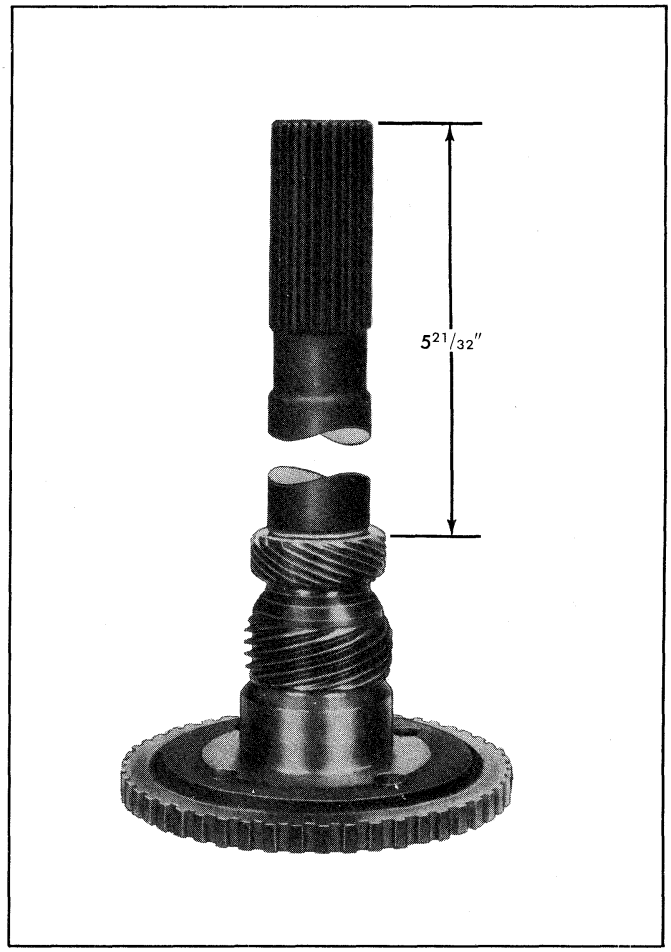


Fig. 7A-85 Installing Steel Speedometer Drive Gear

horizontal position. Do not over-tighten transmission Holding Fixture side pivot pin as this will cause binding when gear unit is installed.

7. Install proper diameter length of pipe to output shaft to be used as a handle and to prevent any damage to case bushing when installing unit assembly.

CAUTION: *Be careful not to drop or bump assembly in transmission case during installation. This could result in damage to output shaft case bushing as well as to assembly itself.*

8. Install gear unit with center support and reaction carrier, by lining up slots and carefully guiding complete assembly horizontally into transmission case, making certain the center support bolt hole is properly aligned with hole in case.

9. Position transmission vertically with front end of case facing upward. Remove tool, J-21365 or J-21795-02.

10. Lubricate center support to case snap ring with transmission fluid and install snap ring in transmission case with beveled side up, flat side against center support, locating gap adjacent to front band anchor pin, Fig. 7A-100. Expand snap ring until center support is against shoulder of case.

11. Install case to center support bolt.

NOTE: To correctly perform this operation, it will be necessary to use tool, J-23093 or to make the tool and follow the installation procedure described below.

Make the tool from 3/8" (.375" diameter) cold roll steel or from a screwdriver with a 3/8" diameter shank. The stock should be approximately 12" long. Grind the stock to a blunt point, tapering it 7/8" from the end of the bar to a 1/8" diameter at the end, Fig. 7A-102.

Bend the bar to a 45° angle 2-1/2" from the pointed end, Fig. 7A-102.

Place the center support locating tool into the direct

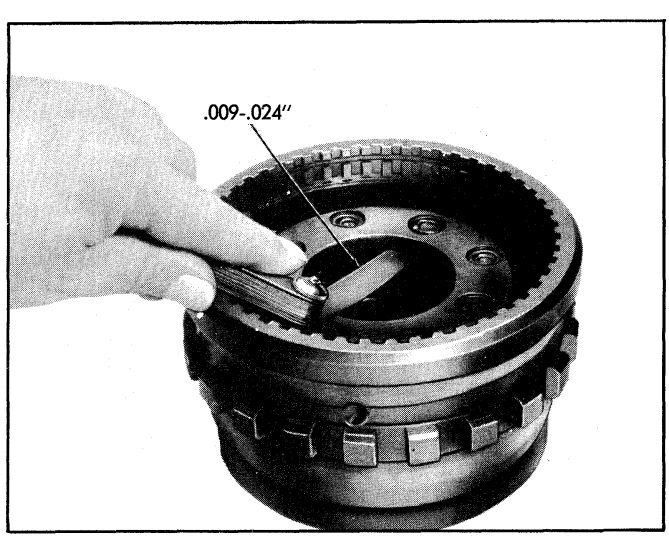


Fig. 7A-86 Checking Output Carrier Pinion End Play

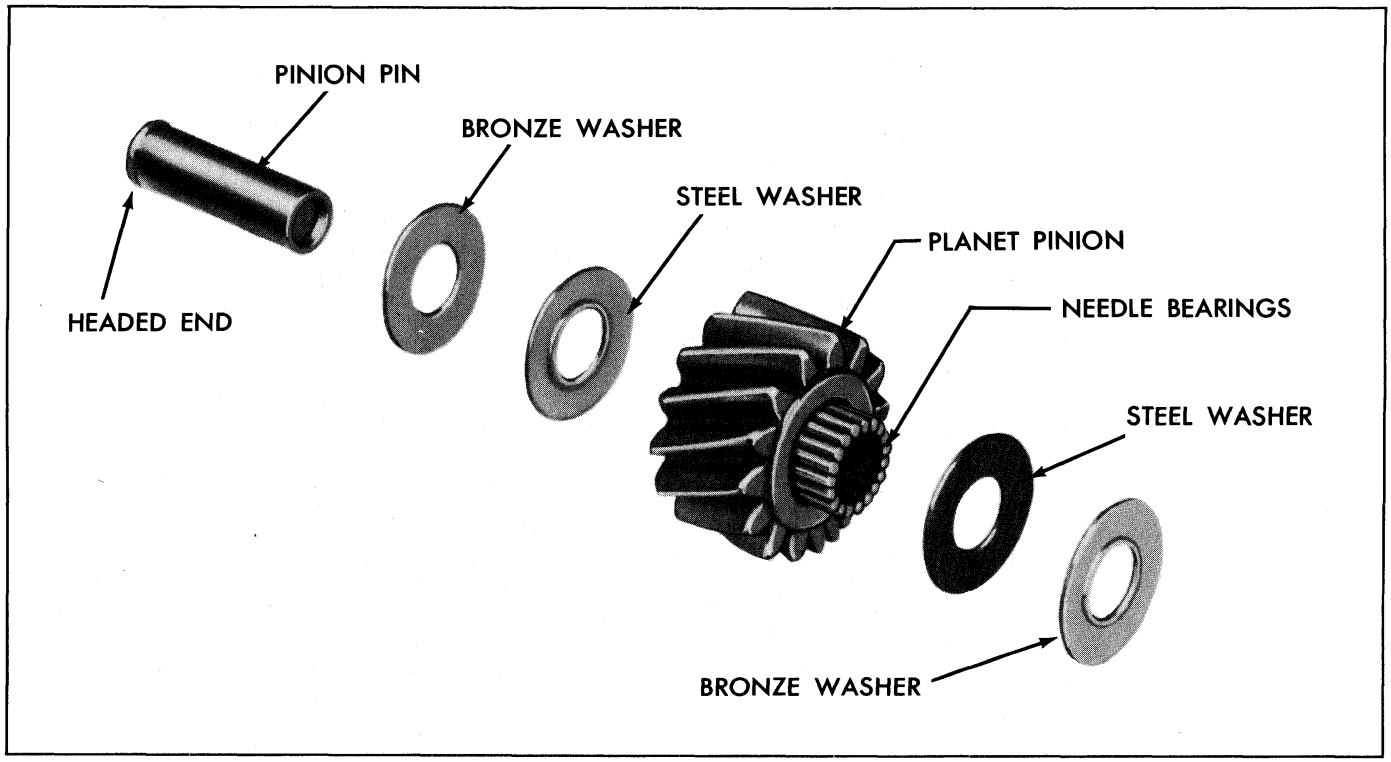


Fig. 7A-87 Planet Pinion - Disassembled View

clutch passage in the case, with the handle of the tool pointing to the right as viewed from the front of the transmission and parallel to the bell housing mounting face.

Apply pressure downward on the tool handle, which will tend to rotate the center support counterclockwise as viewed from the front of the transmission. While holding the center support firmly counterclockwise against the case splines, torque the case-to-center support bolt to 23 ft.lbs. using a 3/8" thin wall deep socket.

CAUTION: *When using the locating tool, take care not to raise burrs on the case valve body mounting face.*

12. Before installing intermediate clutch plates, inspect plates for signs of burning, scoring, and wear.

13. Lubricate three steel and three composition faced intermediate clutch plates with transmission fluid and install clutch plates in transmission case, Fig. 7A-103. **Start with**

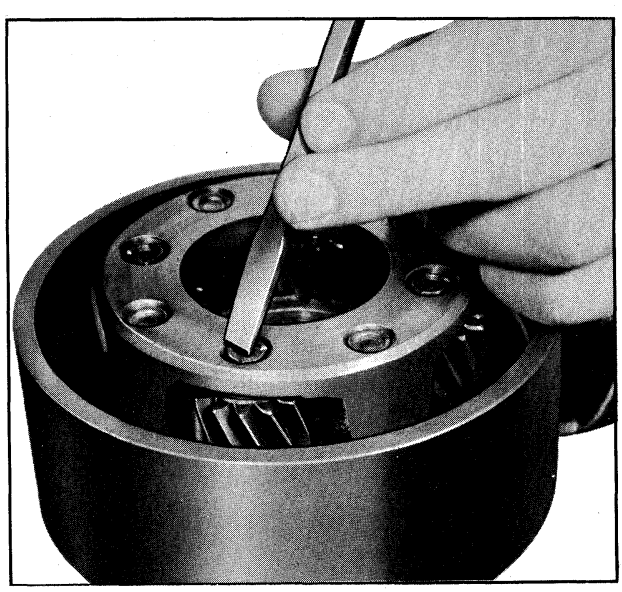


Fig. 7A-88 Staking Pinion Pin

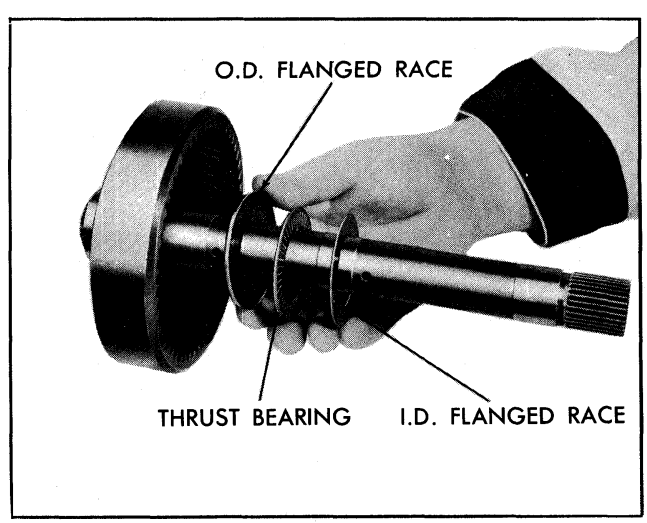


Fig. 7A-89 Installing Rear Internal Gear-to-Sun Thrust Bearing and Races

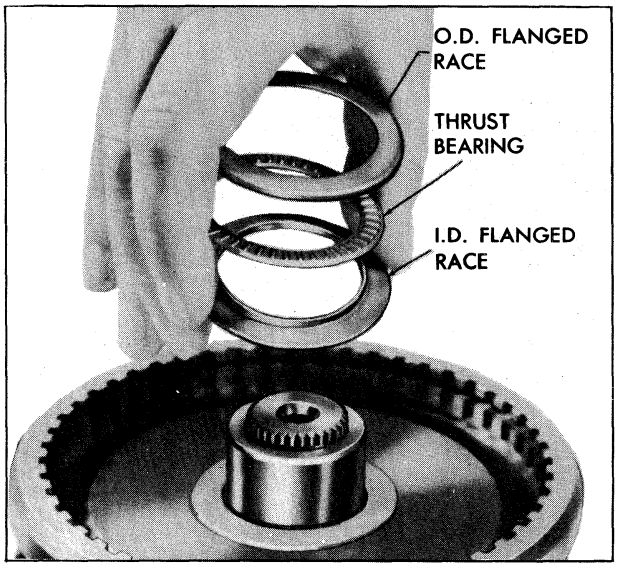


Fig. 7A-90 Internal Gear, Thrust Bearing and Races

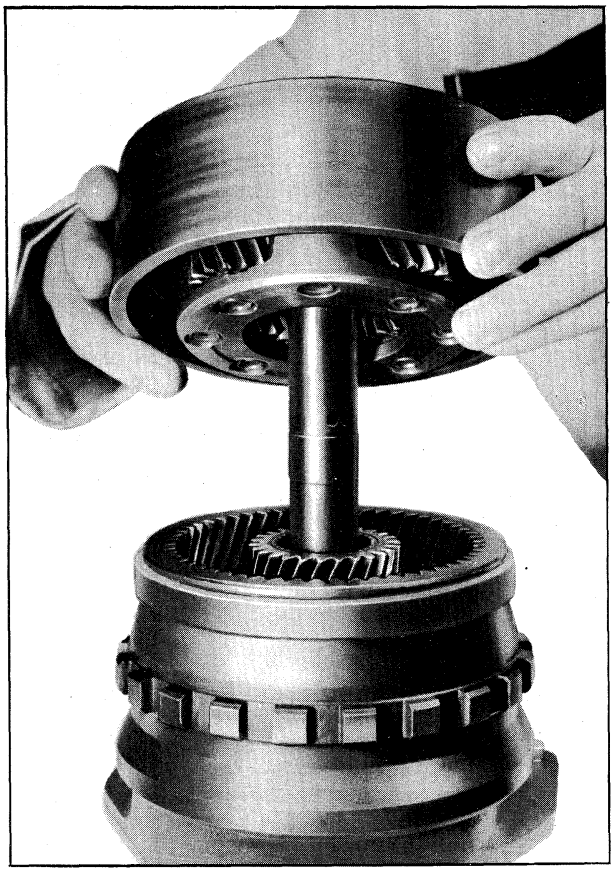


Fig. 7A-92 Installing Reaction Carrier to Output Carrier

the waved steel plate and alternate composition faced and flat steel plates.

14. Install intermediate clutch backing plate with flat machined surface against clutch plates.

15. Install backing plate to case snap ring with snap ring gap on side of case opposite front band anchor pin.

NOTE: Both sides of the snap ring are flat and it is approximately .093" thick.

16. Recheck rear unit end play as described on Page 7A-37.

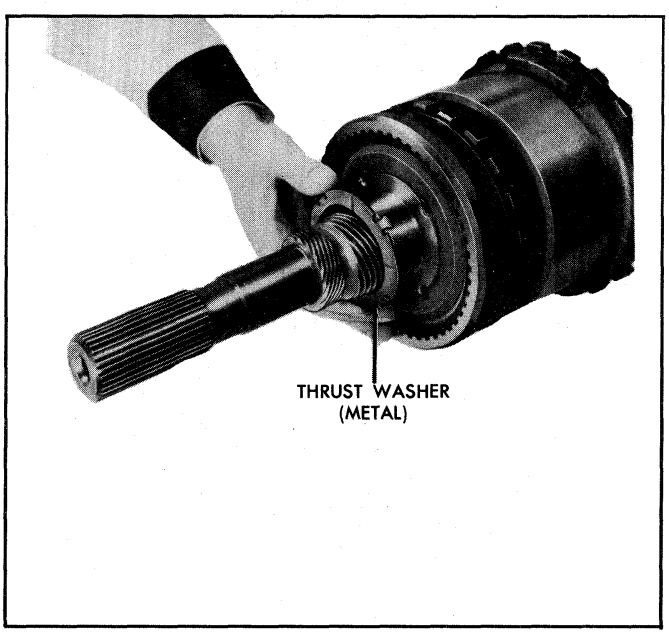


Fig. 7A-91 Installing Case-to-Output Shaft Metal Thrust Washer

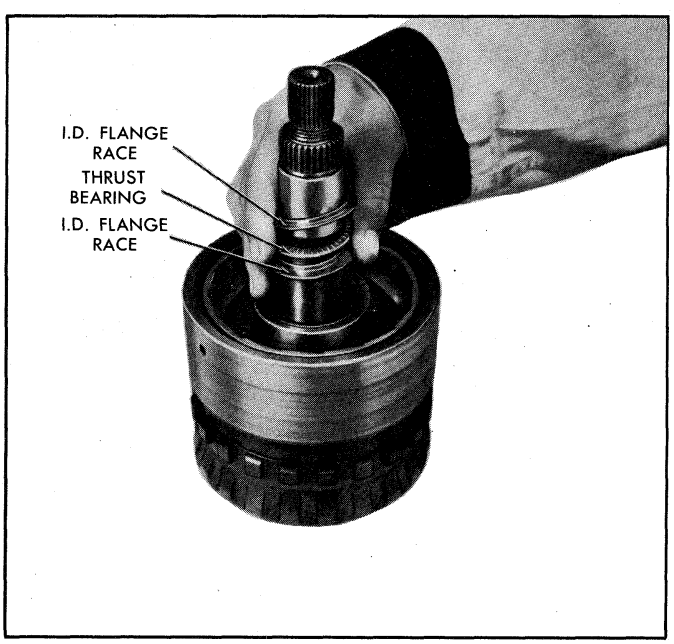


Fig. 7A-93 Installing Center Support Thrust Bearing Over Sun Gear Shaft

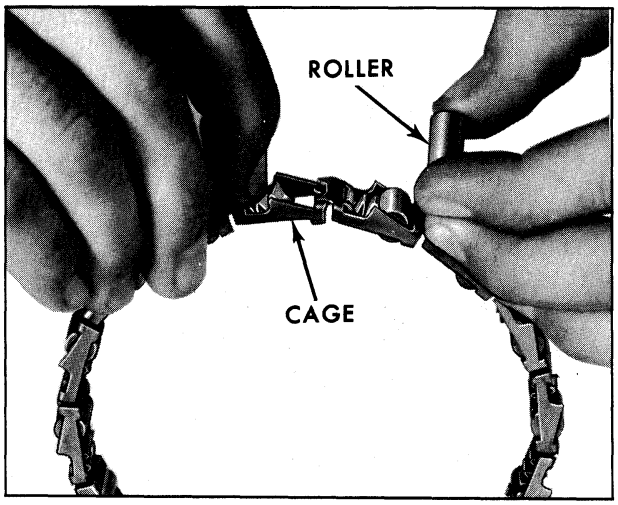


Fig. 7A-94 Installing Rollers in Roller Clutch Cage

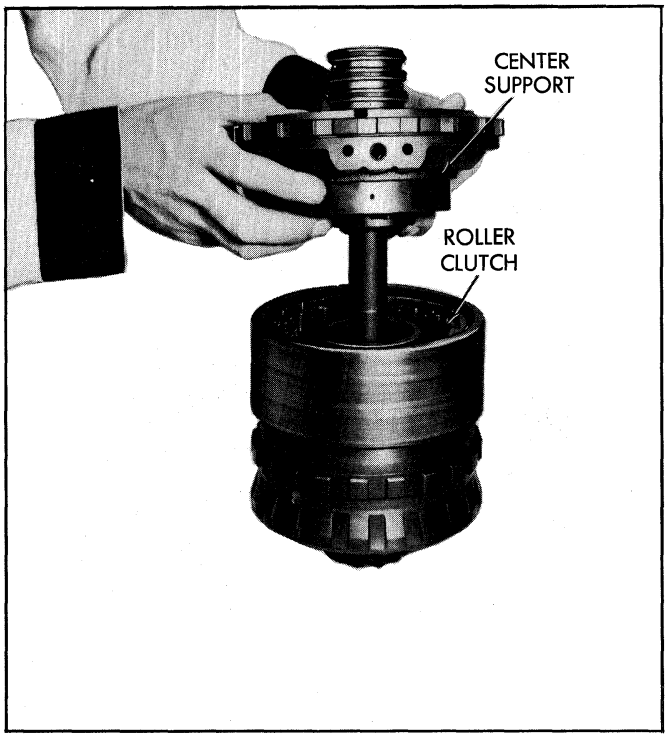


Fig. 7A-96 Installing Center Support to Reaction Carrier

Install Front Band and Remaining Clutch Assemblies

1. Inspect front band for cracks or distortion and band ends for damage at anchor lug and apply lug. Also inspect lining for cracks, flaking, burning, and looseness.

2. Install front band with band anchor hole over band anchor pin, and apply lug facing servo hole, Fig. 7A-104.

3. Install direct clutch housing and intermediate roller assembly. Make certain that clutch housing hub bottoms on sun gear shaft and splines on forward end of sun gear shaft are flush with splines in direct clutch housing. Clutch Alignment Tool J-24396 is available to position clutch plates for ease of installation.

NOTE: It will be necessary to rotate clutch housing to allow roller outer race to index with intermediate clutch composition-faced plates. Removal of direct clutch

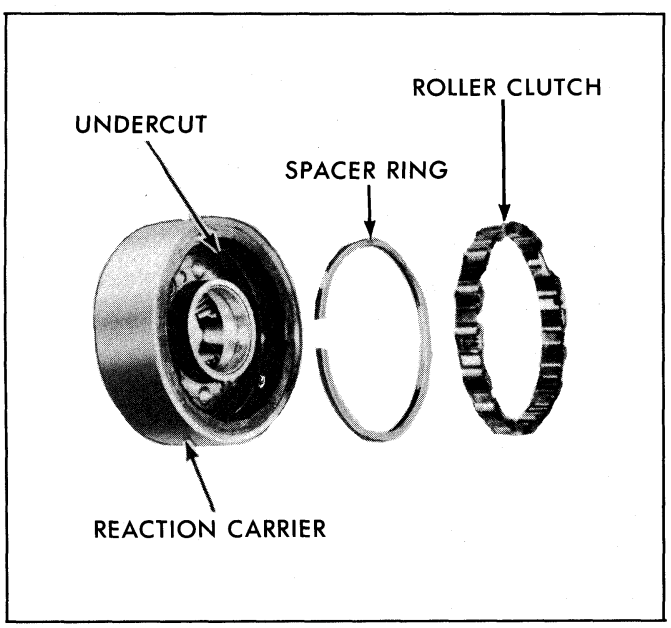


Fig. 7A-95 Installing Spacer Ring and Roller Clutch Assembly

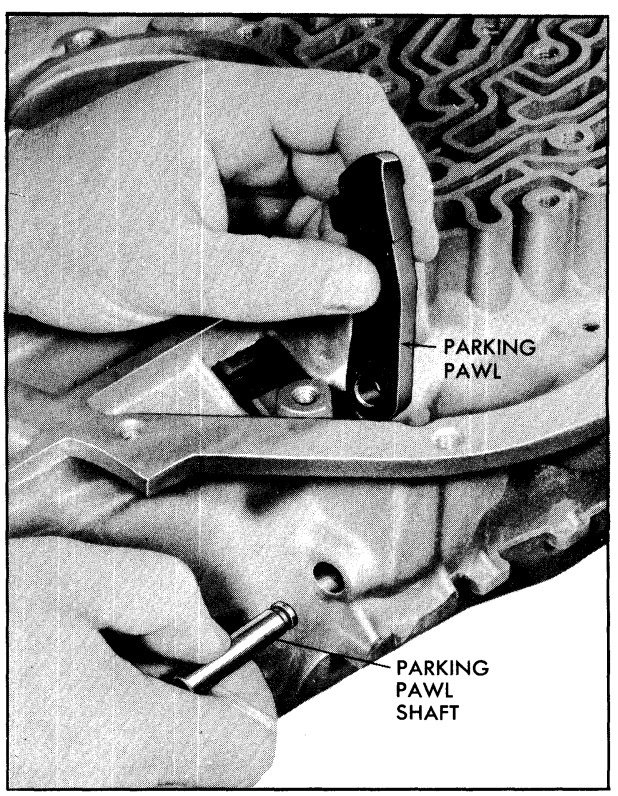


Fig. 7A-97 Installing Parking Pawl and Shaft

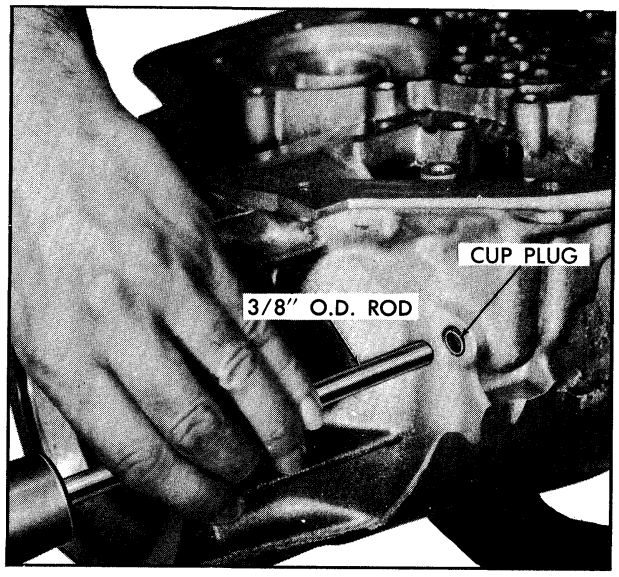


Fig. 7A-98 Installing Cup Plug

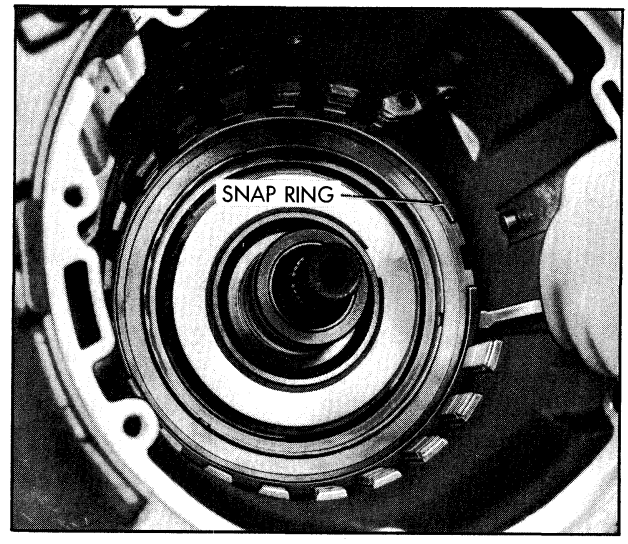


Fig. 7A-100 Beveled Snap Ring Location

composition and steel plates may be helpful and applying air pressure through the center support screw to apply the intermediate clutch plates may facilitate assembly.

4. Install forward clutch hub to direct clutch housing thrust washer on forward clutch hub. Retain with petrolatum.

5. Position transmission horizontally in Holding Fixture and install forward clutch assembly and turbine shaft, Fig. 7A-105. Make certain end of main shaft goes all the way into forward clutch hub. It will be necessary to rotate clutch housing to allow direct clutch driving hub to index with direct clutch composition plates. When forward clutch is seated, it will be approximately 1-1/4 inches from pump mounting face in case. **Measure this distance.**

NOTE: Missing internal splines in forward clutch hub are lubrication passages and do not have to be indexed with any particular spline on main shaft.

Install Oil Pump

1. Lubricate turbine shaft journals with transmission fluid and lubricate teflon oil rings on pump delivery sleeve with petrolatum.

2. Install Slide Hammer Bolts, J-6125-1, through two opposite unthreaded holes in pump assembly to serve as guide pins when installing pump.

3. Properly align pump to case gasket on case mounting face.

4. Position pump assembly in transmission case and thread Slide Hammer assemblies into their corresponding threaded holes in transmission case.

5. Install pump assembly in transmission case. Do not

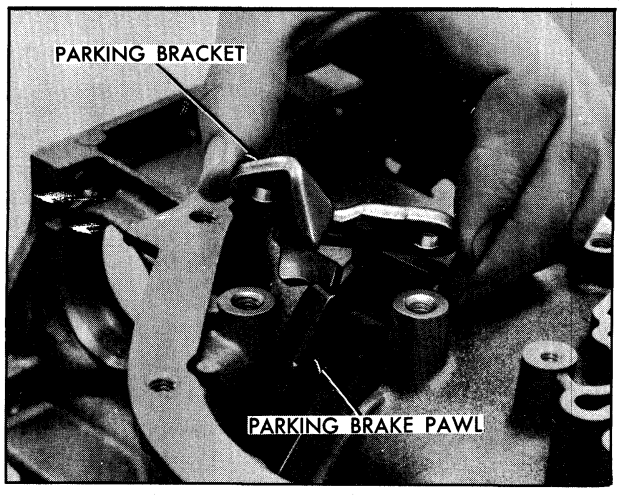


Fig. 7A-99 Installing Parking Pawl Bracket

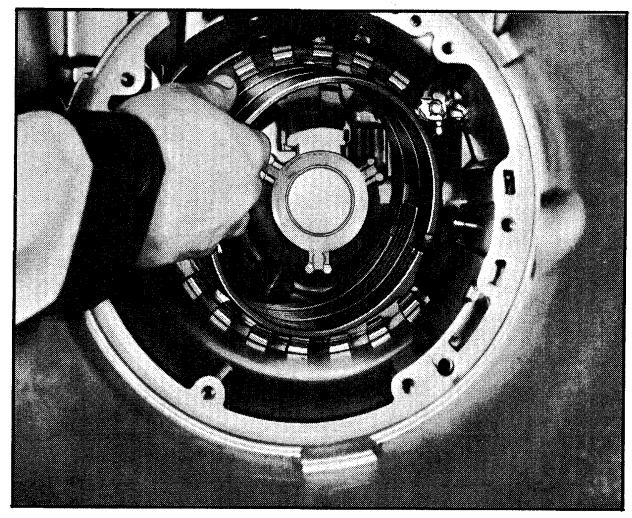


Fig. 7A-101 Installing Rear Band Assembly

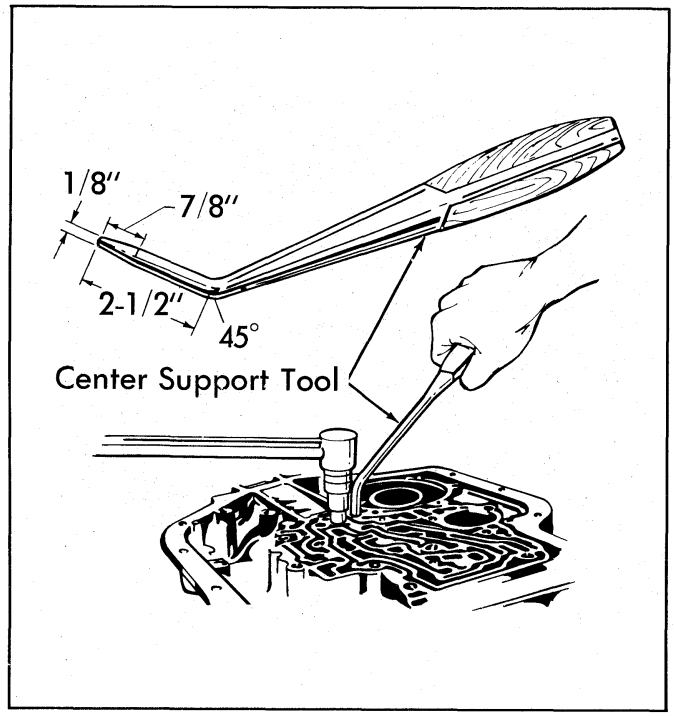


Fig. 7A-102 Locating Center Support

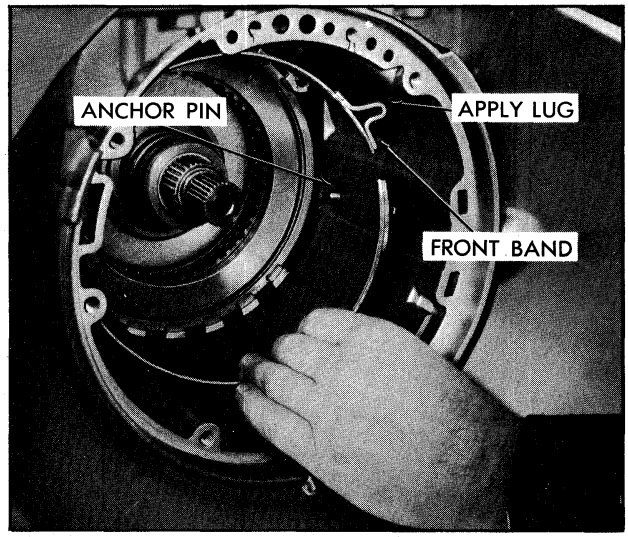


Fig. 7A-104 Installing Front Band

remove slide hammer bolts until last two pump attaching screws are installed.

6. Using six new rubber-coated washers on pump attaching screws, install all but one attaching screw at either 5 o'clock or 10 o'clock position so that front unit end play can be rechecked. Tighten screws to 18 foot-pounds.

NOTE: If turbine shaft cannot be rotated as pump is being pulled into place, the forward or direct clutch housings have not been installed properly to index with all the clutch plates. This condition must be corrected before pump is pulled fully into place.

7. Recheck front unit end play as described on Page 7A-36.

8. Install remaining pump attaching screw using new rubber coated washer. Tighten screw to 18 foot-pounds.

9. Apply non-hardening sealer to outside of new seal and install new front seal using Pump Oil Seal Installer, J-21359.

Install Parking Linkage, Detent Lever, and Manual Shaft

1. If necessary install a new manual shaft lip seal into transmission case using a 3/4" diameter rod to seat the seal.

2. Insert actuator rod into manual detent lever from side opposite pin.

3. Install actuator rod plunger under parking bracket and over parking pawl.

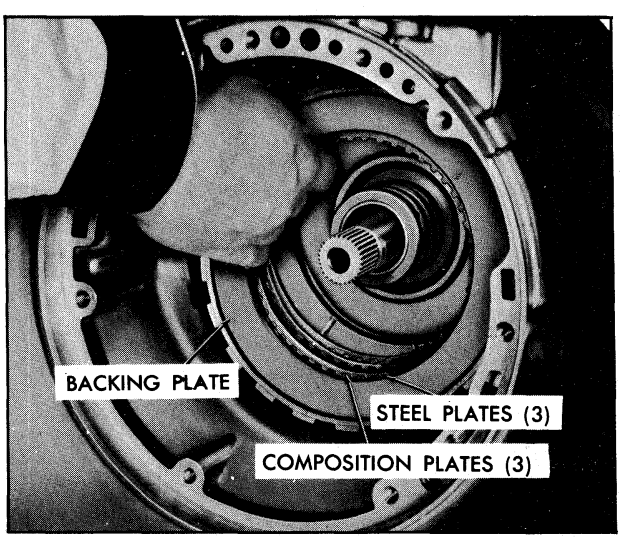


Fig. 7A-103 Installing Intermediate Clutch Plates

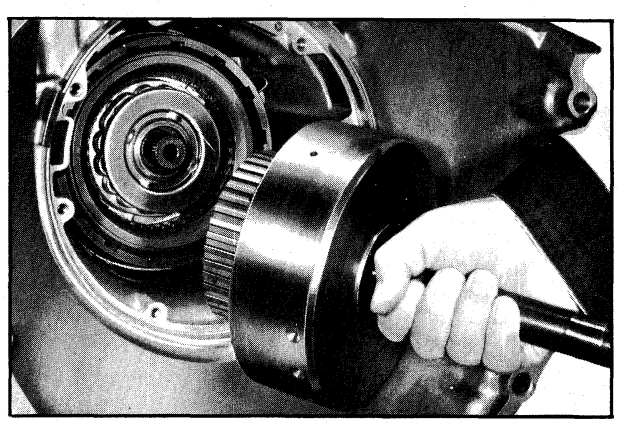


Fig. 7A-105 Installing Forward Clutch Assembly

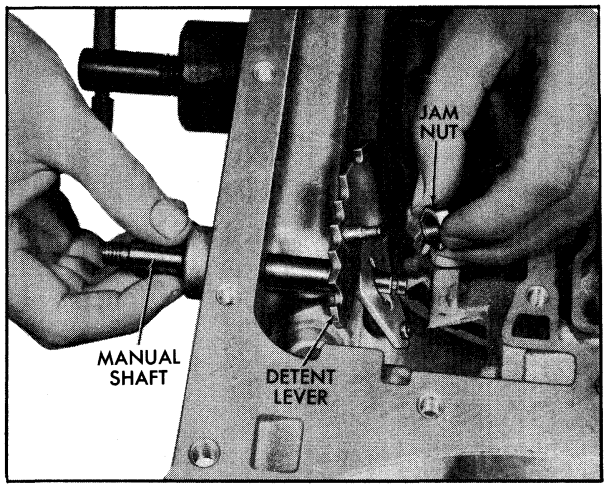


Fig. 7A-106 Installing Manual Shaft

4. Install manual shaft into case and through detent lever, Fig. 7A-106.

5. Install locknut on manual shaft. Tighten nut to 18 foot-pounds.

6. Install external manual yoke on manual shaft if removed. Tighten nut to 18 foot-pounds.

7. Install retaining pin in case, indexing it with groove in manual shaft, Fig. 7A-107.

NOTE: If procedure is being performed with transmission in car, install and straighten bent pin.

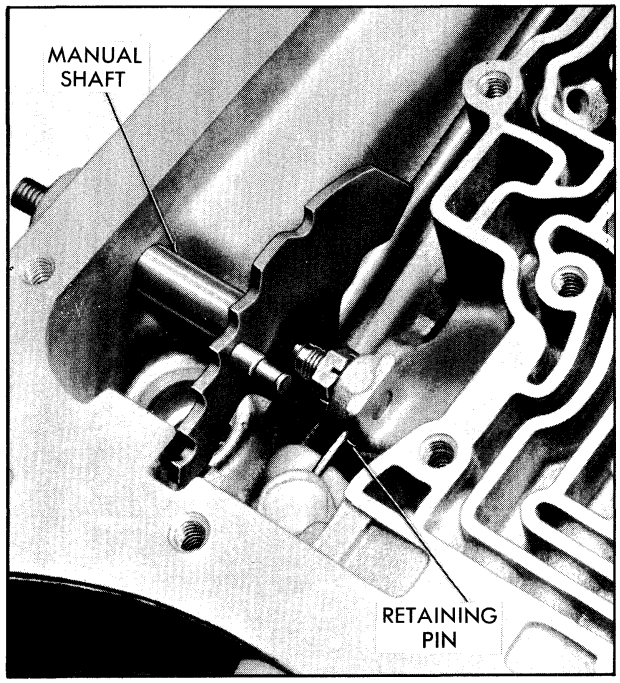


Fig. 7A-107 Retaining Pin

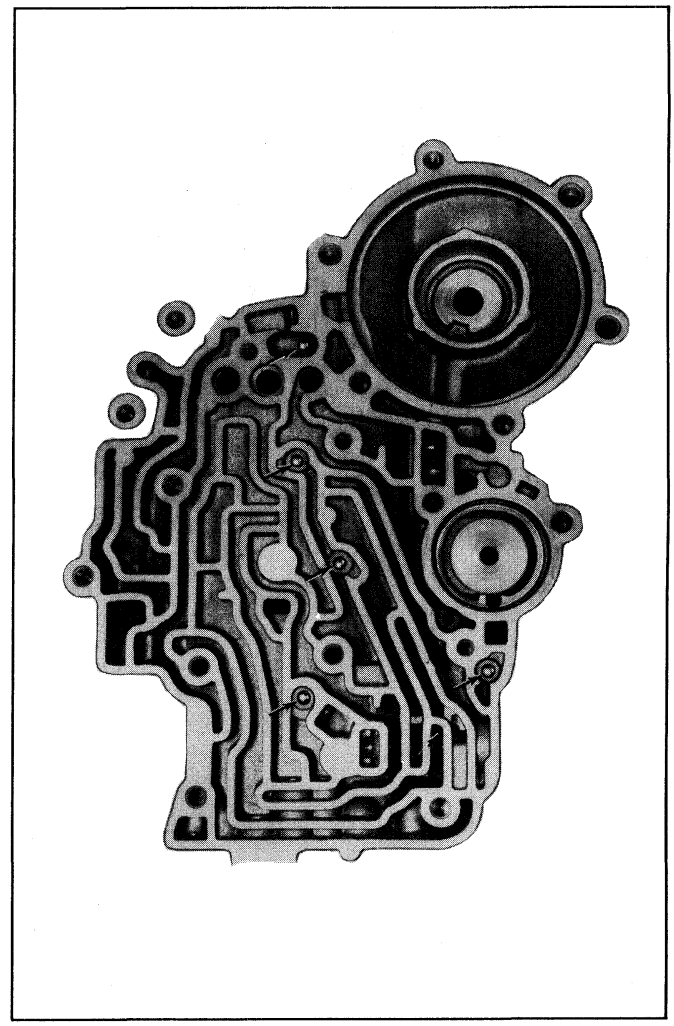


Fig. 7A-108 Location of Check Balls

Install Extension Housing

1. Install new gasket on extension housing, retaining with petrolatum.

2. Check O-ring on output shaft for any nicks or flattening and replace O-ring if either condition exists.

3. Secure extension housing to case with six attaching screws. Tighten screws to 23 foot-pounds.

4. If necessary, install a new extension housing oil seal using Oil Seal Installer, J-21359. Apply non-hardening sealer to outside of seal before installation.

Install Check Balls, Control Valve, Spacer Plate & Gaskets, Detent Solenoid, Front Servo Assembly and Electrical Connector

1. Install two control valve assembly attaching bolts with heads cut off as guide pins as shown in Fig. 7A-112.

2. Install five check balls into ball seat pockets in transmission case, Fig. 7A-108.

NOTE: If transmission is in car, install check balls into ball seat pockets on spacer plate, Fig. 7A-109.

3. Install control valve spacer plate-to-case gasket (gasket with extension for detent solenoid and a "©" near front servo location).

4. Install control valve spacer plate.

5. Install detent solenoid gasket.

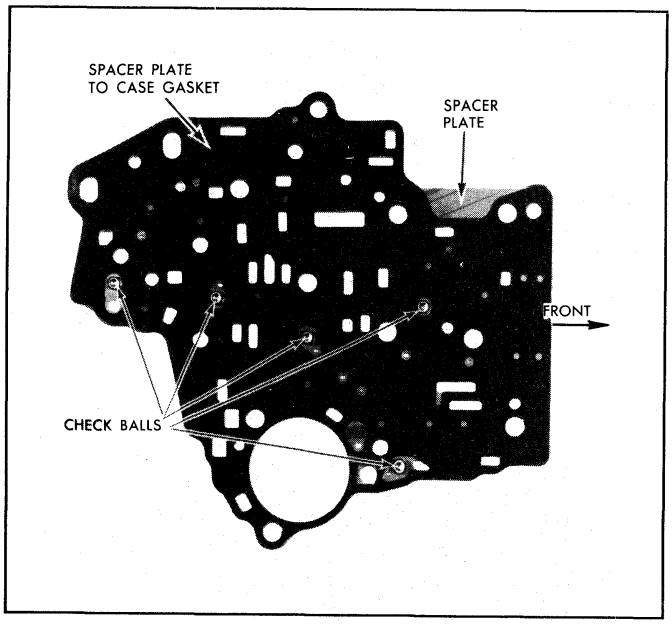


Fig. 7A-109 Spacer Plate Gasket with Check Balls

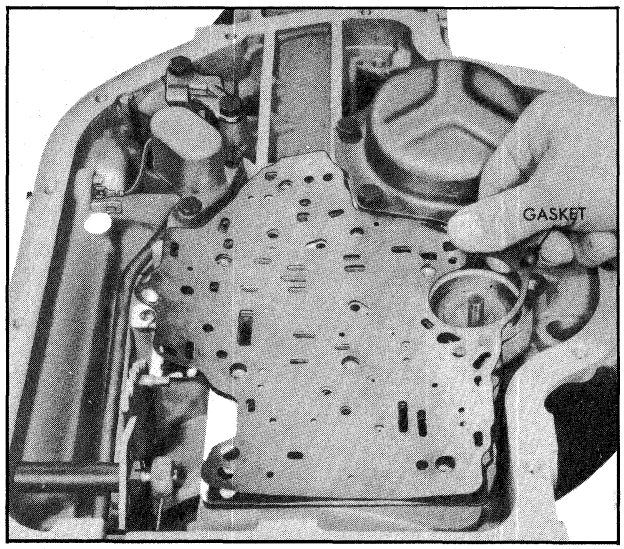


Fig. 7A-110 Installing Spacer Gasket

6. Install detent solenoid assembly with connector facing outer edge of case. **Do not tighten bolts at this time.**

7. Install front servo spring and spring retainer into transmission case.

8. Install retainer ring in front servo pin groove and install pin into case so that tapered end contacts band. Make certain retainer ring is installed in servo pin groove.

9. Install seal ring on servo piston, if removed, and install on servo pin with flat side of piston positioned toward bottom pan.

NOTE: The ring allows the front servo piston to slide very freely in the case. The free fit of the ring in the bore is a normal characteristic and does not indicate leakage during operation. The teflon ring should only be replaced if it shows damage or if evidence of leakage during operation exists.

NOTE: If transmission is in car, assembly front servo group as shown in Figure 7A-55 and install this group of parts into front servo bore in case and hold. Slip a length of straight, clean feeler gauge or shim stock (about .020") between spacer plate and front servo piston to temporarily retain front servo group.

10. Install new O-ring on solenoid connector.

11. Install connector with lock tabs pointing into case. Position locator tab in notch on side of case.

12. Connect detent solenoid wire to connector terminal, Fig. 7A-111.

Install Rear Servo Assembly

1. Lubricate inner and outer rear servo bores in transmission case with transmission fluid and install rear accumulator spring in servo inner bore.

NOTE: Before installing rear servo assembly, make certain that rear band apply lug is aligned with servo pin bore in transmission case. Otherwise servo pin will not apply band.

2. Position rear servo assembly in transmission.

3. Press down on rear servo assembly, making certain it is properly seated in case bore, and install rear servo cover and new gasket. Install six attaching screws, tightening screws to 18 foot-pounds.

Install Control Valve Assembly, Governor Pipes & Governor Screen Assembly

1. Install control valve assembly-to-spacer gasket (gasket with "VB" near front servo location).

2. Install governor pipes on control valve assembly. Governor pipes are interchangeable.

3. Install governor screen assembly, open end first; into governor feed pipe hole in case (hole nearest the center of transmission). Fig. 7A-31.

4. Install control valve assembly and governor pipes on transmission, while carefully aligning the governor feed pipe over the governor screen, Fig. 7A-112. Make certain gaskets and spacer do not become mispositioned. See Fig. 7A-110.

NOTE: Check manual valve to make sure it is indexed properly with pin on detent lever and governor pipes to

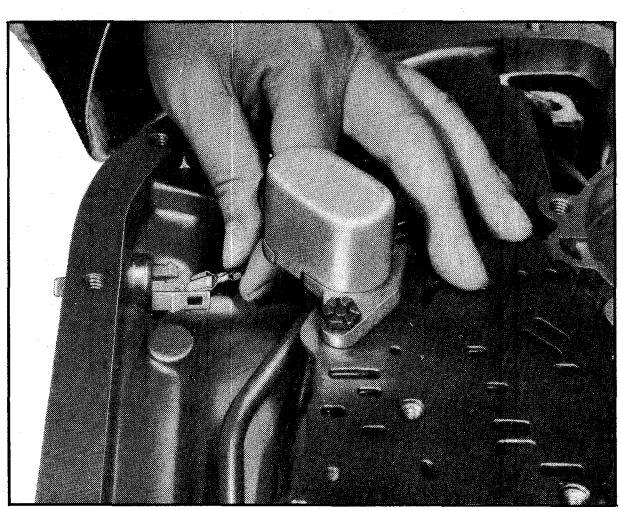


Fig. 7A-111 Installing Wire onto Electrical Connector

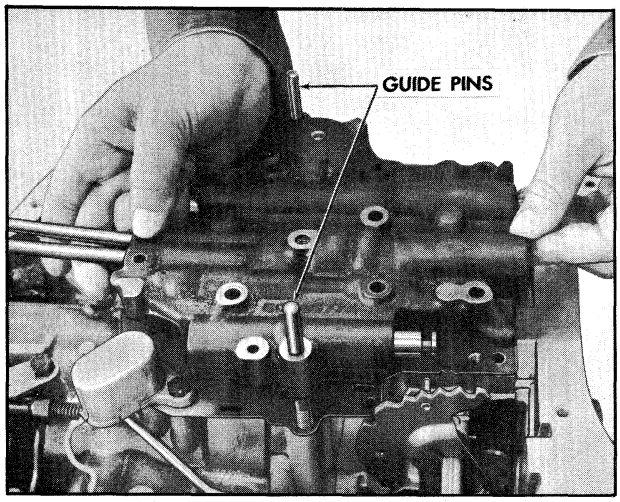


Fig. 7A-112 Installing Control Valve Assembly.

make certain they are properly seated in case holes.

5. Start control valve assembly attaching screws.

NOTE: If transmission is in vehicle, remove feeler stock before tightening any control valve screws.

6. Remove guide pins and install detent roller and spring assembly and remaining screws, Fig. 7A-113. Torque bolts to 8 ft.lbs.

7. Tighten detent solenoid attaching screws to 10 foot-pounds. Solenoid screws should be zinc plated to provide a good electrical connection.

Install Modulator Valve and Vacuum Modulator

1. Install modulator valve into case with stem end out.

2. Install new O-ring on vacuum modulator.

3. Install vacuum modulator into case with vacuum hose pipe facing front of car and angled 5° toward top of case.

4. Install modulator retainer with curved side of tangs, inboard and install attaching screw. Tighten screw to 18 foot-pounds.

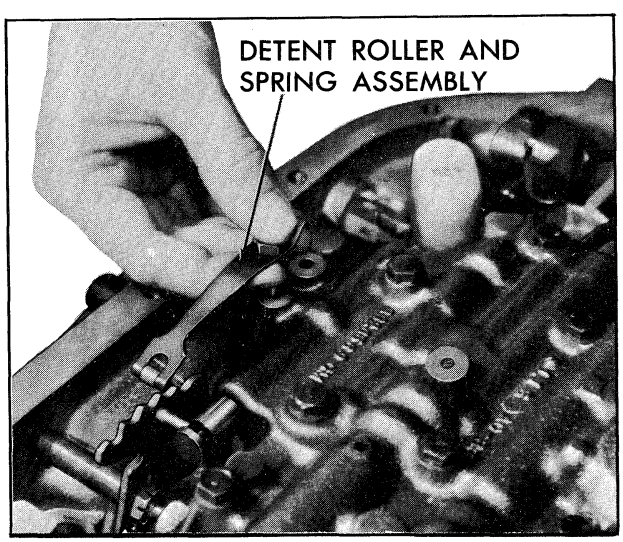


Fig. 7A-113 Installing Detent Roller and Spring

Install Governor Assembly

1. Install governor assembly into case.

2. Using a new gasket, attach governor cover to case with four attaching screws. Torque screws to 18 foot-pounds.

NOTE: If transmission is in car proceed as follows.

3. Install two bolts securing transmission extension housing to crossmember.

Install Speedometer Driven Gear Assembly

Speedometer driven gears are provided in three different tooth sizes. Driven gear and matching sleeve must be installed to correspond with axle ratio. Refer to Page 8-8.

1. Lubricate driven gear selected from chart with a small amount of DEXRON ® - 11 transmission fluid and position driven gear as shown in Section 8, Fig 6.

2. Install speedometer driven gear retainer with tangs in sleeve positioning bosses, and install attaching screw. Tightening screw to 18 foot-pounds.

CAUTION: *Never turn sleeve in transmission case as shaft centerline is eccentric with outside diameter and gear damage will result.*

Install Intake Pipe and Filter Assembly and Bottom Pan

1. Install new intake pipe O-ring onto pipe and install pipe assembly into new filter assembly.

2. Install filter and intake pipe assembly into case bore, Fig. 7A-29.

3. Install filter retainer bolt, and tighten to 10 foot-pounds. Fig. 7A-28.

4. Install new gasket on bottom pan and install bottom pan.

5. Install 13 bottom pan attaching screws. Tighten screws to 12 foot-pounds.

NOTE: Intake pipe is marked "filter" and "case". Assemble "filter" end into filter.

Install Converter

1. Install converter on turbine shaft making certain that converter drive hub slots are fully engaged with the pump drive gear tangs.

2. Install Converter Holding Clamp, J-21366, on front of transmission case, Fig. 7A-22.

Transmission Case Repairs

a. Repairing Tapped Holes

Thread repair inserts are available from various sources and are recommended for restoring damaged threads. The instructions provided with your specific repair kit should be followed.

b. Repairing Case Porosity

Leaks caused by case porosity can be successfully repaired with the transmission in the car, using the following procedure:

1. Road test and bring transmission to operating temperature approximately 170 degrees.

2. Raise car on a hoist with engine running and locate source of oil leak.

NOTE: Use of a mirror is helpful in finding leaks.

3. Shut engine off and thoroughly clean area to be repaired with a cleaning solvent and a brush. Air dry.

NOTE: A clean, dry soldering acid brush can be used to clean the area and also to apply the epoxy cement.

4. Using instructions provided, mix a sufficient amount of epoxy, No. 136 0016, or equivalent to make repair.

NOTE: Observe cautions of manufacturer in handling.

5. While the transmission case is still HOT, apply the epoxy to the area to be repaired.

NOTE: Make certain the area to be repaired is fully covered.

6. Allow cement to cure for three hours before starting engine.

7. Road test and check for leaks.

TORQUE SPECIFICATIONS
C-CAR — SEVILLE

Material Number	Application	Thread Size	Foot Pounds
260M	Filter to Valve Body Screw	5/16-18	10
280M	Solenoid to Case Screw	1/4-20	10
260M	Control Valve Assembly to Case Screw	1/4-20	10
		5/16-18	10
Special	Line Pressure Plug	1/8 Pipe	10
601M	Flywheel Housing Cover to Transmission Screw	1/4-20	5
280M	Pump Body to Cover Screw	5/16-18	20
280M	Pump Assembly to Case Screw	5/16-18	20
280M	Rear Servo Cover to Case Screw	5/16-18	20
260M	Governor Cover to Case	5/16-18	20
260M	Parking Pawl Bracket to Case Screw	5/16-18	20
9.8	Vacuum Modulator Retainer to Case Screw	5/16-18	20
260M	Speedometer Driven Gear Retainer to Case Screw	3 x 1.00	6
1010-1020	Oil Pan to Case Screw	5/16-18	13
260M	Extension Housing to Case Screw	3/8-16	35
286M	Manual Shaft to Detent Lever Nut	3/8-24	20
286M	Manual Yoke to Manual Shaft Nut	3/8-16	18
280M	Case to Center Support Screw	3/8-16	25
280M	Flywheel to Converter Screw	3/8-16	30
280M	Transmission Case to Engine Screw	3/8-16	35
Steel	Oil Cooler Pipe Connector Nut at Case and Radiator	1/2-20	20
Steel	Cooler Pipe Connector at Case	1/4 Pipe	20
280M	Engine Rear Mount to Transmission Bolt	7/16-14	50
286M	Engine Rear Support Bracket to Frame Nut	7/16-14	50

NOTE: Refer to back of Manual for bolt and nut markings and steel classifications.

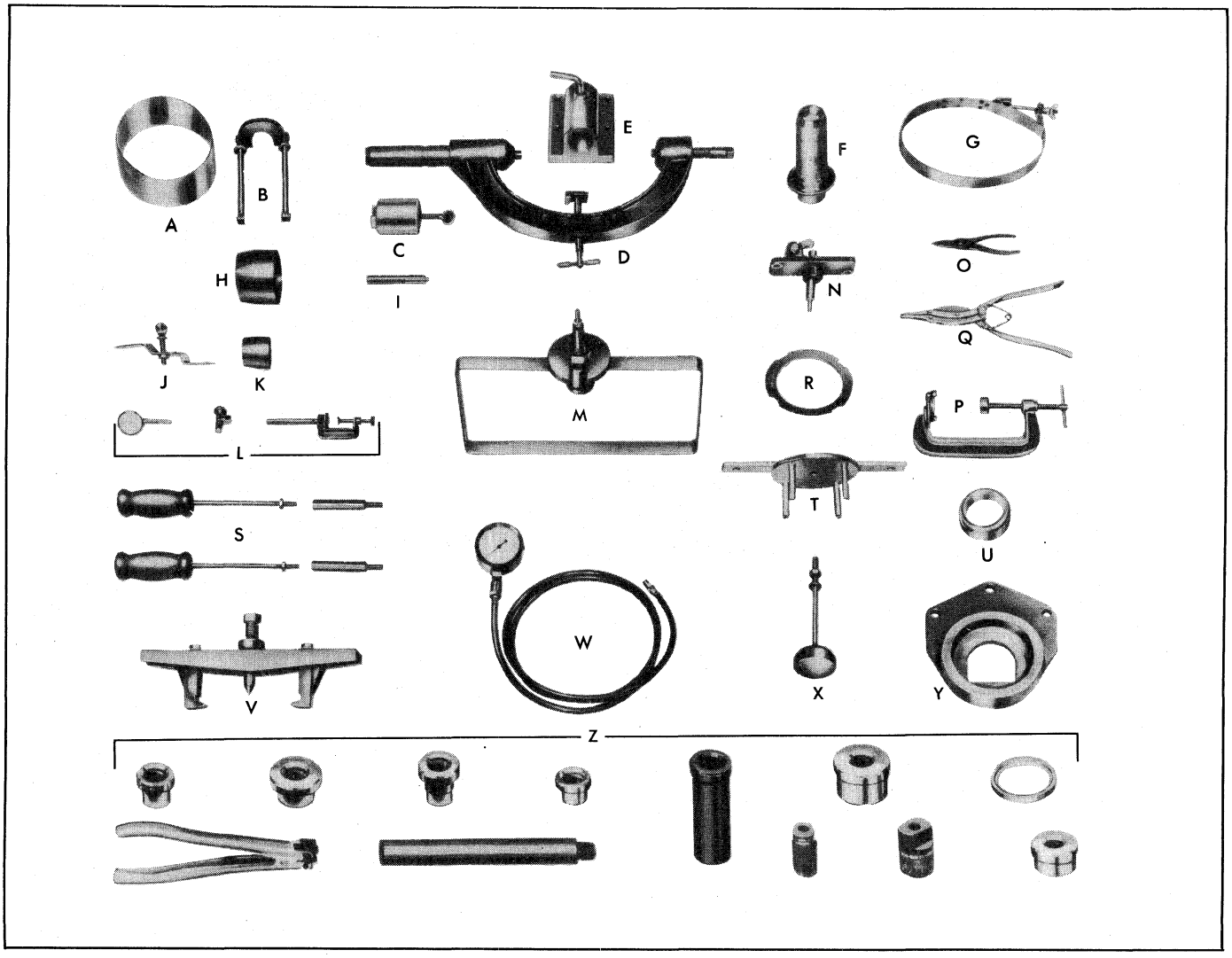


Fig. 7A-114 Special Tools

Key	Tool No.	Name	Key	Tool No.	Name
A	J-21409	Forward and Direct Coutch Piston Installer	M	J-21369	Converter Leak Test Fixture
B	J-21427	Speedometer Drive Gear Remover	N	J-21370	Band Apply Pin Selector Gage (use J-21370-5 Pin)
C	J-21795	Gear Assembly Remover and Installer Adapter	O	J-5403	Snap Ring Pliers (#21)
D	J-8763-02	Transmission Holding Fixture	P	J-21885	Control Valve Accumulator Piston Installer
E	J-3289-20	Holding Fixture Base	Q	J-8059	Snap Ring Pliers
F	J-21359	Pump Oil and Extension Housing Seal Installer	R	J-21664	Clutch Spring Compressor Adapter
G	J-21368	Pump Body and Cover Alignment Band	S	J-6125	Slide Hammer Assemblies
H	J-21363	Intermediate Clutch Inner Seal Protector	T	J-4670	Clutch Spring Compressor
I	J-21360	Pump Check Valve Seat Installer	U	J-21364	Rear Unit Holding Fixture Adapter
J	J-21366	Converter Holding Clamp	V	J-8433	Pulley Puller
K	J-21362	Forward and Direct Clutch Inner Seal Projector	W	J-5907	0-300 PSI Pressure Case
L	J-8001	Dial Indicator Set	X	J-6129	Rear Clutch Spring Compressor
			Y	J-6116	Rear Unit Holding Fixture
			Z	J-21465-01	Bushing Service Set

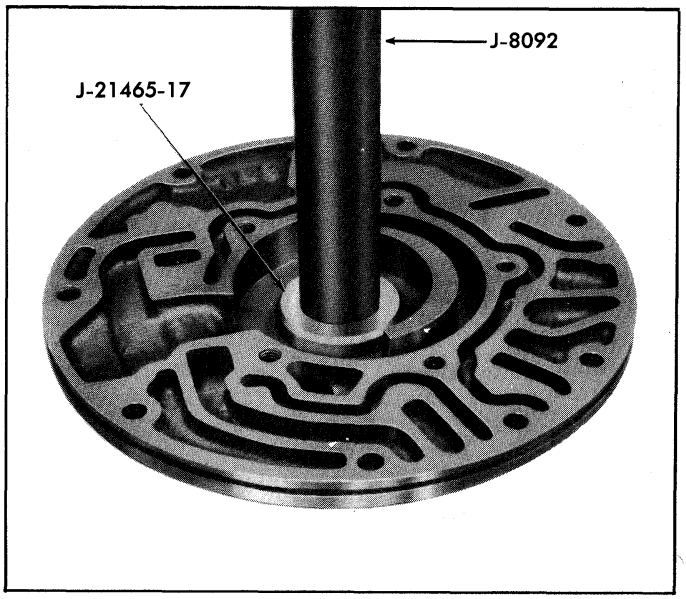


Fig. 7A-115 400 Pump Bushing Removal

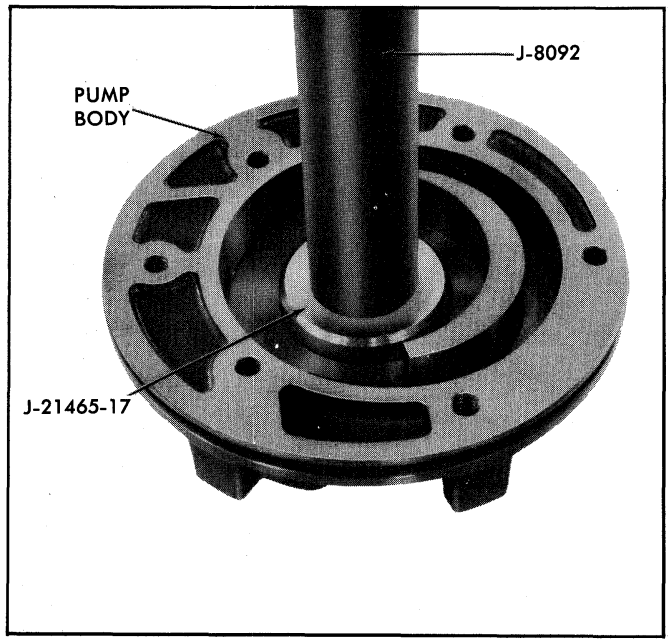


Fig. 7A-117 425 Pump Bushing

Bushing Service 400 and 425

When inspecting bushings, fit the mating part into the bushing and observe the amount of looseness. Bushing clearance is excessive if more than .008" exists when checked with a wire feeler gauge.

Bushings are available and can be replaced in the following units. Service bushings do not require reaming.

1. Pump Body
2. Sun Gear Shaft
3. Center Support
4. Output Shaft or Output Flange
5. Case
6. Extension Housing
7. Stator Shaft

a. Front Bushing

b. Rear Bushing

a. PUMP BODY BUSHING (Figs. 7A-115 thru 117)

1. With pump disassembled and front seal removed, support pump body on wood blocks. Drive bushing out as shown using J-8092 Drive Handle and J-21465-17 Bushing Remover and Installer. Fig. 7A-115 or 7A-117. Use a lead or brass hammer to drive out bushing.

2. Clean pump bushing bore, install new bushing on

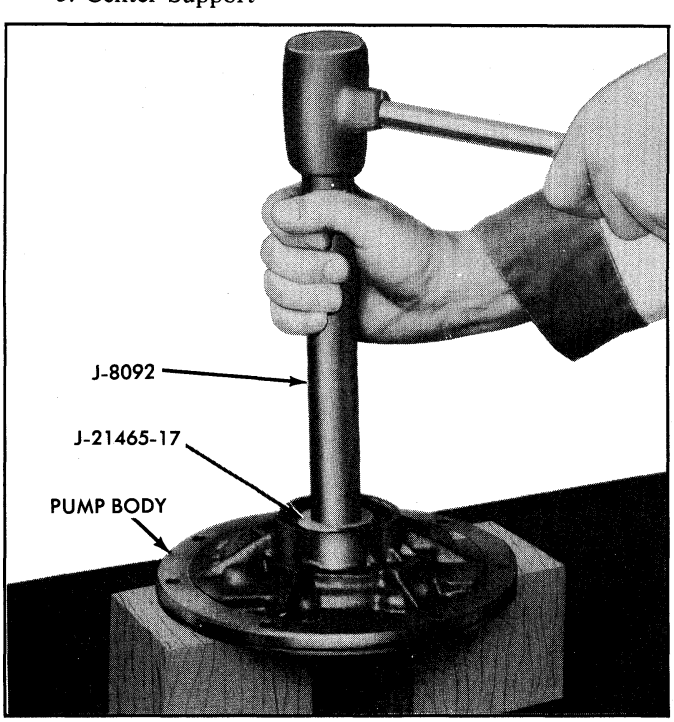


Fig. 7A-116 Pump Bushing Installation

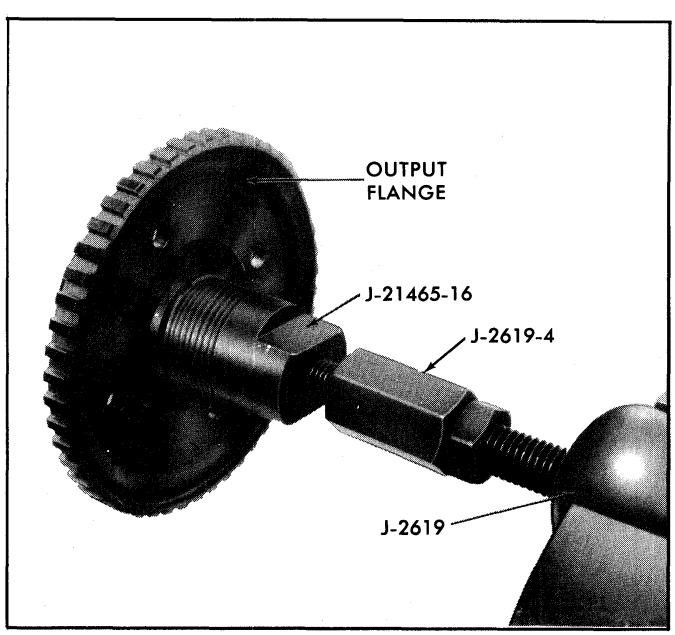


Fig. 7A-118 Output Flange Bushing Removal

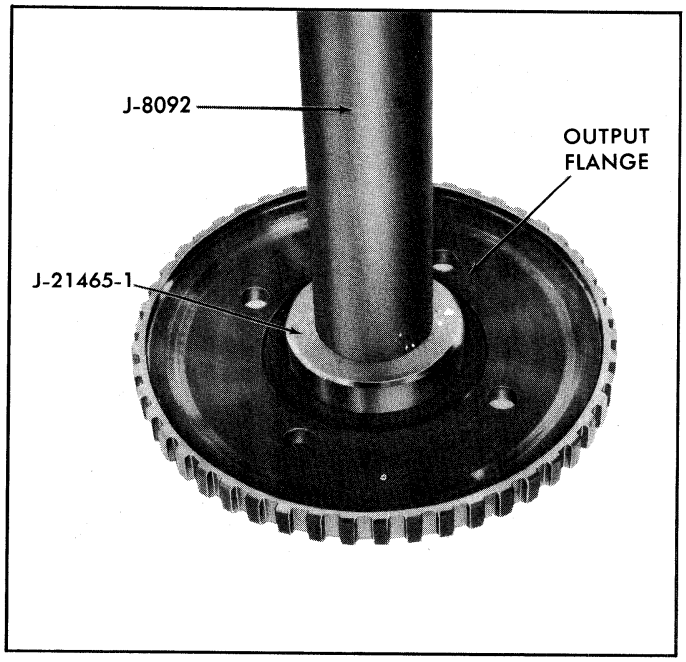


Fig. 7A-119 Output Flange Bushing Installation

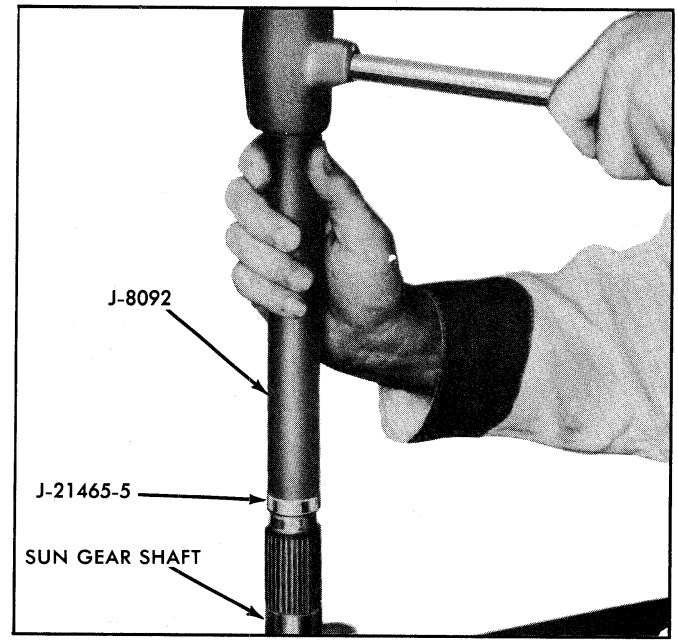


Fig. 7A-121 Sun Gear Shaft Bushing Installation

shoulder of Tool J-21465-17 with J-8092; and drive bushing squarely into the bore until it is flush to .010" below gear pocket face. Fig. 7A-116. Remove tool and inspect bearing.

b. OUTPUT SHAFT OR OUTPUT FLANGE BUSHING

1. With output shaft or output flange properly supported using Tool J-21465-16, with Slide Hammer J-2619 and Adapter Tool J-2619-4, remove bushing. (Fig. 7A-118).

2. Using Tool J-21465-1, with Drive Handle J-8092, press or drive replacement bushing into place until tool bottoms. Fig. 7A-119.

NOTE: Output flange bushing must be installed with oil hole in bushing aligned with oil hole in hub of output flange and notch in bushing outward.

c. SUN GEAR SHAFT BUSHING - FRONT AND REAR

1. With sun gear shaft properly supported, using Tool J-21465-15, with Slide Hammer Tool J-2619 and Adapter J-2619-4, remove bushing. (Fig. 7A-120)

2. Using Tool J-21465-5 with Drive Handle J-8092, press or drive replacement bushing into place until tool bottoms. Fig. 7A-121.

d. CENTER SUPPORT BUSHING - (Figs. 7A-122 and 7A-123)

1. Position center support, oil delivery sleeve down, on wooden blocks that are long enough to clear bushing during removal. Assemble remover Tool J-21465-6 to Drive Handle

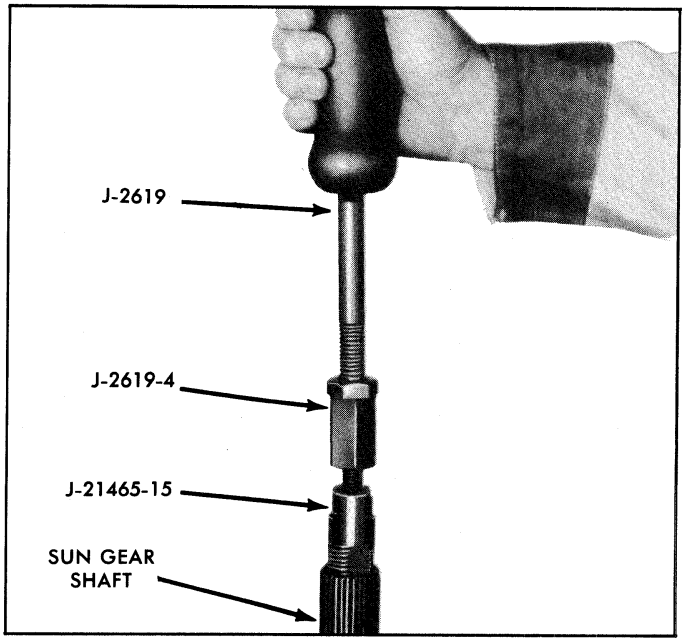


Fig. 7A-120 Sun Gear Shaft Bushing Removal

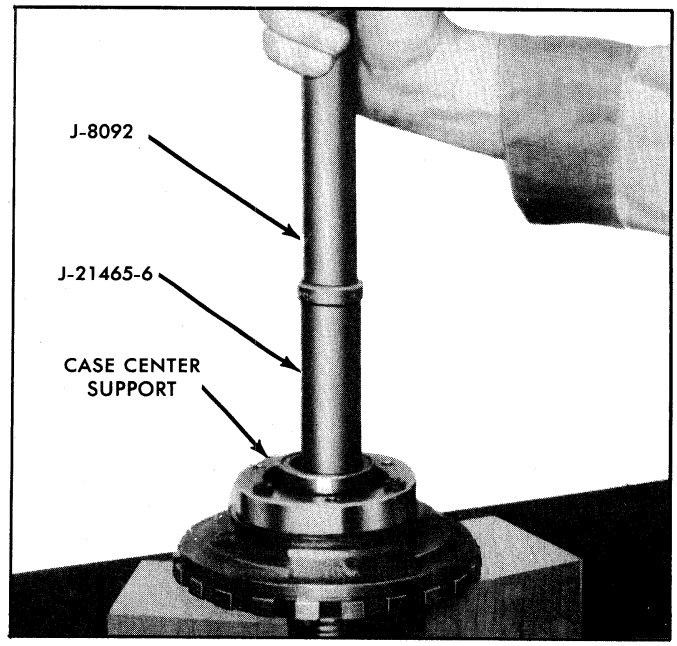


Fig. 7A-122 Center Support Bushing Removal.

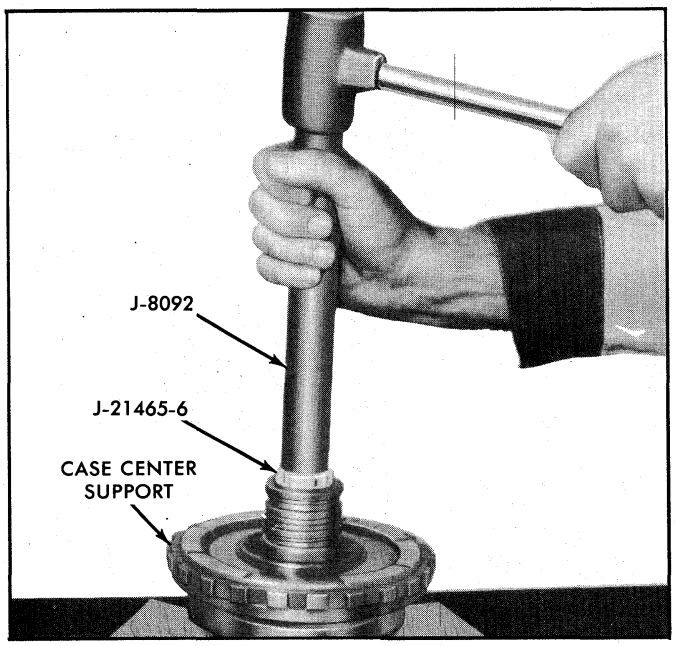


Fig. 7A-123 Center Support Bushing Installation

J-8092 and drive bushing out as shown in, Fig. 7A-122, using a lead or brass hammer.

2. Invert center support and using the same tools drive new bushing squarely into the bore until bushing is flush to .010" below end of oil delivery sleeve as shownin, Fig. 7A-123. Remove tools and inspect bushing and oil hole alignment.

NOTE: Slot in bushing must be aligned with the drilled hole in the oil delivery sleeve closest to the piston.

e. TRANSMISSION CASE BUSHING - 400 (Figs. 7A-124 thru 7A-126)

1. Position transmission case (converter end down). Assemble Remover Tool J-21465-8 on Drive Handle J-8092

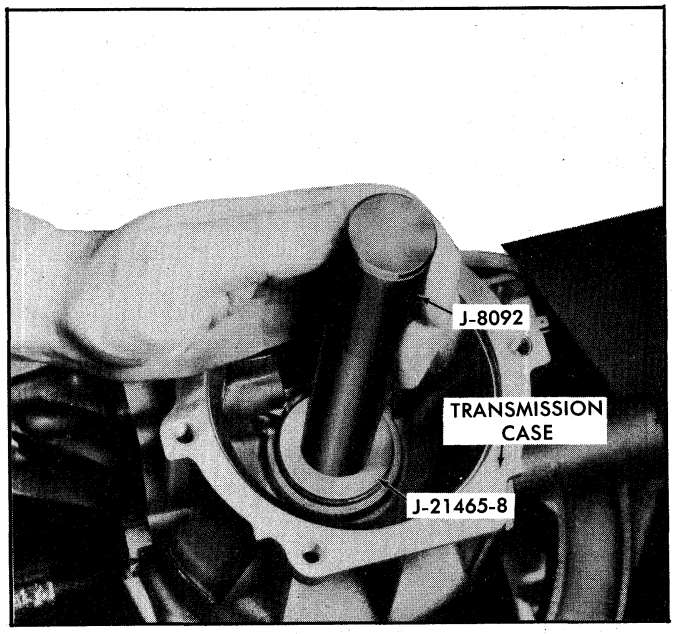


Fig. 7A-124 Transmission Case Bushing Removal

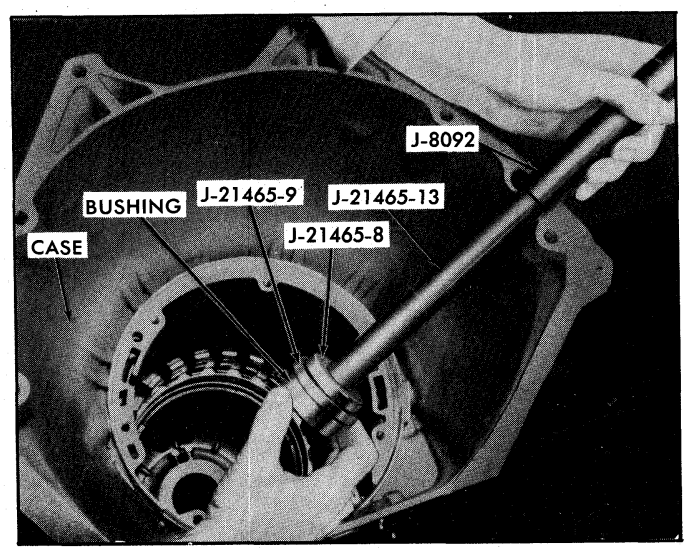


Fig. 7A-125 Transmission Case Bushing Installation

and drive bushing out using a lead or brass hammer, as shown in, Fig. 7A-124.

2. Invert transmission case in holder. Assemble Drive Handle J-8092 and Adapter J-21465-13 on Installer J-21465-8. Assemble Adapter Ring J-21465-9 on installer and install new bushing on shoulder of installer with lube passage facing adapter ring, see, Fig. 7A-125. Drive bushing squarely into bore with lead or brass hammer until adapter ring bottoms, as shown. This will leave the bushing. 040 to .055" above the selective thrust washer surface.

3. Remove tools and stake bushing with Tool J-21465-10 as shown in Fig. 7A-126. Stake marks must be in the bushing groove. Remove staking tool and inspect bushing.

f. EXTENSION HOUSING BUSHING - (Figs. 7A-127 thru 7A-129)

1. With rear seal removed, position extension housing

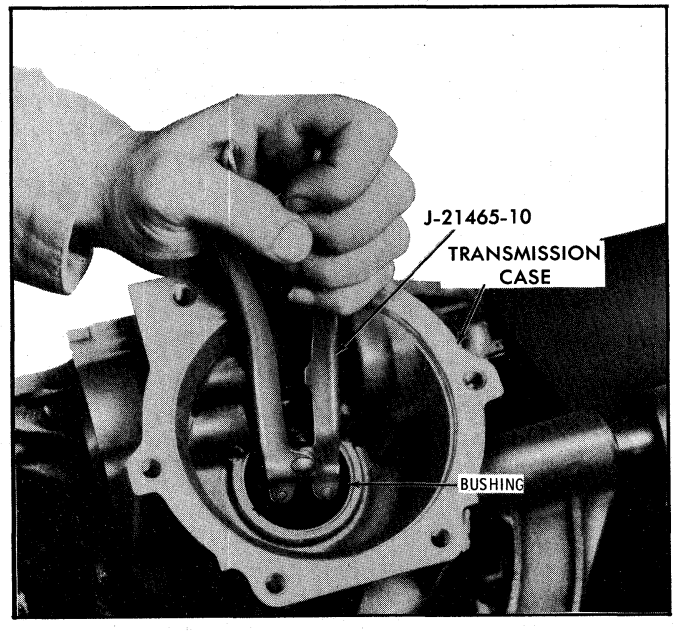


Fig. 7A-126 Staking Transmission Case Bushing

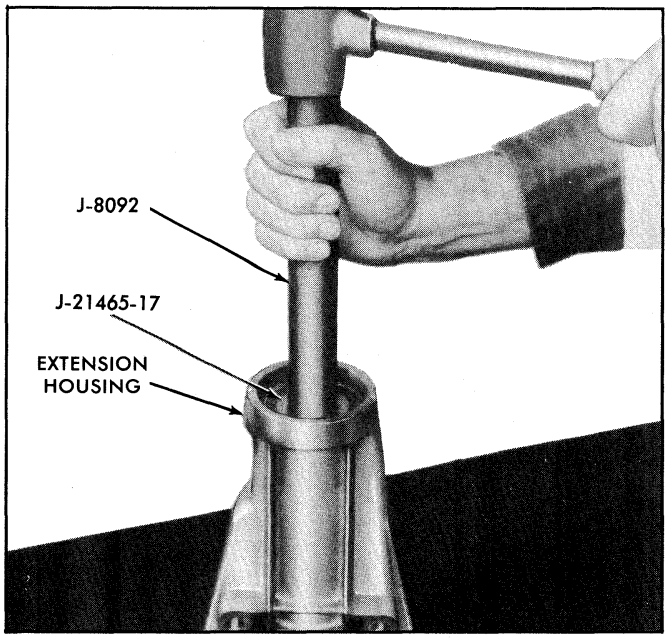


Fig. 7A-127 Removing Extension Housing Bushing

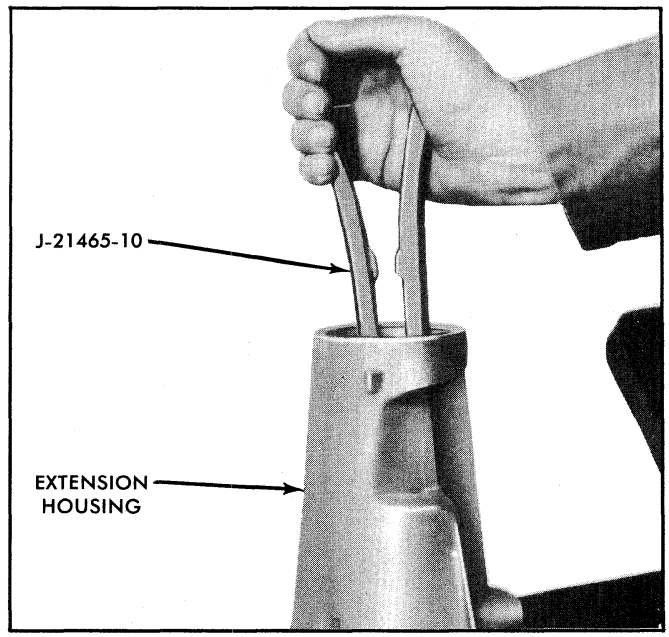


Fig. 7A-129 Staking Extension Housing Bushing

on bench, seal end up. Assemble Remover J-21465-17 on Drive Handle J-8092 and drive out bushing with lead or brass hammer, as shown in, Fig. 7A-127.

2. Assemble Drive Handle J-8092 and new bushing on Tool J-21465-17 and drive bushing squarely into bore until flush to .010" below oil seal counter bore surface using a lead or brass hammer, as shown in, Fig. 7A-128.

3. Remove tools and use Tool J-21465-10 to stake bushing in place as shown in, Fig. 7A-129. Stake marks must be in bushing lubrication grooves. Remove tool and inspect bushing.

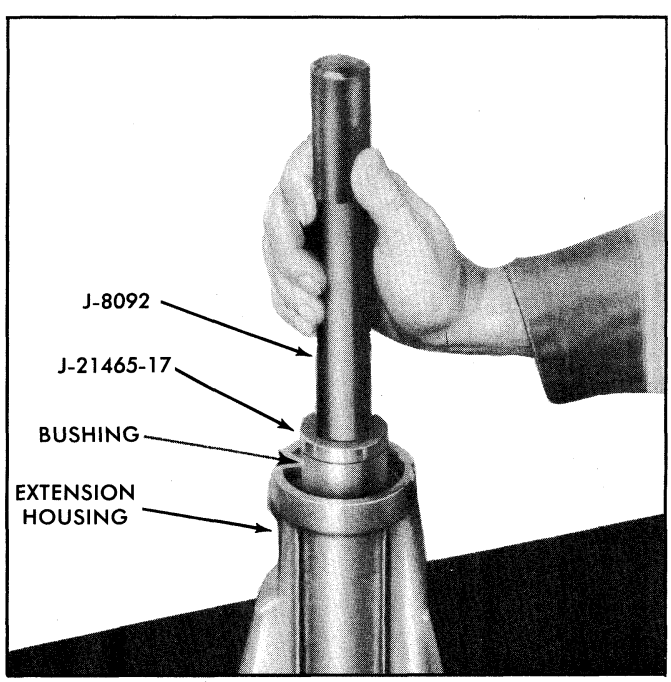


Fig. 7A-128 Installing Extension Housing Bushing

NOTE: Staking in production bushings may or may not be in lubrication grooves. Production equipment does not distort bushing surface making location of stakes optional.

g. STATOR SHAFT REAR BUSHING - 400 (Figs. 7A-130 and 7A-131)

1. Mount pump cover and stator shaft in vise as shown. Use brass jaws to protect shaft. Assemble Remover J-21465-15 to J-2619 Slide Hammer and J-2619-4 Adapter. Thread

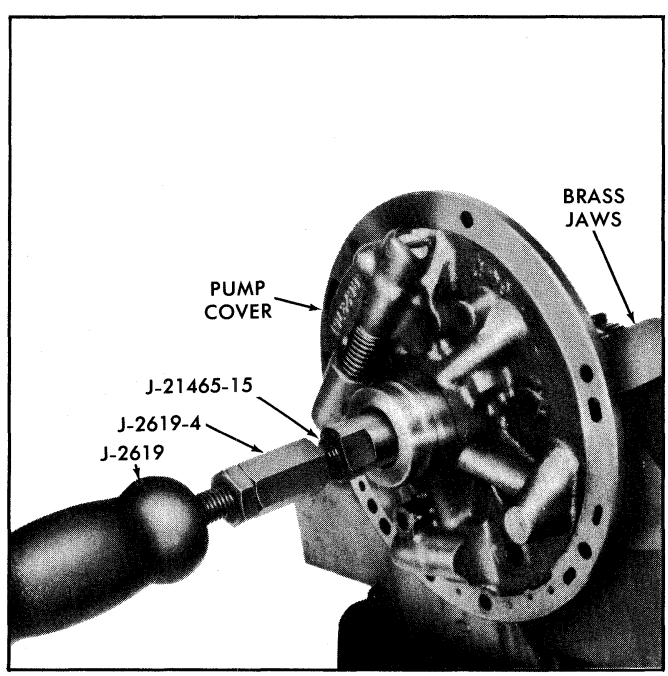


Fig. 7A-130 Removing Stator Shaft Rear Bushing

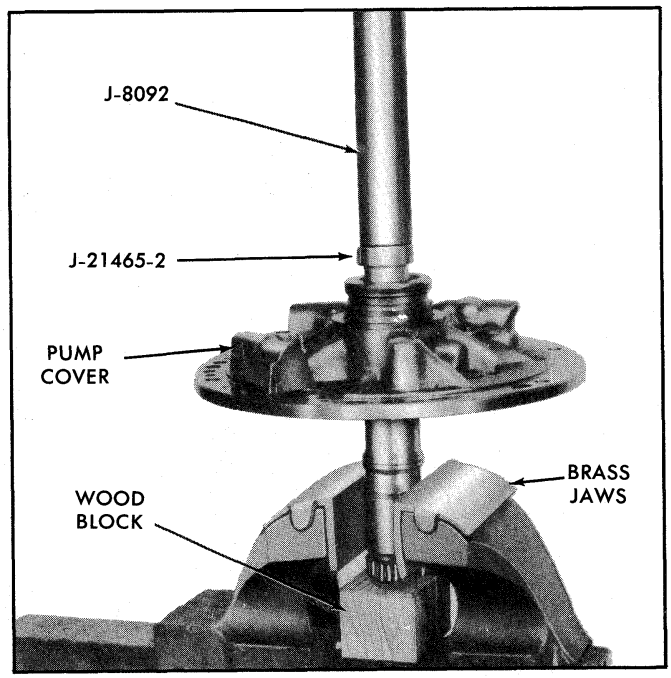


Fig. 7A-131 Installing Stator Shaft Rear Bushing.

remover into rear bushing and remove bushing with slide hammer, Fig. 7A-130.

2. Clean all shavings from stator shaft bore. Install pump cover in vise supporting shaft on wood block. Assemble Installer J-21465-2 to J-8092 Drive Handle. Install new bushing on shoulder of installer and drive bushing squarely into the bore to a depth of 19/32", Fig. 7A-131. Remove tools and inspect bushing.

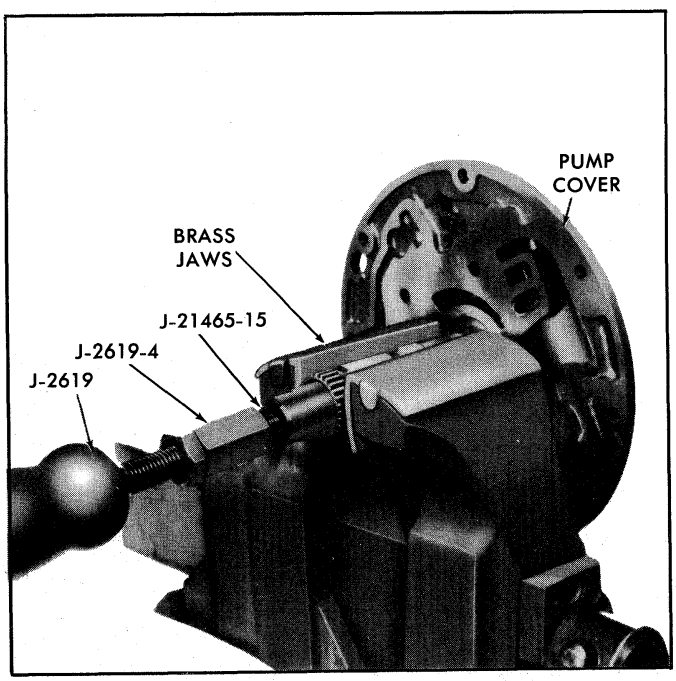


Fig. 7A-132 Removing Stator Shaft Front Bushing

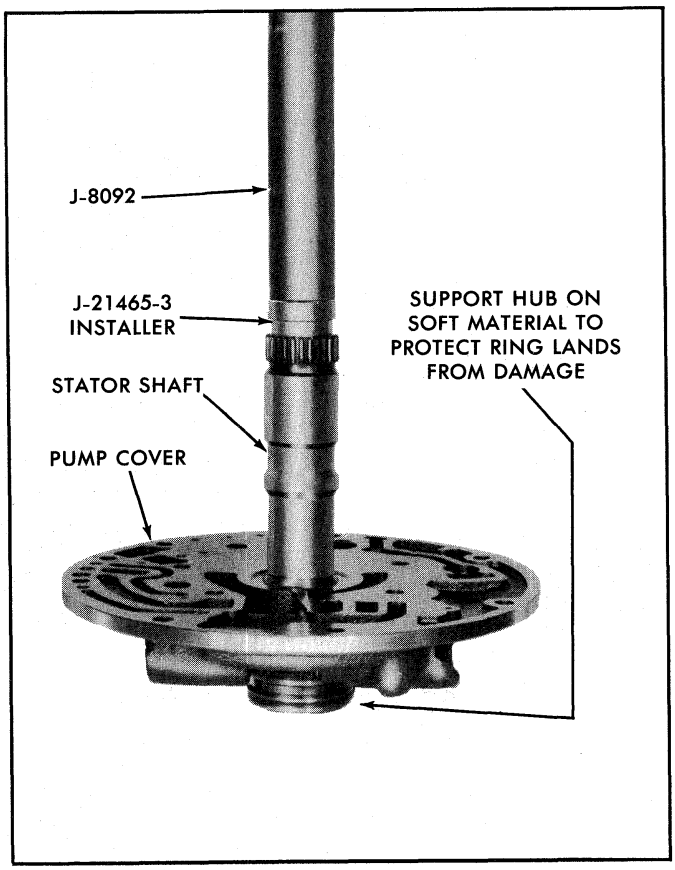


Fig. 7A-133 Installing Stator Shaft Front Bushing

h. STATOR SHAFT - FRONT BUSHING

1. Mount pump cover and stator shaft in vise as shown. Use brass jaws to protect shaft. Assemble Slide Hammer J-

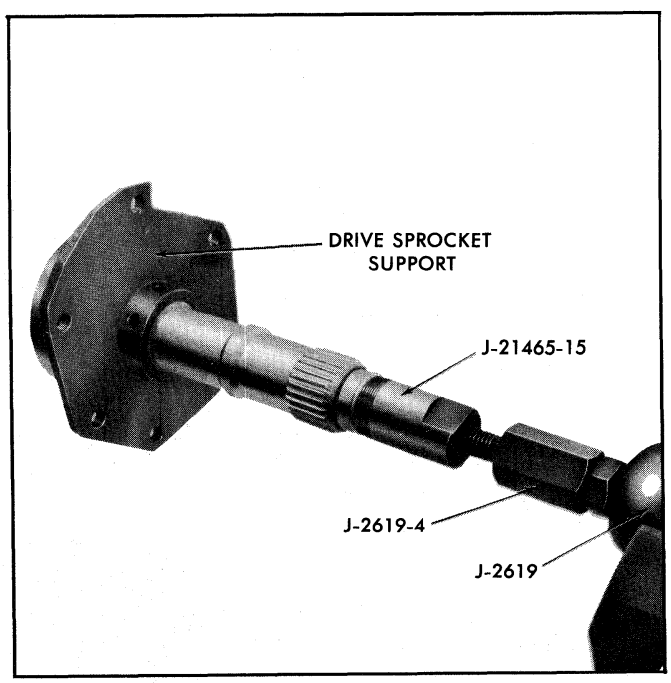


Fig. 7A-134 Stator Shaft Bushing Removal

2619 and Adapter J-2619-4 on Remover J-21465-15. Thread remover into front bushing and remove bushing with slide hammer, Fig. 7A-132.

2. Clean all shavings from stator shaft. Assemble installer J-21465-3 to Drive Handle J-8092. Locate new bushing on shoulder of installer and drive bushing squarely into bore with a lead or brass hammer, as shown in, Fig. 7A-133. Remove tool and inspect bushing.

i. STATOR SHAFT BUSHING - 425 ELDORADO

1. With drive sprocket support and stator shaft properly supported, using Tool J-21465-15 or J-8647-1, with Slide Hammer J-2619 and Adapter Tool J-26194, remove bushing, Fig. 7A-134.

2. Using Tool J-21465-3 with Drive Handle J-8092, press or drive replacement bushing into place until tool bottoms, Fig. 7A-135.

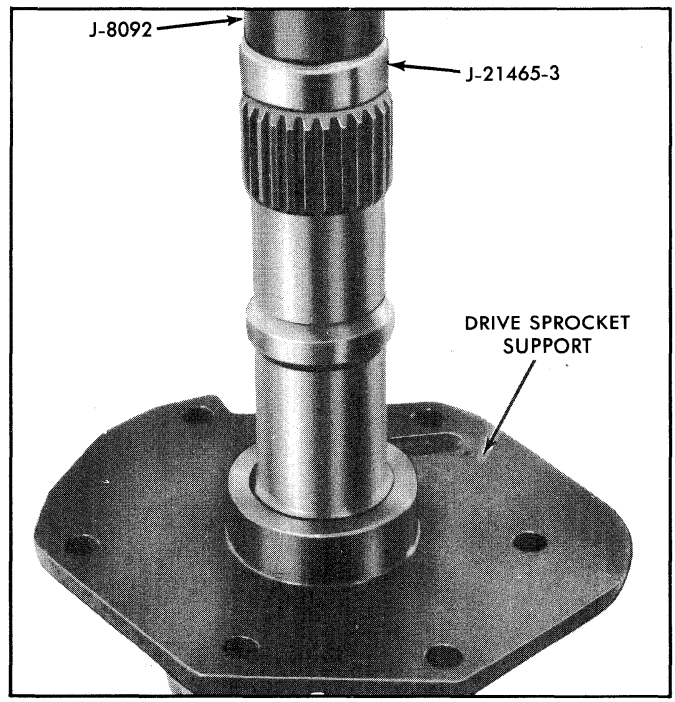


Fig. 7A-135 Stator Shaft Bushing Installation

TRANSMISSION — ELDORADO GENERAL DESCRIPTION

TRANSMISSION - ELDORADO

NOTE: The following information pertains only to the Eldorado.

Refer to the 1973 shop manual for information pertaining to theory of operation, hydraulic system description, valve and hydraulic control functions and oil circuit diagrams.

The Turbo Hydra-matic transmission consists primarily of a three-element hydraulic torque converter, a dual sprocket and link assembly and a compound planetary gear set. Three multiple-disc clutches, a sprag unit, a roller clutch unit, and two bands provide the friction elements required to obtain the desired functions of the compound planetary gear set, Fig. 7B-1.

The torque converter, the dual sprocket and link, the clutches, the sprag and roller clutch, couple the engine to the planetary gears, providing three forward speeds and reverse. The torque converter, when required, will supplement the gears by multiplying engine torque.

The torque converter is of welded contruction and is serviced as an assembly. The unit is made up of two vaned sections, or halves, that face each other in an oil filled housing. The pump half of the converter is connected to the engine and the turbine half is, in effect, connected to the transmission.

The torque converter couples the engine to the planetary gear set through the use of a drive sprocket, a link assembly, and a driven sprocket. Clockwise engine torque turns the drive sprocket clockwise, which, in turn, drives the driven sprocket in a clockwise direction. This in effect is a reverse in the direction of engine torque due to the side mounting of the gear unit.

When the engine makes the converter pump revolve, it sends oil against the turbine, making it revolve also. The oil then returns in a circular flow back to the converter pump, continuing this flow as long as the engine is running.

The converter also has a smaller vaned section, called a stator, that funnels the oil back to the converter pump through smaller openings, at increased speed. The speeded up oil directs additional force to the engine-driven converter pump, thereby multiplying engine torque.

A hydraulic system pressurized by an internal-external type gear pump provides the working pressure required to operate the friction elements and automatic controls.

External control connections to the transmission are:

Manual Linkage - To select the desired operating range.

Engine Vacuum - To operate a vacuum modulator unit.

12 Volt Electrical Signal - To operate an electrical detent solenoid.

Gear or Torque ratios of the transmission are as follows:

First = 2.48:1 gear ratio

Second = 1.48:1 gear ratio

Third = 1.0:1 gear ratio

Reverse = 2.08:1 gear ratio

Each gear ratio can be multiplied by as much as 2, depending upon the slip speed of the converter pump and turbine.

A vacuum modulator is used to sense engine torque input to the transmission automatically. The vacuum modulator transmits this signal to the pressure regulator, which controls line pressure, so that all torque requirements of the transmission are met and proper shift spacing is obtained at all throttle openings.

The downshift solenoid is activated by a switch at the carburetor. When the throttle is opened sufficiently to close this switch, the solenoid in the transmission is activated, causing a downshift at speed below approximately 70 miles per hour. At lower speeds, downshift will occur at lesser throttle openings without use of the switch.

The oil cooler is located in the right hand tank of the radiator. The transmission is cooled by directing oil from the converter to the radiator. Oil returning from the radiator feeds the transmission lubrication system.

The oil system incorporates an intake pipe and filter assembly. The filter assembly should be replaced after 100,-000 miles have been traveled. It should be replaced after the first 50,000 miles if heavy duty operation is encountered; such as constant use in heavy metropolitan traffic, pulling trailers, etc. In addition, replace oil and filter assembly when a major transmission failure occurs, and the oil cooler and lines should be flusher. This is particularly important in case of converter failure.

The transmission quadrant has six selector positions that enable the driver to control the operation of the transmission under various driving conditions. The six selector positions appear on the quadrant in the following sequence, from left to right; P-park, R-reverse, N-neutral, DRIVE left, DRIVE right (intermediate) and L-lo.

P - Park position positively locks the output flange to the transmission case by means of a locking pawl and prevents the vehicle from rolling either forward or backward. For this reason, it is recommended that the engine be started with transmission selector lever in Park position. If it is necessary to re-start the engine with car rolling, place selector lever in Neutral.

R - Reverse enables the vehicle to be operated in a reverse direction.

N - Neutral position enables the engine to be started and run without driving the vehicle. It is recommended that Neutral be used to start the engine only if it is necessary to re-start the engine with the car rolling. At all other times use Park.

Drive (left) - Drive (left) is used for all normal driving conditions and maximum economy. Drive (left) has three gear ratios from starting to direct drive. Down-shifts are available for safe passing, by depressing the accelerator pedal.

Drive (right) - Drive (right) adds performance for congested traffic or hilly terrain. This range has the same starting ratio as Drive (left), but prevents the transmission from shifting above second speed to retain acceleration when extra performance is desired. Additional engine braking is provided in this range.

L - Lo range permits operation at a lower gear ratio, and should be used where maximum torque multiplication is desired, such as in pulling a heavy load or descending a steep grade. When selector lever is moved from Drive to Lo range at normal highway speeds, the transmission will shift to second gear and remain in second gear until vehicle speed is reduced to approximately 45 mph. The transmission will then shift to first gear and remain in first gear regardless of vehicle or engine speed, until selector lever is moved back into either of the Drive positions.

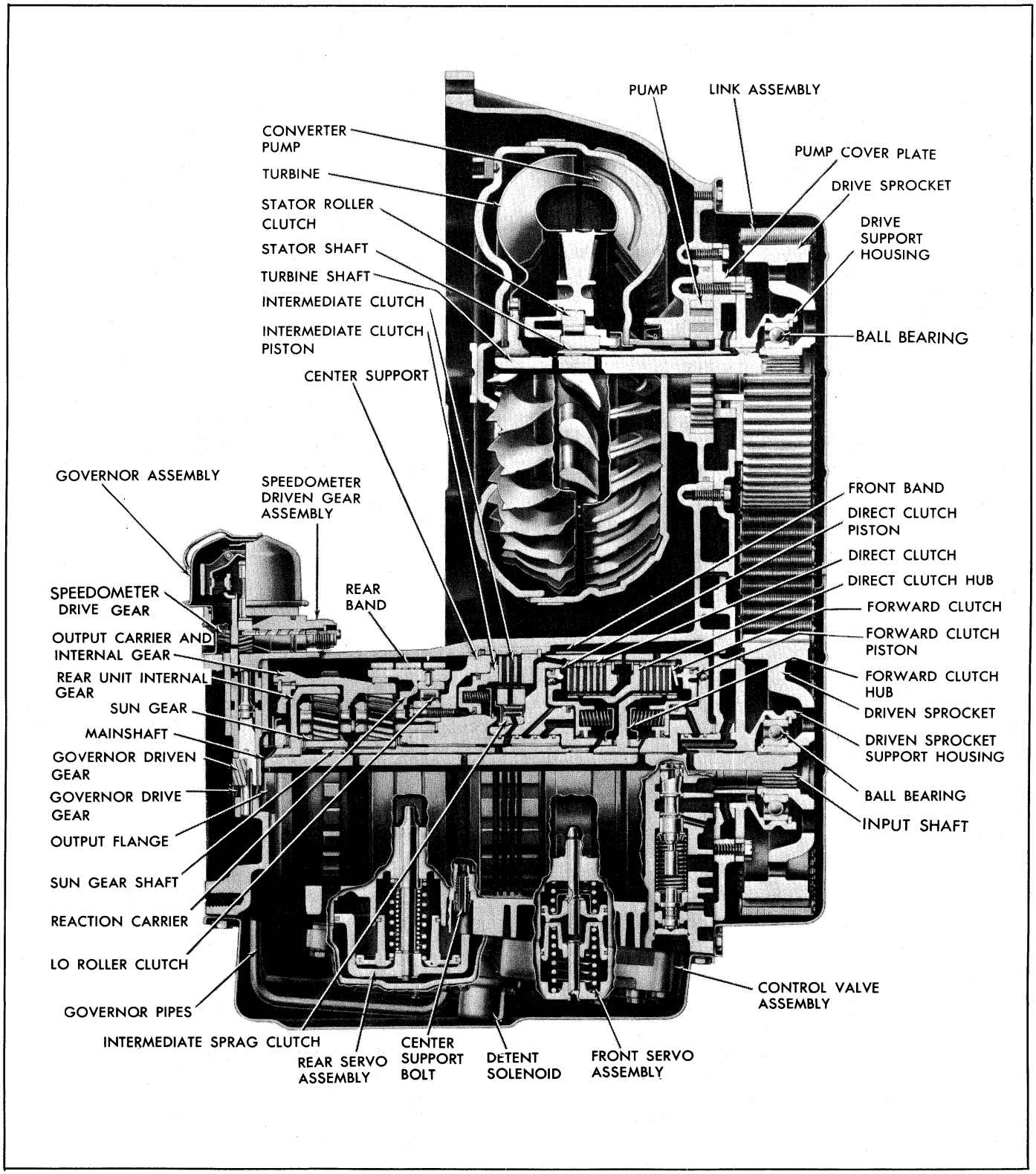


Fig. 7B-1 Turbo-Hydramatic Transmission Cutaway View

Pressure Control

The transmission is controlled automatically by a hydraulic system. Hydraulic pressure is supplied by the transmission oil pump, which is engine driven. Main line pressure is controlled by a pressure regulator valve train located in the transmission case and by the vacuum modulator which is connected to engine vacuum. The pressure regulator controls line pressure automatically, in response to a pressure signal from a modulator valve in such a way that the torque requirements of the transmission clutches are met and proper shift spacing is obtained at all throttle openings.

DIAGNOSIS

NOTE: The following information is applicable to the Eldorado only. Where service procedures are similar to the Turbo Hydra-matic transmission used on other Cadillac models, reference will be made to the appropriate page in the forward part of this section.

CAUTION: *In the event of a major transmission malfunction, replace filter assembly and flush oil cooler and oil cooler lines.*

It is particularly important in the case of a converter or pump malfunction to perform these service procedures.

425 Turbo Hydra-Matic Diagnosis Procedure

The diagnosis procedures for the Turbo Hydra-matic transmission used on the Eldorado are identical to the procedures given for C-car, with the following exceptions:

1. Figures 7B-2 through 7B-6 are to be used in place of Figures 7A-8 through 7A-12, when diagnosing an Eldorado Turbo Hydra-matic transmission.

2. Transmission Noise - Sprocket and Link Assembly.

a. Link assembly too long. Sounds similar to pop corn popping. (There will be a rough burr along the teeth of the drive sprocket if the link assembly is too long). Replace sprocket and link assembly.

b. Drive or Driven sprocket teeth damaged.

c. Engine mounts worn or damaged.

DOWNSHIFT SOLENOID CIRCUIT CHECK

The procedure for checking downshift solenoid circuitry is the same except for different color wire on the 1977 model.

NOTE: Before checking the downshift solenoid circuitry, make certain that the transmission downshift switch is properly adjusted as described on page 7A-25.

1. With transmission shift lever in Park, turn ignition switch to "ON" position, but do not start car. Leave ignition switch "ON" throughout checking procedure.

2. Working under hood, slowly advance throttle linkage to wide open position. One click should be heard from transmission.

3. Allow throttle to return to closed position. One click should be heard from transmission.

4. If system performed as described above, downshift circuit is operating properly. If system does not perform as described above, proceed to step 5.

5. Use test light to check brown wire at connector on side of transmission case. Test light should light with throttle wide open and go out when throttle is released.

a. If system operates as described above, but did not perform properly during steps 1-3, replace solenoid after first checking to see that internal wiring is operational. Solenoid installation described on page 7A-67.

b. If light fails to light with throttle in wide open position, the circuit is open, proceed to step 6.

c. If light lights with throttle closed, the circuit is shorted. Proceed to step 9.

6. Remove air cleaner. Remove brown wire connector at transmission downshift switch. Use test light to check from the bare terminal at switch with throttle wide open.

a. If test light lights, replace brown wire. Recheck system.

b. If test light fails to light, proceed to step 7.

7. Check orange feed wire at transmission downshift with test light.

a. If test light lights, replace transmission downshift switch. Recheck system.

b. If test light fails to light, proceed to step 8.

8. Check 25 amp backup light and transmission control fuse in fuse panel.

a. If necessary to replace fuse, recheck system.

b. If fuse is all right, it will be necessary to locate the open in the wiring. Test the circuit continuity from the orange wire at the downshift switch to the battery.

9. Remove air cleaner. Remove orange wire connector at transmission downshift switch. Use test light to check from the bare terminal at switch with throttle closed.

a. If test light fails to light, orange wire is shorted. Correct shorting condition.

b. If test light lights, proceed to step 10.

10. With throttle in closed position, check orange feed wire at transmission downshift switch.

a. If test light fails to light, replace transmission downshift switch. Recheck system.

b. If test light lights, it will be necessary to locate the short in the wiring. Test the circuit from the orange wire at the downshift switch to the battery.

Fluid Leakage Precautions

The fluid leakage precautions are listed on page 7A-20.

Points of Possible Oil Leaks

When checking for oil leaks, first determine whether leak originates from transmission or engine. The original factory fill fluid in the transmission is formulated with a red aniline dye to assist in locating leaks. If the color of the dye cannot be detected in the transmission fluid, the fluid should be changed. Red dye appearing in the leaking oil will give positive identification as to the location of the leak.

If oil leak is found to be in transmission, check for leak in following area:

a. Rear End

It will be necessary to remove converter cover to determine location of leaks at rear end. To correct leaks at rear end, it will be necessary to remove transmission from car.

1. Pump oil seal leak - Check pump oil seal to make certain it is correctly installed and not damaged.

When installing a new pump oil seal, make certain that bore is free from foreign material and that garter spring on seal is correctly positioned. Check finish of converter neck and bearing surface in pump body.

2. Pump assembly-to-case O-ring damaged.

3. Converter - Inspect converter for indications of leakage. See page 7A-33 for checking procedure.

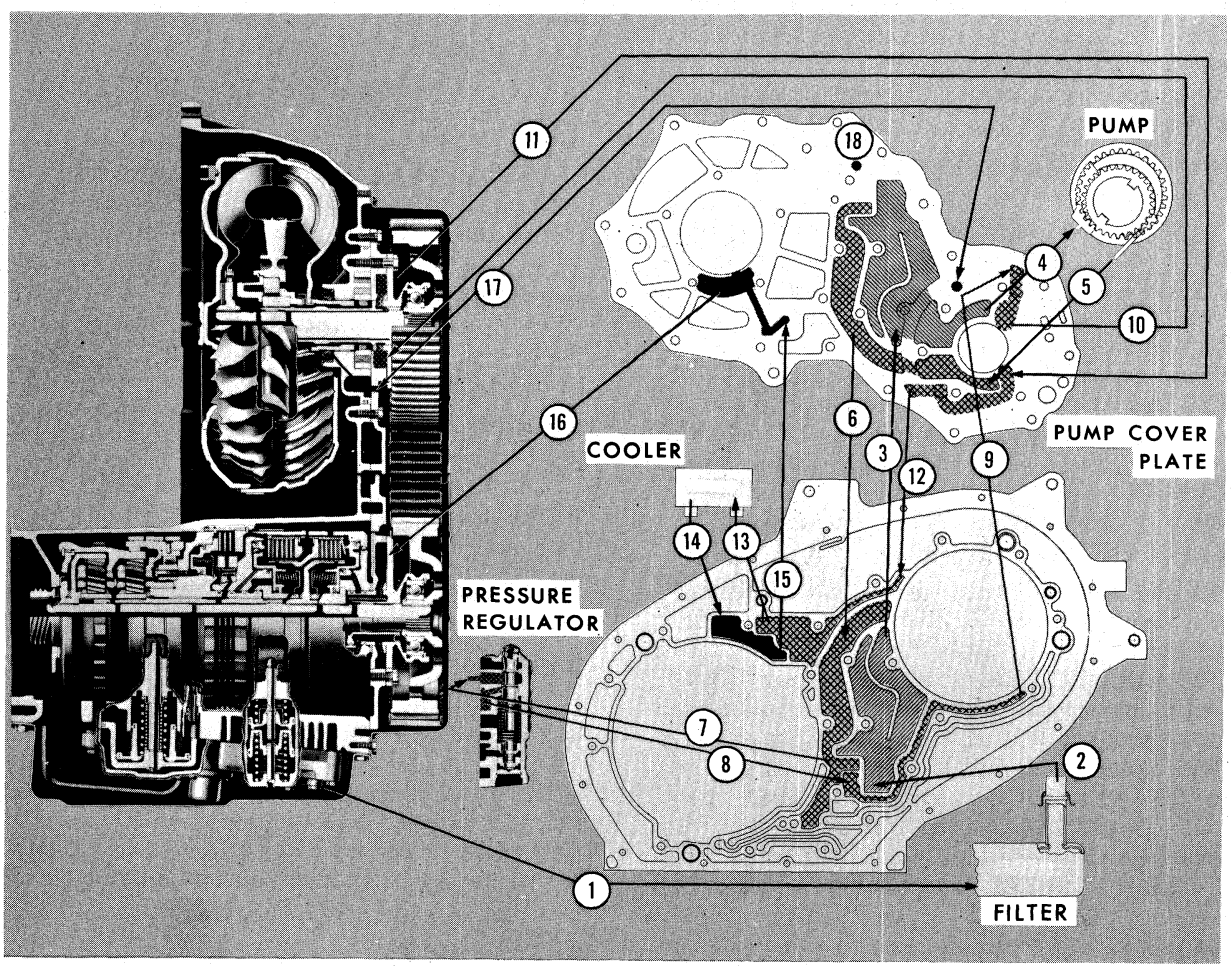
4. Vent fitting damaged.

b. Cover and Plate Assembly Sprocket Housing Leak

1. Attaching bolts not correctly torqued.

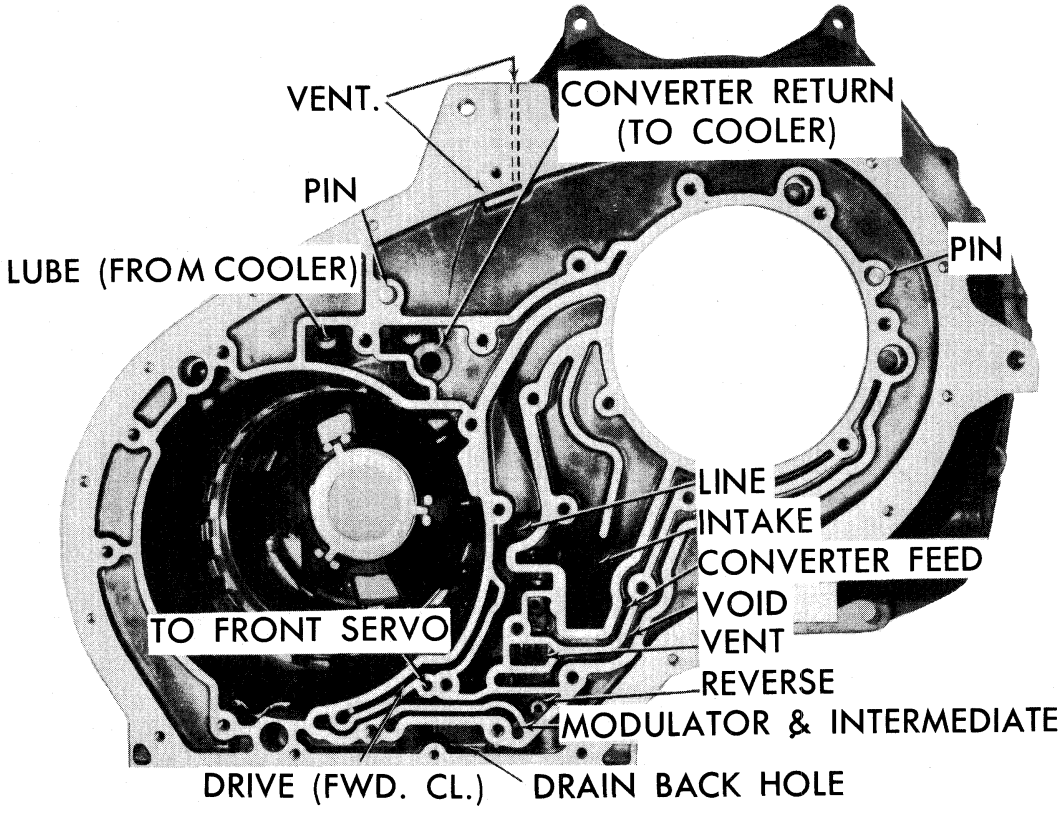
2. Housing to case gasket improperly installed or damaged.

3. Housing to case gasket face not flat.



1 OIL FROM SUMP TO FILTER
2 FILTER TO CASE PASSAGE
3 CASE PASSAGE TO PUMP COVER PLATE PASSAGE
4 PUMP COVER PLATE PASSAGE TO PUMP
5 PUMP TO PUMP COVER PLATE PASSAGE
6 PUMP COVER PLATE PASSAGE TO CASE PASSAGE
7 CASE PASSAGE TO PRESSURE REGULATOR VALVE
8 PRESSURE REGULATOR VALVE TO CASE PASSAGE
9 CASE PASSAGE TO PUMP COVER PLATE PASSAGE
10 PUMP COVER PLATE PASSAGE TO CONVERTER
11 CONVERTER TO PUMP COVER PLATE PASSAGE
12 PUMP COVER PLATE PASSAGE TO CASE PASSAGE
13 CASE PASSAGE TO COOLER
14 COOLER RETURN TO CASE PASSAGE
15 CASE PASSAGE TO PUMP COVER PLATE PASSAGE
16 PUMP COVER PLATE PASSAGE TO TRANSMISSION POWER TRAIN (ALL INTERNAL LUBRICATION)
NOTE: THE NUMBERS IN THE CROSS SECTION INDICATE THAT THERE ARE ADDITIONAL LUBRICATION HOLES IN THIS AREA THAT ARE NOT SHOWN IN THE CROSS SECTION
17 FRONT SEAL DRAIN BACK HOLE
18 PRESSURE REGULATOR VENT HOLE

Fig. 7B-2 Lubrication Chart



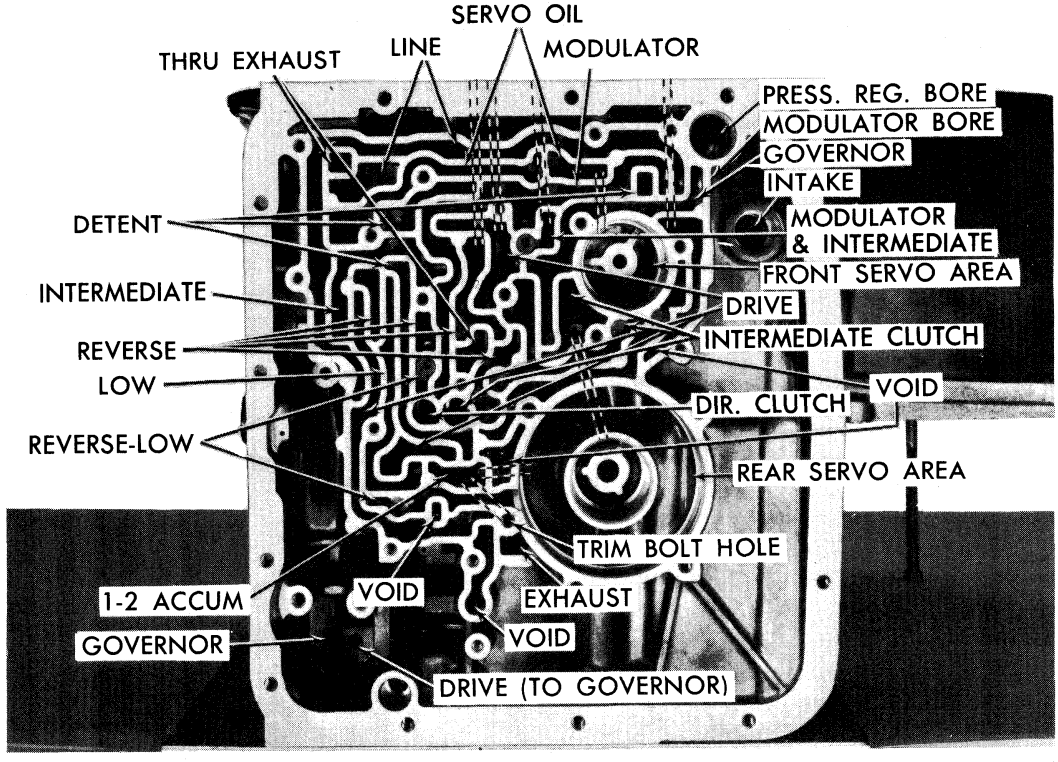


Fig. 7B-3 Case Oil Passages - Front and Bottom Views

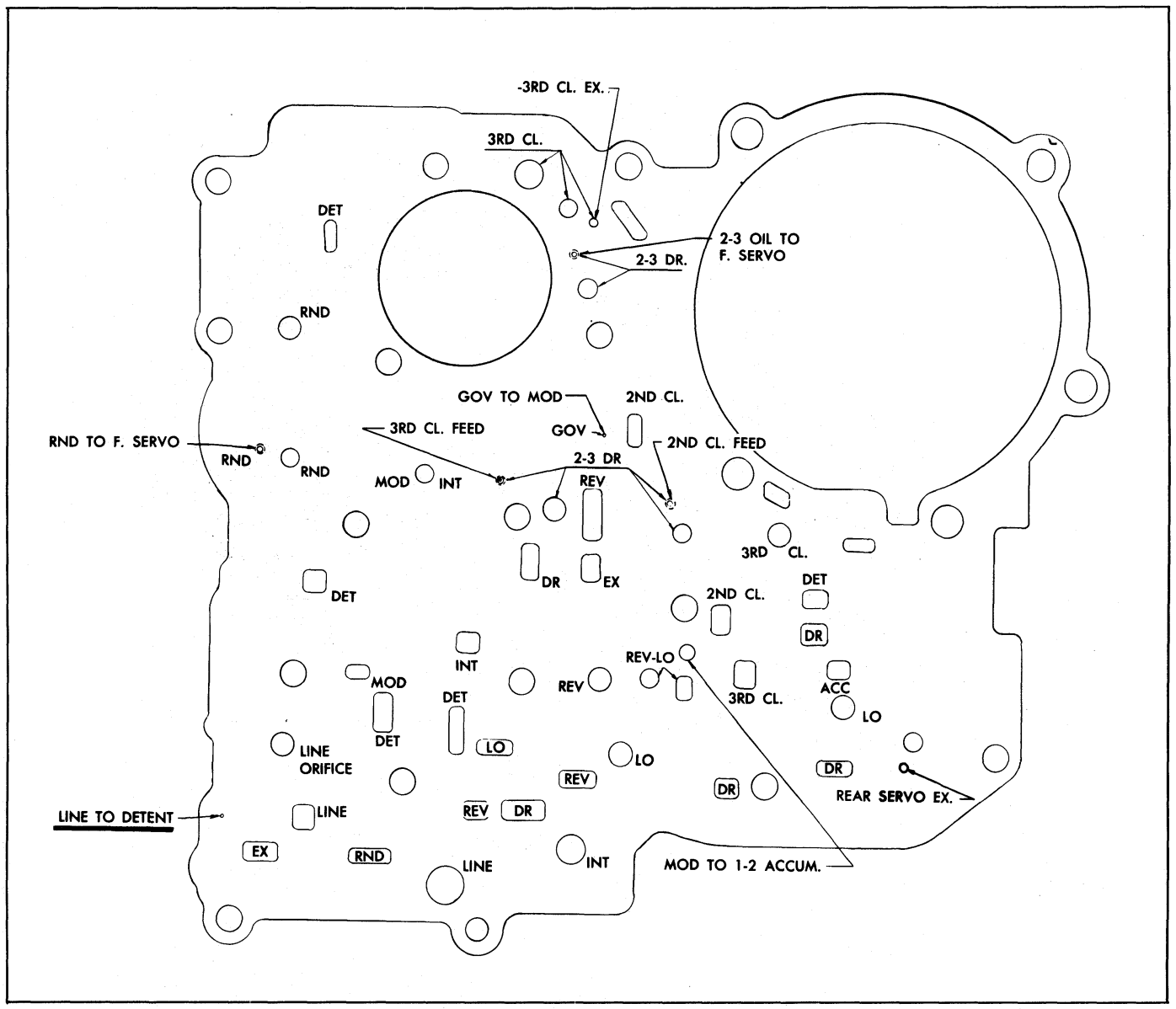


Fig. 7B-4 Spacer For Control Valve Assembly

c. Final Drive to Transmission Leak

1. Attaching bolts not correctly torqued.
2. Final drive to transmission gasket improperly installed or damaged.
3. Mounting surfaces not flat.

d. Transmission Case

1. Speedometer driven gear housing retainer attaching screw loose. Tighten to 18 foot-pounds.
2. Speedometer driven gear housing O-ring or lip seal damaged.
3. Governor cover bale-type attaching retainer not tight.
4. Damaged governor O-ring.
5. Solenoid connector terminal O-ring damaged.
6. Manual shaft O-ring damaged.
7. Vacuum modulator damaged.
8. Vacuum modulator retainer screw loose. Tighten to 18 foot-pounds.
9. Vacuum modulator diaphragm damaged. Check as described in Diagnosis Part V.

NOTE: A ruptured diaphragm would allow transmission oil to be drawn into intake manifold and vacuum line. Usually the exhaust will be excessively smoky due to transmission oil added to the combustion. Oil level of transmission will also be low.

10. Bottom pan gasket damaged.
11. Bottom pan attaching screws loose. Tighten to 12 foot-pounds.
12. Line Pressure plug not tight. Tighten to 10 foot-pounds.
13. Porous or cracked casting.
14. Vent pipe.

a. Transmission over-filled.

b. Water in oil.

c. Pump to case gasket mispositioned.

d. Foreign material between pump and case, or between pump cover and body.

e. Case - Porous, pump face improperly machined.

f. Pump - Shy of stock, porous.

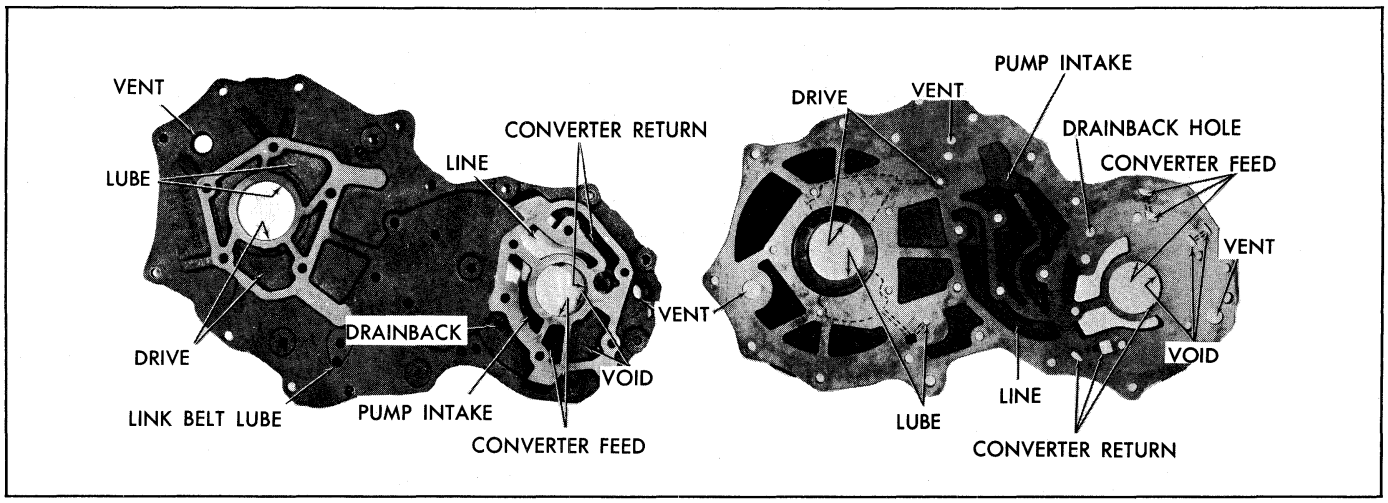


Fig. 7B-5 Pump Cover Oil Passages

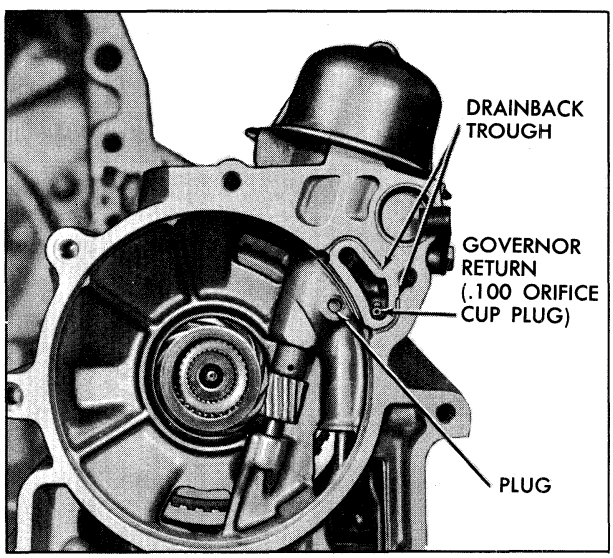


Fig. 7B-6 Governor Oil Passages

e. Oil Cooler Pipe Connections

1. Outside oil cooler pipe connections improperly installed or damaged. Also connectors in radiator and transmission.

2. Oil cooler pipe connections not tight. Tighten to 20 foot-pounds.

3. Flare on oil cooler pipe damaged at radiator or transmission.

f. Filler Pipe

1. O-ring damaged or improperly installed on pipe.

2. Filler pipe not fully seated in case.

g. Internal Leaks

It will be necessary to remove bottom pan to determine location of internal leaks.

1. Governor pipes damaged.

2. Control valve assembly-to-spacer or case gaskets damaged.

3. Control valve assembly attaching screws loose. Tighten to 8 foot-pounds.

4. Solenoid gaskets damaged.

5. Solenoid attaching screws loose. Tighten to 10 foot-pounds.

6. Intake pipe O-ring damaged.

7. Rear servo square cut O-ring improperly installed or damaged.

ON-CAR SERVICE

Manual Linkage Adjustment (Fig. 7B-7)

NOTE: Cotter pins removed should be discarded and replaced with new cotter pins.

1. Pull relay rod up to position transmission shift valve in Park, then push rod down to the third (Neutral) step. Make sure rod is centered in this detent position.

2. Loosen adjusting screw on relay lever.

3. Position selector lever in Neutral detent in steering column.

4. Tighten relay rod adjusting screw, making sure shift lever is held against Neutral stop while this operation is being performed.

5. Check operation of selector lever by performing the following steps:

a. Lift lever and move to Neutral detent. (This is the detent in the transmission). Release the lever and check to make sure that the lever fits into the neutral notch in the steering column.

b. Move lever to Drive detent. There should be a slight travel of the lever beyond this detent until the drive stop in the steering column is reached.

c. Move lever to Reverse detent and check as in b. above.

WARNING: WHENEVER LINKAGE IS READJUSTED, CHECK FOR PROPER OPERATION OF SEAT BELT WARNING SWITCH, PARKING BRAKE RELEASE AND BACK-UP LIGHTS. REFER TO SECTION 12 FOR PROPER METHOD OF CHECKING FUNCTION OF SEAT BELT WARNING SWITCH.

Transmission Downshift Switch Adjustment

The procedur for adjusting the transmission downshift switch is described on page 7A-25.

Checking and Adding Fluid

When checking fluid level the oil temperature and having the car on a level surface are particularly important. Careful attention to the following procedures is necessary in order to determine the actual fluid level.

a. Turbo Hydra-Matic Oil Recommendations

Whenever fluid is added to the transmission use only DEXRON ® or DEXRON ® II fluid, or fluids of equivalent quality that have been especially formulated and tested for use in the Turbo Hydra-matic transmission.

The transmission dipstick and filler tube on the Eldorado is located under the hood at the left center side of engine.

Under normal driving conditions, the transmission filter and fluid should be changed every 100,000 miles. If the car is driven extensively in heavy city traffic during hot weather, or is used to pull a trailer, change fluid every 50,000 miles. Likewise, operators of cars in commercial use (such as taxi-cab or limousine service) where the engine idles for long periods, should change fluid every 50,000 miles. In any case of a major transmission malfunction, the filter assembly and fluid must be replaced.

b. Checking and Adding Fluid

Automatic transmissions are frequently overfilled because the fluid level is checked when the fluid is cold and the dipstick indicates fluid should be added. However, the low reading is normal since the level will rise as the fluid temperature increases. A level change of over 3/4 inch will occur as fluid temperature rises from 16 to 82°C (60°F to 180°F).

Overfilling can cause foaming and loss of fluid through the vent. Slippage and transmission failure can result.

Fluid level too low can cause slipping, particularly, when the transmission is cold or the car is on a hill.

Check the transmission fluid level with the engine running, the shift lever in Park, and the car level.

NOTE: If the vehicle has recently been operated for an extended period at high speed or in city traffic in hot weather or the vehicle is being used to pull a trailer, an accurate fluid level cannot be determined until the fluid has cooled down - usually about 30 minutes after the vehicle has been parked.

Remove the dipstick and touch the transmission end of the dipstick cautiously to find out if the fluid is cool, warm or hot.

Wipe it clean and re-insert until cap seats. Remove dipstick and note reading.

If the fluid feels cool, about room temperature 18 to 29°C (65°F to 85°F) the level should be 1/8 to 3/8 inch below the ADD mark.

If it feels warm the level should be close to the ADD mark (either above or below).

If it feels hot (cannot be held comfortably) the level should be between the ADD and FULL marks.

NOTE: DO NOT OVERFILL. It takes only one pint to raise level from ADD to FULL with a hot transmission.

c. Draining Bottom Pan and Replacing Intake Pipe and Filter Assembly

To drain bottom pan only, eliminate steps 5 and 6.

1. Remove dipstick from filler tube and insert a length of hose secured to a suction gun down the dipstick tube. Remove enough transmission fluid so that bottom pan will not overflow when removed.

2. Raise car on hoist or place on jack stands, and provide container to collect draining oil.

3. Remove bottom pan and gasket. Discard gasket.

4. Drain fluid from bottom pan. Clean pan with solvent and dry thoroughly with clean compressed air.

5. Remove intake pipe and filter assembly. Remove and discard intake pipe O-ring.

6. Install new intake pipe O-ring into pipe bore in transmission case and install new intake pipe and filter assembly.

7. Install new gasket on bottom pan and install bottom pan. Tighten bottom pan attaching screws to 12 foot-pounds.

8. Lower car and add five quarts of transmission fluid through filler tube when replacing intake pipe and filter assembly. When draining bottom pan only, add four quarts of transmission fluid.

9. Operate engine at 800 rpm for approximately 1-1/2 minutes with selector lever in park "P" position.

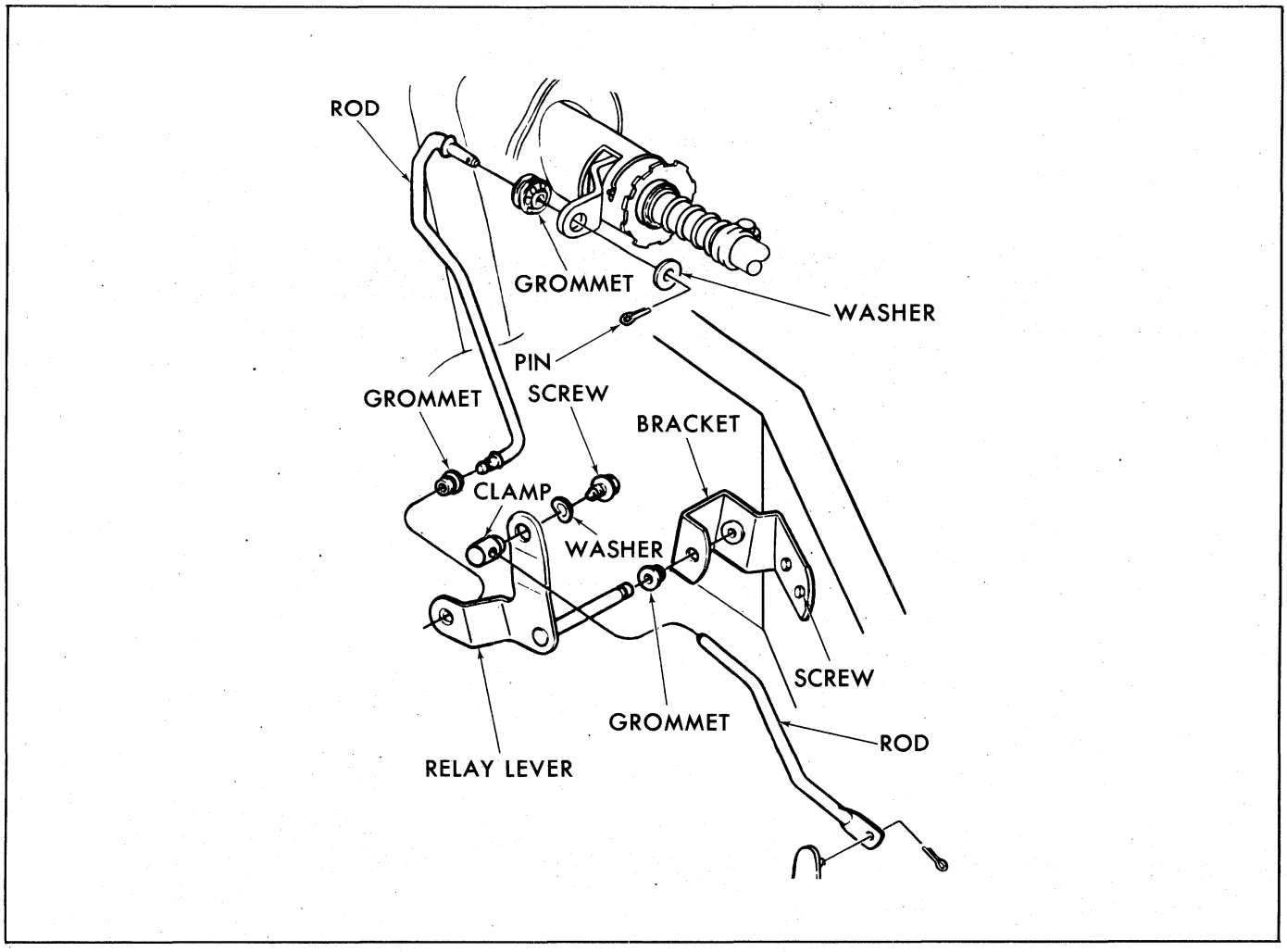


Fig. 7B-7 Transmission Linkage

10. Reduce engine speed to slow idle and check fluid level. Add fluid to bring to proper level, Fig. 7B-8

d. Adding Fluid to Dry Transmission and Converter Assembly

The fluid capacity of the Turbo Hydra-matic transmission and converter assembly is approximately 13 quarts, but correct level is determined by mark on dipstick rather than by amount added. It is important that proper level be maintained. In cases of transmission overhaul, when a complete fill is required, including converter, proceed as follows:

1. Add 9 quarts of transmission fluid through filler tube.

2. Operate engine at 800 rpm for approximately 1-1/2 minutes with selector lever in park "P" position.

3. Reduce engine speed to slow idle.

4. Check fluid level and add additional fluid to bring to proper level, Fig. 7B-8.

e. Sprocket Housing Cover Removal

If the sprocket housing cover is removed, add transmission oil as described in part b. of this note.

Towing Instructions

Refer to the General Motors Passenger Car and Light Truck Towing Instructions Manual.

Units That Can Be Removed With Transmission in Car

The following units can be removed from the transmission without removing transmission from car.

While the detailed procedure for removing each of the units is not outlined separately, the procedures covered under the transmission disassembly and assembly will apply.

a. Governor Assembly

Removal - page 7B-13

Disassembly - page 7B-45

Installation - page 7B-45

b. Speedometer Driven Gear Assembly

Removal - page 7B-13

Installation - page 7B-46

c. Intake Pipe and Filter Assembly and Bottom Pan

Removal - page 7B-14

Installation - page 7B-44

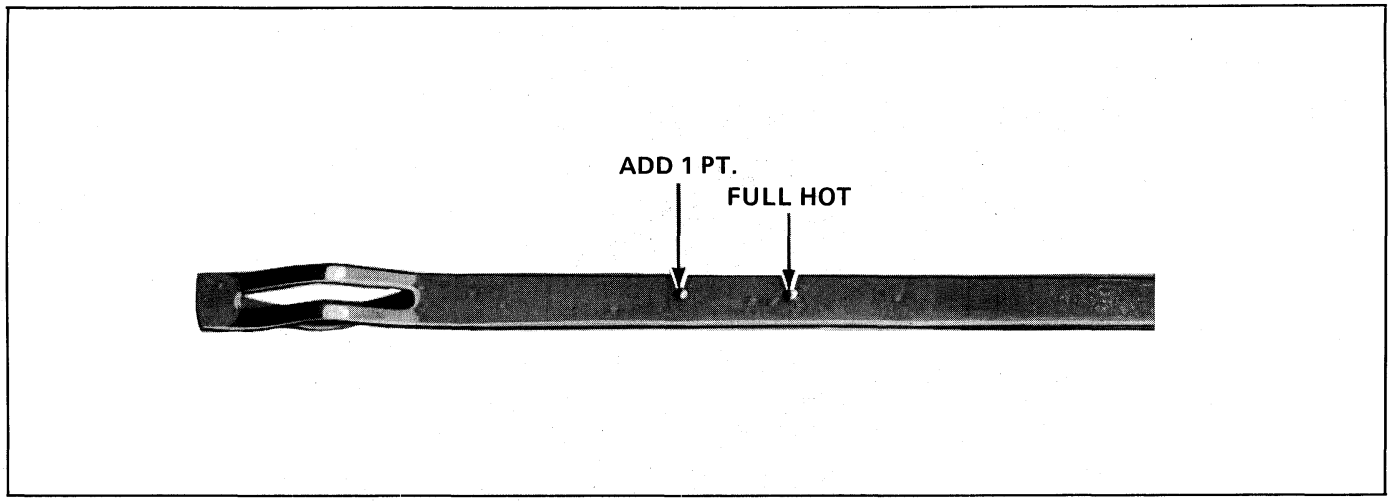


Fig. 7B-8 Transmission Oil Level (Eldorado Only)

d. Control Valve Assembly, Governor Pipes, Detent Spring and Roller Assembly, and Check Balls

Removal - page 7B-15
Disassembly - page 7B-38
Installation - page 7B-42

e. Vacuum Modulator and Valve

Removal - page 7B-13
Installation - page 7B-44

f. Pressure Regulator

Removal - page 7B-14
Installation - page 7B-43

g. Front Servo and Rear Servo and Accumulator Assembly

Removal - page 7B-15
Disassembly page 7B-36
Installation - page 7B-37

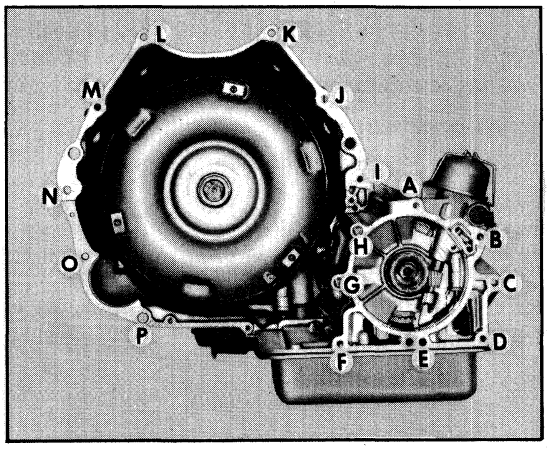


Fig. 7B-9 Transmission Attaching Bolts

h. Detent Lever, Manual Shaft, and Parking Linkage

Removal - page 7B-16
Installation - page 7B-36

Transmission Removal and Installation (Fig. 7B-9)

a. Removal

1. Disconnect negative battery cable.
2. Remove transmission dipstick.
3. Loosen nut securing filler tube bracket to exhaust manifold and remove filler tube, catching fluid in clean pan.
4. Remove and discard O-ring on filler tube.
5. Remove bolts at locations "A", "B" and "C", securing final drive case to transmission, Fig. 7B-9.
6. Disconnect detent solenoid connector at transmission case.
7. Disconnect speedometer cable from governor assembly.
8. Disconnect oil cooler pipes at transmission using an open end wrench to hold fitting and a tubing wrench or a crowfoot adapter to remove tube nut. Cap pipes and plug connector holes in transmission. Position oil cooler pipes out of way.
9. Remove nut at location "H", securing final drive case to transmission, Fig. 7B-9.
10. Remove bolts at locations "I", "J", "K" and "L", securing transmission to engine, Fig. 7B-9.
11. Remove ground strap from cowl.
12. Loosen upper left bolt securing converter cover plate to transmission by using a 7/16 inch universal socket and extension. Bolt can be seen from engine compartment.
13. Disconnect starter harness from engine harness.
14. Raise car.
15. Remove bolt at location "O", Fig. 7B-9 securing starter motor to transmission case and remove ground strap from bolt.
16. Holding starter, remove bolt at location "P", Fig. 7B-9 and remove starter, wiring clip and harness.
17. Disconnect transmission downshift switch connector at transmission.
18. Remove vacuum pipe from vacuum modulator.
19. Remove three remaining bolts securing converter

cover plate to transmission and remove cover plate.

20. Position transmission jack, equipped with front wheel drive transmission adapter plate, to transmission at starter motor lower mounting hole, Fig. 7B-11.

21. Secure transmission to transmission jack adapter plate with safety chain.

22. Remove three flywheel to converter attaching bolts.

CAUTION: *This can be done by installing a 9/16-18 screw, and washer into end of crankshaft at harmonic balancer, after removing cork plug, and rotating converter and flywheel until screws are accessible for removal. Do not pry on flywheel ring gear to rotate flywheel and converter, as flywheel may be damaged.*

23. Remove cotter pin securing relay rod to manual yoke on left side of transmission and separate relay rod from yoke.

24. Remove bolts at location "M" and "N", Fig. 7B-9, securing transmission to engine.

25. Remove bolts at location "D", "E", "F" and nut location "G", securing final drive to transmission, Fig. 7B-9.

NOTE: Position drain pan under point where transmission and final drive meet as transmission fluid will be lost when transmission and final drive are separated.

26. Loosen final drive through bolt at upper mount.

27. Through access holes in bottom of transmission support bar, remove two bolts securing rear motor mount to transmission support bar.

28. Remove motor mount from bracket and remove both from chassis.

29. Use small pry bar to separate transmission from engine and final drive.

CAUTION: *Select pry points with care to avoid damaging any components.*

30. After initial separation has been made, allow transmission oil to drain at final drive junction.

31. Pry and hold final drive forward, move transmission rearward to disengage transmission case from dowels on engine and to disengage final drive from studs on transmission case.

CAUTION: *Final drive unit is limited in its forward travel.*

32. Slowly lower transmission, making certain top of transmission case clears flywheel ring gear.

33. Pry final drive forward and input end downward pivoting around through bolt to provide clearance for final drive input shaft.

34. When converter is approximately half-way exposed from flywheel, install Converter Holding Clamp, J-21366, using a 5/16-18 nut to hold clamp screw to transmission case at location "N", Fig. 7B-9.

CAUTION: *Converter Holding Clamp, J-21366, must be used to avoid the possibility of the converter becoming disengaged when the transmission is removed.*

35. Remove and discard final drive gasket and clean mounting surface of final drive.

b. Installation

1. Position transmission on jack equipped with adapter plate, under car.

2. Install new gasket on final drive, after first soaking gasket with transmission fluid.

3. Remove Converter Holding Clamp, J-21366, from transmission.

4. Raise transmission in place while prying final drive forward and input shaft downward.

5. Holding final drive with pry bar, continue raising transmission, making certain top of transmission case clears splined input shaft of final drive, and position to engine.

6. Position transmission to engine assembly and final drive by aligning the following points in order listed:

a. Studs on transmission case to mounting holes in final drive.

b. Guide holes in transmission case to dowels on engine crankcase.

c. Internal flange on final drive to transmission.

CAUTION: *As engagement of splined final drive input shaft to transmission is hidden, extreme care must be taken to avoid damaging transmission or final drive assembly.*

d. To facilitate engagement of final drive splines, rotate one front wheel while helper holds other.

NOTE: When alignment is complete and proper, gap between final drive case and transmission should not exceed 1/4 inch.

7. Loosely install bolts at locations "D" and "F" attaching transmission to final drive and bolt at location "N" attaching transmission to engine, Fig. 7B-9. Alternately tighten bolts to avoid cocking transmission. Do not torque bolts at this time.

8. Position rear engine mount and bracket on top of transmission support bar against underbody. Secure mount to bracket with three screws. Loosely install two screws holding transmission mount to support bar.

9. Perform following work in engine compartment:

a. Loosely install bolts at locations "M" and "J" attaching transmission to engine crankcase, Fig. 7B-9. Do not torque bolts at this time.

b. Position rear engine mount bracket to engine and install bolts at locations "K" and "L", Fig. 7B-9.

10. Remove safety chain, remove bolt securing jack adapter plate to transmission case and remove transmission jack.

11. Torque the following bolts as specified.

a. Rear engine mount to transmission support bar - 55 foot-pounds.

b. Rear engine mount to bracket - 25 foot-pounds.

c. Transmission to engine (locations "M" and "N", Fig. 7B-9) - 30 foot-pounds.

CAUTION: *The procedure for attaching the converter to the flywheel as described in steps 12 through 14 must be strictly followed. Any deviation from this procedure will result in improper installation and damage to flywheel and transmission.*

12. Rotate converter until two of the three weld nuts on converter line up with two of the three holes in flywheel. Position converter so that weld nuts are flush with flywheel, making certain converter is not cocked and that pilot in center of converter is properly seated in crankshaft.

13. Install two flywheel to converter attaching bolts through accessible holes in flywheel and tighten finger tight.

14. Rotate flywheel and converter by rotating screw previously installed in forward end of crankshaft, until third hole is accessible. Install third bolt and tighten all bolts to 30 foot-pounds. Remove screw from crankshaft and install cork plug.

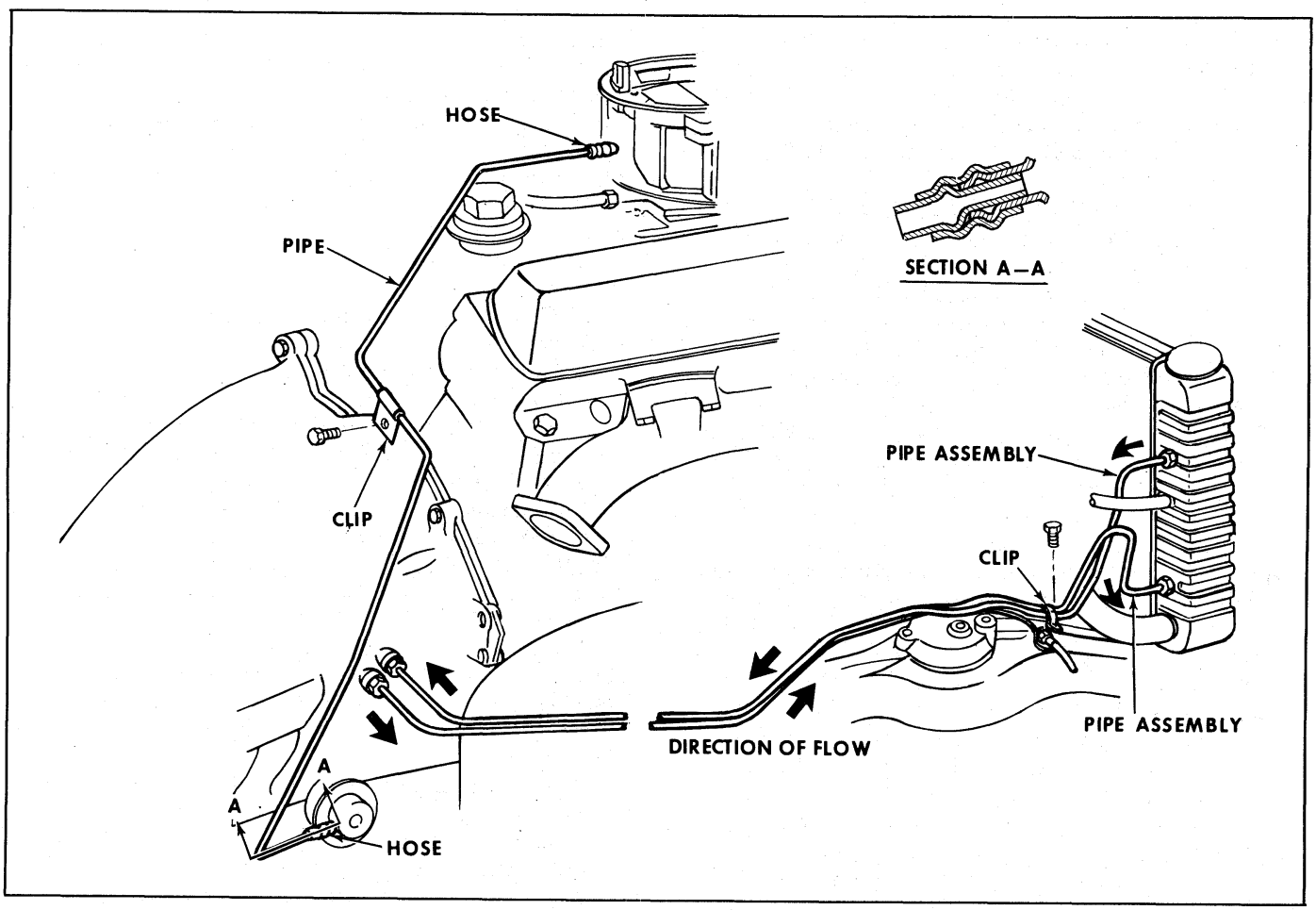


Fig. 7B-10 Transmission External Components

15. Install vacuum hose on vacuum modulator assembly and connect transmission downshift switch wire at connector.

16. Position converter cover plate to transmission case and install two lower and one upper right bolts securing cover plate to transmission, tightening to 5 foot-pounds.

17. Position starter to transmission case and install bolt and starter motor wiring clip at location "P", Fig. 7B-9.

18. Position ground strap to transmission and install bolt securing ground strap and starter motor to transmission at location "O". Tighten bolts at locations "O" and "P" to 25 foot-pounds, Fig. 7B-9.

19. Install bolts at locations "C" and "E" and nut at location "G", securing transmission to final drive, Fig. 7B-9.

20. Torque bolts at locations "C" through "F" to 35 foot-pounds, Fig. 7B-9.

21. Position relay rod to manual lever and secure with cotter pin.

22. Check operation of manual linkage and adjust, if necessary, as described on page 7A-8.

23. Lower car.

24. Connect starter harness to engine harness.

25. Install bolts at location "A" and "B" and nut at location "H", securing transmission to final drive, Fig. 7B-9. Tighten bolts to 35 foot-pounds.

26. Install upper left bolt securing converter cover plate to transmission using 7/16 inch universal socket and extension.

27. Torque bolts at locations "I", "J", "K" and "L" to 25 foot-pounds, Fig. 7B-9. Vacuum modulator pipe bracket is also installed at location "L".

28. Tighten cooler pipe connectors at case to 20 foot-pounds. Clean ends of cooler pipes with solvent, reposition cooler pipes and connect pipes to transmission using an open end wrench to hold fitting and a tubing wrench or crowfoot

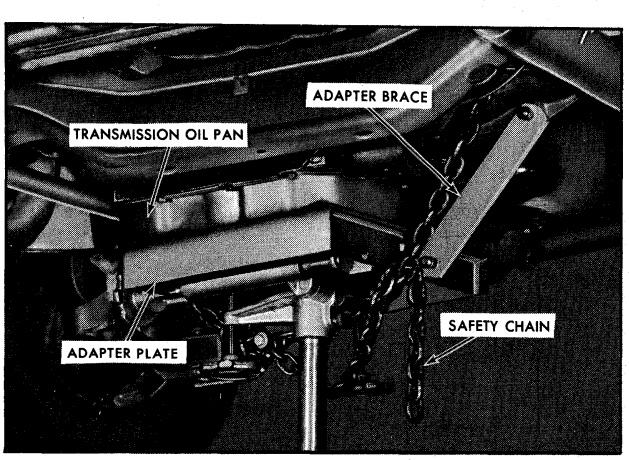


Fig. 7B-11 Positioning Transmission Jack

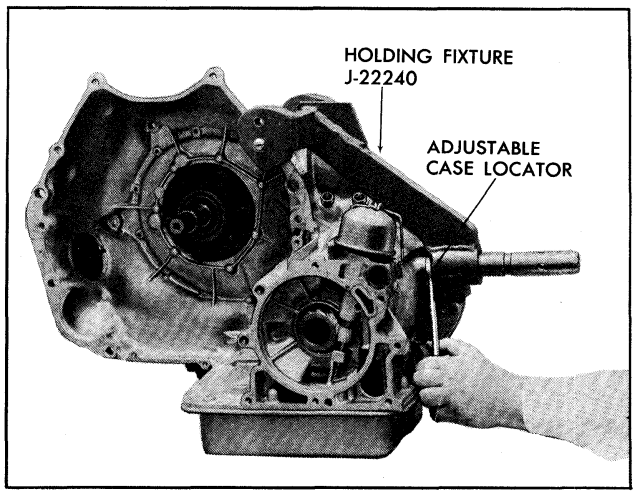


Fig. 7B-12 Attaching Transmission Holding Fixture

adapter, Fig. 7B-10. Tighten to 20 foot-pounds.

29. Install speedometer cable and detent solenoid connector.

30. Install new O-ring on transmission filler tube and install filler tube through hole in final drive case.

31. Position transmission filler tube bracket to exhaust manifold and install retaining nut.

32. Install body ground strap to cowl.

33. Connect negative battery cable.

34. Fill transmission with fluid as required, see page 7B-9.

Installing Transmission on Holding Fixture

1. With transmission on portable jack, remove Converter Holding Clamp, J-21366, and then remove converter assembly from transmission by pulling converter straight out of housing.

CAUTION: *Converter with oil weighs approximately 50 pounds. Be careful not to drop or damage converter when removing it.*

If transmission is to be overhauled, place converter on opposite end of workbench from transmission Holding Fixture Base.

2. Position Transmission Holding Fixture, J-22240, to transmission, Fig. 7B-12.

3. Attach Holding Fixture, J-22240, to transmission using a 3/8-16 x 2-1/4 inch bolt and nut at location "J". Use special screw provided with Holding Fixture to attach Holding Fixture to rear side of transmission case.

4. Tighten adjustable case locator pivot bolt to boss on side of transmission case.

CAUTION: *Do not over torque adjustable case locator nut.*

5. Install Transmission Holding Fixture, J-22240, and transmission into Holding Fixture Base, J-3289-01, then install lock pin in base.

6. Remove transmission jack from transmission.

7. Provide a container to catch any oil that may drain from transmission.

UNIT OVERHAUL

Remove Vacuum Modulator and Valve

NOTE: Unit may be removed without removing transmission or bottom pan, after removing vacuum hose.

1. Remove vacuum modulator attaching screw and retainer from transmission case.

2. Remove modulator assembly and O-ring from transmission case. Remove and discard O-ring from vacuum modulator, Fig. 7B-13.

3. Remove modulator valve from transmission case, Fig. 7B-14.

NOTE: Modulator bushing is a tight fit in transmission case and should not be removed forcibly unless it is damaged, scored, or otherwise deformed.

Remove Governor Assembly

NOTE: Unit may be removed without removing transmission from car.

1. Force top of spring clip downward, releasing governor assembly.

2. Remove governor assembly from case, and remove square-cut O-ring from governor assembly and discard O-ring, Fig. 7B-15.

NOTE: The governor assembly, including the driven gear, is replaceable. See page 7B-45.

Remove Speedometer Driven Gear

NOTE: Unit may be removed without removing transmission from car or without removing governor assembly.

1. Remove attaching screw and retainer from left side of case. Apply slight pressure to remove sleeve and speedometer driven gear.

2. Remove and discard O-ring from speedometer driven gear assembly.

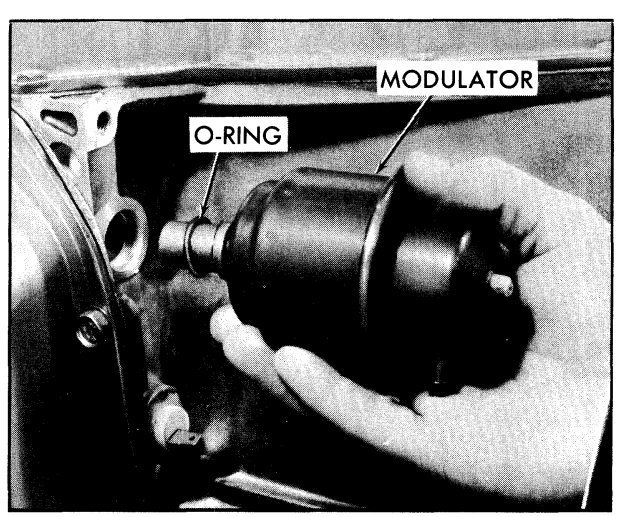


Fig. 7B-13 Removing Vacuum Modulator

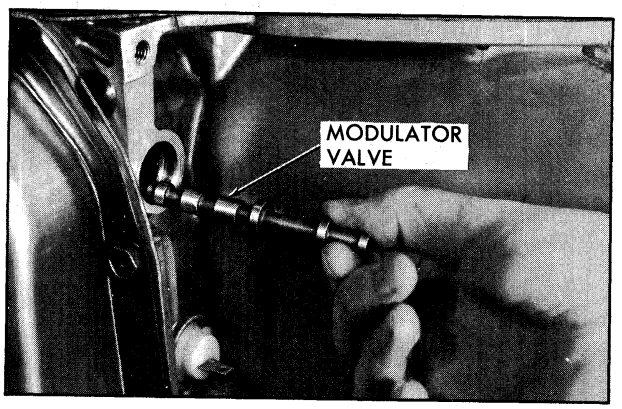


Fig. 7B-14 Removing Modulator Valve

Remove Intake Pipe and Filter Assembly and Bottom Pan

NOTE: Units may be removed with transmission in car. In cases of transmission malfunction, intake pipe and filter must be replaced.

1. Rotate transmission and Holding Fixture in Holding Fixture Base so that transmission bottom pan is up. Position container to catch any fluid which may drain from transmission.
2. Remove 13 bottom pan attaching screws.
3. Remove bottom pan and gasket, discarding gasket.
4. Lift out intake pipe and filter assembly, Fig. 7B-16.
5. Remove and discard intake pipe O-ring, Fig. 7B-16.

Remove Pressure Regulator Valve

NOTE: Unit may be removed with transmission in car after removing bottom pan.

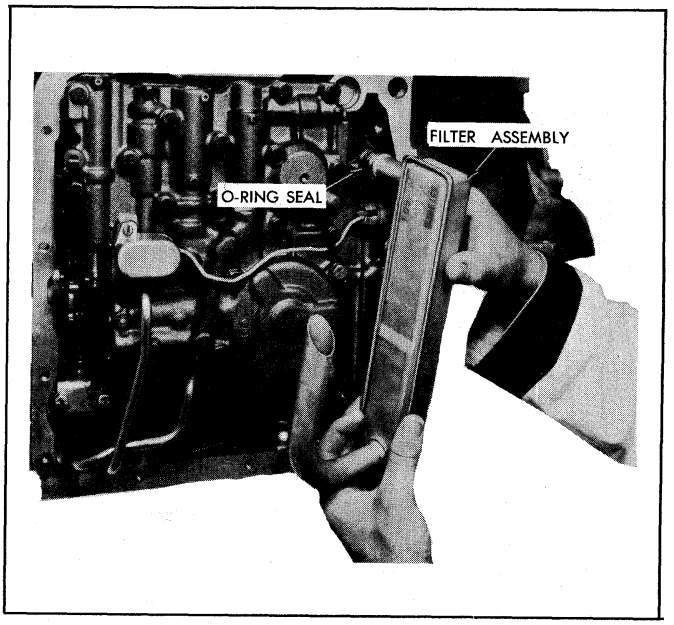


Fig. 7B-16 Removing Filter Assembly

1. Compress regulator boost valve bushing against pressure regulator spring and remove snap ring using Snap Ring Pliers, J-5403 (#21), Fig. 7B-17.

WARNING: PRESSURE REGULATOR SPRING IS TIGHTLY COMPRESSED.

2. Remove regulator boost valve bushing and valve.
3. Remove pressure regulator spring.
4. Remove regulator valve, spring retainer, and spacer or spacers if present.

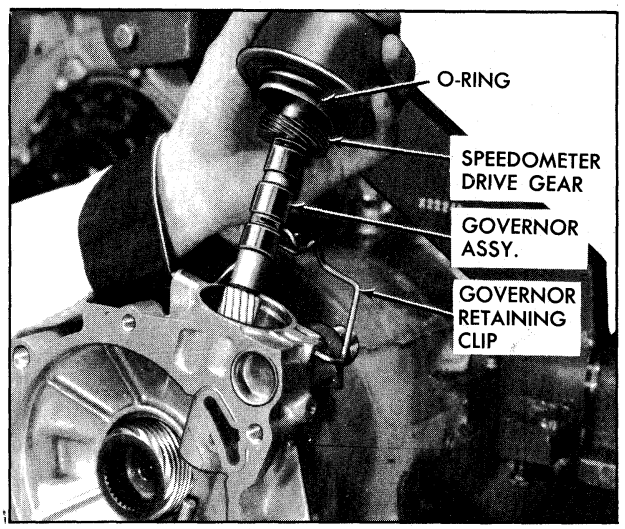


Fig. 7B-15 Removing Governor Assembly

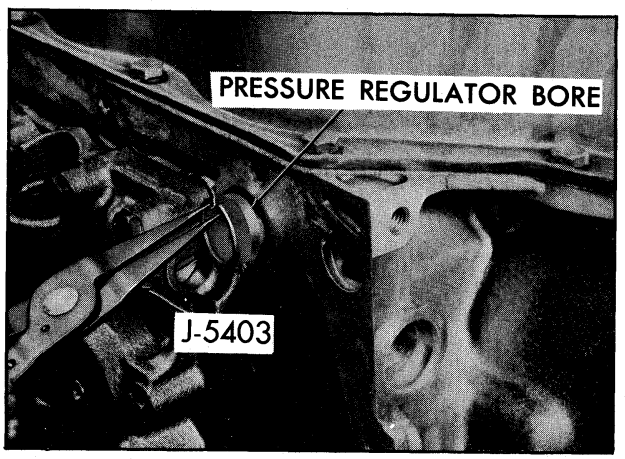


Fig. 7B-17 Removing Pressure Regulator Valve

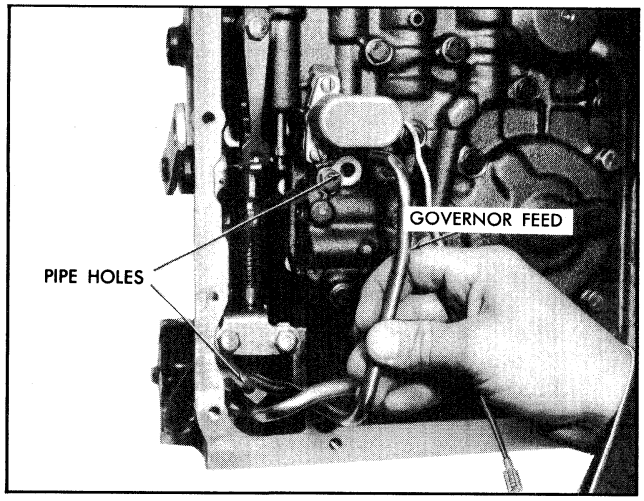


Fig. 7B-18 Removing Governor Feed Pipes

Remove Control Valve Assembly, Governor Pipes, Detent Spring, and Roller Assembly, and Check Balls

NOTE: Units may be removed with transmission in car, after removing bottom pan.

1. Remove attaching screw and remove detent roller and spring assembly.
2. Disconnect detent wire from case connector.
3. Remove governor feed pipe from transmission case and valve body by lifting straight out, Fig. 7B-18.
4. Remove nineteen remaining control valve assembly attaching screws. Do not remove detent solenoid attaching screws at this time.

NOTE: If the transmission is in the vehicle, the front servo piston assembly may drop down as the control valve assembly and governor pipe are removed.

5. Remove control valve assembly with remaining governor pipe attached, Fig. 7B-19.

CAUTION: *Do not allow manual valve to fall out of its bore in control valve assembly.*

6. Remove remaining governor pipe from valve body.
7. Remove control valve assembly to spacer gasket.
8. Remove control valve spacer and spacer-to-transmission case gasket, Fig. 7B-20.

CAUTION: *If control valve assembly is removed in car, seven check balls will come down with spacer.*

9. Remove seven check balls from cored passages in transmission case.

NOTE: The eighth check ball is held in by a retainer and should not be removed unless replacement is required.

Remove Front Servo Piston and Rear Servo Piston

NOTE: Units may be removed with transmission in car after removing bottom pan and control valve assembly.

1. Lift front servo piston retainer ring, pin, spring retainer and spring out of transmission case.

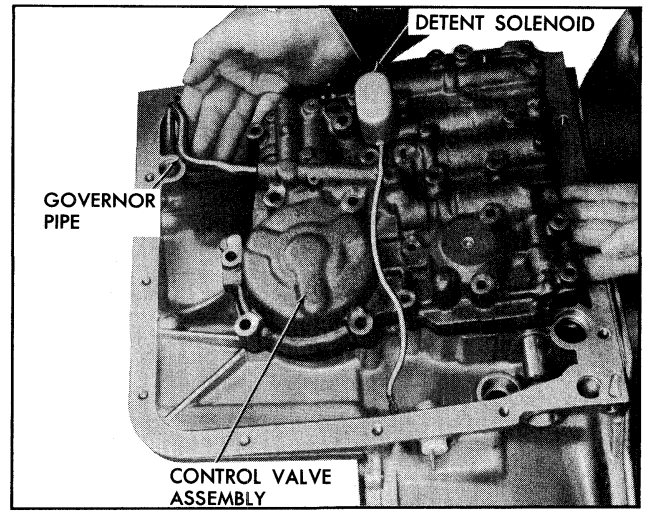


Fig. 7B-19 Removing Control Valve Assembly

2. Remove rear servo assembly from transmission case.
3. Remove rear servo accumulator spring.
4. Make band apply pin selection check to determine proper size pin to use at time rear servo is assembled. Proceed as described on page 7B-15.

Band Apply Pin Selection Check (Fig. 7B-21)

NOTE: Check may be made with transmission in car. Remove bottom pan, control valve assembly, and rear servo.

1. Position Adapter Plate, J-21370-8, on transmission case over rear servo bore, and, using screws provided with Adapter Plate, attach Band Apply Pin Selector Gage, J-21370-4 to Adapter Plate.
2. Position Band Apply Pin Selector Gage, J-21370-4, with hex nut on side of page facing toward converter housing, and smaller diameter end of Gage Pin, J-21370-7, in servo pin bore.

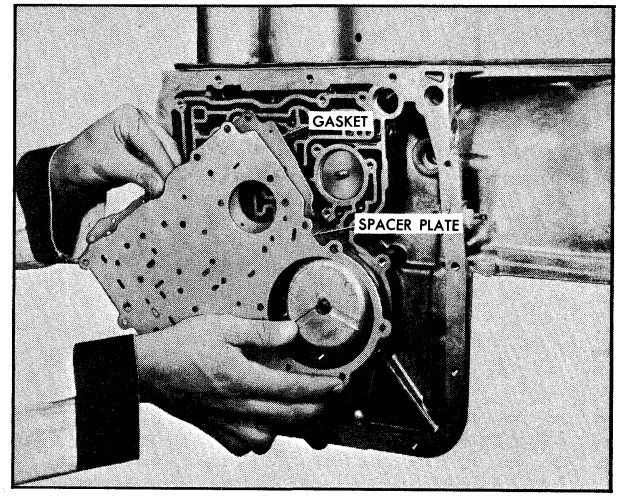


Fig. 7B-20 Removing Control Valve Spacer

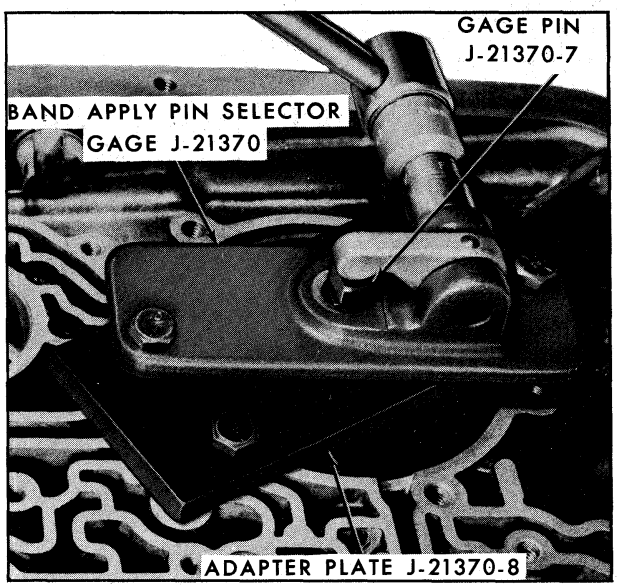


Fig. 7B-21 Band Apply Pin Selection Check

3. Secure Adapter Plate to transmission case with two 5/16-18 x 1 inch screws, tightening screws to 18 foot-pounds and secure Selector Gage to Adapter Plate, tighten attaching screws to 18 foot-pounds. Make certain that stepped gage pin is free to move up and down in both tool and servo pin bore. Stepped side of pin must face rear of transmission case.

Band apply pins are available in three sizes as shown in the following chart:

Identification ring is located on band lug end of pin. Selecting the proper pin is equivalent to adjusting band.

4. To determine proper size pin to use, apply 25 foot-pounds torque on hex nut on side of gage. This will cause lever on top of gage to depress stepped gage pin into servo pin bore, simulating actual operating conditions. Note relation of steps on gage pin and machined surface on top of gage. Determine proper size pin as follows:

a. If machined surface on top of gage is even with or above upper step on gage pin, long size pin (three rings) is required.

b. If machined surface is between the upper and lower steps on the gage pin, medium size pin (two rings) is required.

c. If machined surface on top of gage is even with or below lower step on gage pin, short size pin (one ring) is required.

5. If new pin is required, make note of pin size required, and remove gage from transmission case.

Identification	Length
Three Rings	Long
Two Rings	Medium
One Ring	Short

Remove Detent Lever, Manual Shaft, and Parking Linkage (Fig. 7B-22)

NOTE: Units may be removed with transmission in car after removing bottom pan and detent roller and spring assembly from control valve assembly.

1. Remove pin securing manual shaft to case by pulling straight out.

2. Loosen locknut securing detent lever to manual shaft.

3. Pry or work detent lever loose from ground flats on manual shaft.

4. Remove manual shaft from case bore and remove and discard O-ring seal from manual shaft.

NOTE: Be careful not to drop jam nut inside of case.

5. Remove detent lever and parking brake actuator assembly from case and remove actuator assembly from detent lever.

6. Remove parking brake bracket attaching screws and remove bracket.

7. Remove retainer pin securing parking pawl shaft to transmission case by pulling straight out.

8. Remove parking pawl shaft, parking pawl and return spring.

Remove Sprocket Cover, Link Assembly, Drive and Driven Sprockets

1. Rotate transmission in holding fixture base so that sprocket cover is up and remove eighteen cover attaching screws.

2. Remove cover and gasket and discard gasket.

3. Install Snap Ring Pliers, J-4646, into sprocket bearing retaining snap rings located under the drive and driven sprockets, and remove snap rings from retaining grooves on support housing, Fig. 7B-23.

NOTE: Leave snap rings in a loose position between sprockets and bearing assemblies.

4. Remove drive and driven sprockets, link assembly, bearings, and shafts simultaneously by alternately pulling upwards on the drive and driven sprokets until the bearings are out of the drive and driven support housings, Fig. 7B-24.

NOTE: If the sprockets are difficult to remove, place a small piece of fiberboard between the sprocket and sprocket support cover. Using a 1/2 x 9 inch pry bar, alternately pry upward under each sprocket on sprocket support cover. Do not pry on the guide links or the aluminum case. Pry only on the sprockets, Fig. 7B-25.

5. Remove link assembly from drive and driven sprockets.

6. Remove the teflon oil seal ring from turbine shaft only if the ring requires replacement. For service the ring is hook type cast iron.

7. Inspect drive and driven sprocket bearing assemblies for rough or malfunctioning bearings.

NOTE: Do not remove bearing assemblies from drive and driven sprockets unless they need replacement.

8. If removal of bearing assembly from drive and/or driven sprockets is necessary, proceed as follows:

a. Remove sprocket to bearing assembly retaining snap ring using Snap Ring Pliers, J-8059, Fig. 7B-26.

b. Mount sprocket, with turbine or input shaft placed down between two 2" x 4" x 10" wood blocks.

NOTE: Wood blocks are positioned on sides or ends, depending on which bearing is to be replaced.

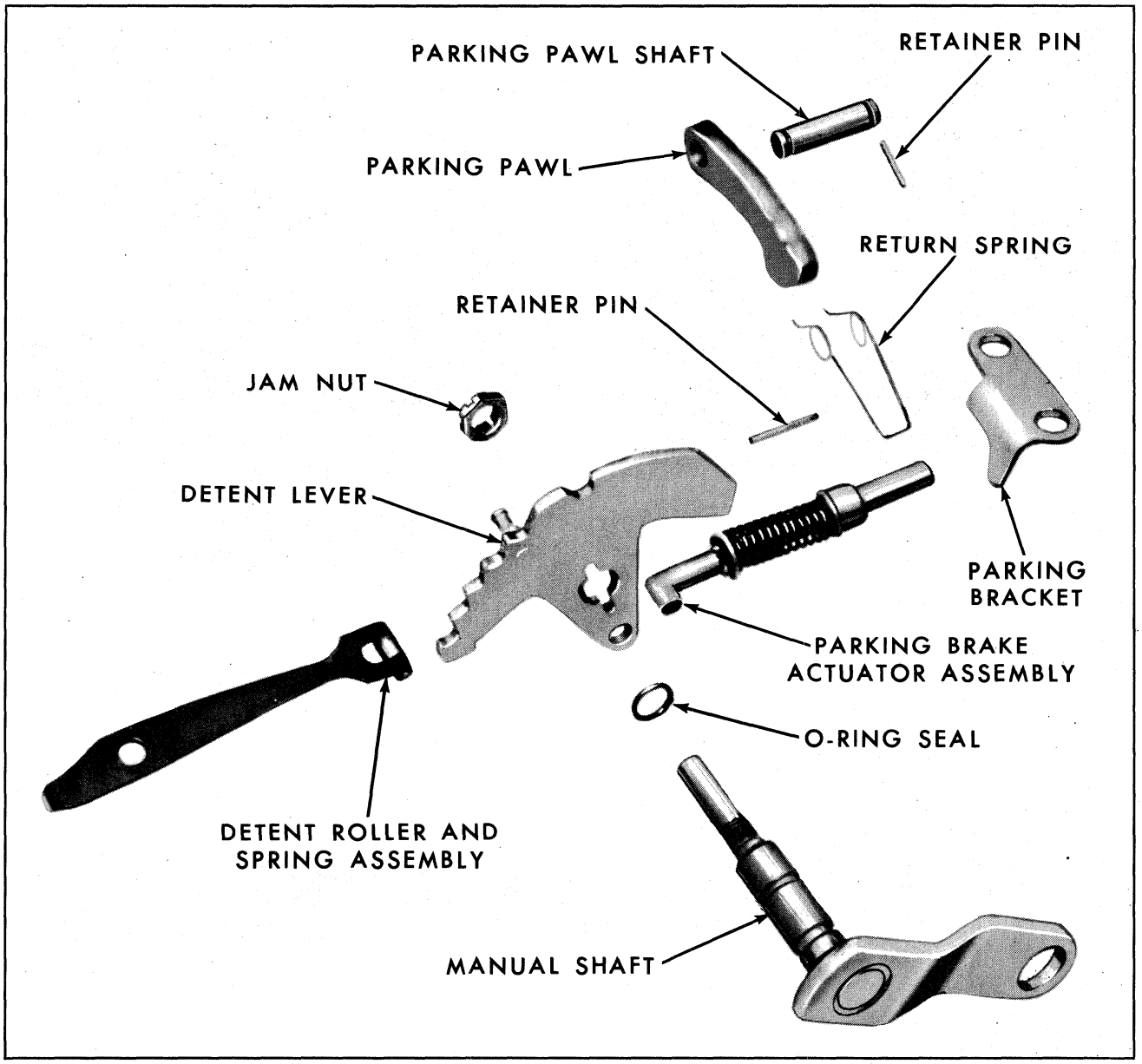


Fig. 7B-22 Manual and Parking Linkage - Disassembled View

c. With a hammer and brass rod, drive the inner race, alternately through each of the access openings, until the bearing assembly is removed from the sprocket hub, Fig. 7B-27.

Inspect Drive Sprocket and Turbine Shaft, and Link Assembly

1. Inspect drive sprocket teeth for nicks, burrs, scoring, galling, and excessive wear.

NOTE: Wear pattern at bottom of tooth form is normal.

2. Inspect drive sprocket to ball bearing retaining snap ring for damage.

3. Inspect drive sprocket ball bearing inner race mounting surface for damage.

4. Inspect turbine shaft for open lubrication passages. Run a tag wire through the passages to be sure they are open. See lubrication chart for passage location, Fig. 7B-2.

5. Inspect spline for damage.

6. Inspect the ground bushing journals for damage.

7. Inspect the oil seal groove for damage or excessive wear.

8. Inspect turbine shaft oil seal ring for damage. Do not remove unless replacement of ring is required for service. The ring is hook type cast iron.

9. Inspect the turbine shaft for cracks or distortion.

10. Inspect the link assembly for damage or loose links.

NOTE: Check the guide links. Guide links are the wide outside links on each side of the link assembly.

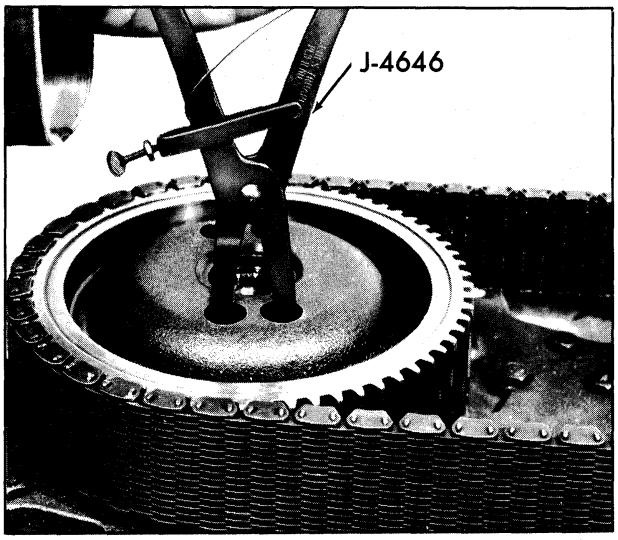


Fig. 7B-23 Removing Sprocket Snap Ring

Inspect Driven Sprocket and Input Shaft

1. Inspect driven sprocket teeth for nicks, burrs, scoring, galling, and excessive wear.

NOTE: Wear pattern at bottom of tooth form is normal.

2. Inspect sprocket to ball bearing retaining snap ring for damage.

3. Inspect ball bearing inner race mounting surface for damage.

4. Inspect input shaft for open lubrication holes. Run a tag wire through the holes to be sure they are open. See Fig. 7B-2 for location of holes.

5. Inspect spline for damage.

6. Inspect ground bushing journal for damage.

Install Sprocket Bearings

1. Turn sprocket so that turbine or input shaft is pointing upward.

2. Install new sprocket bearing as follows:

a. Install support snap ring, letter side down onto shaft.

b. Assemble bearing assembly on turbine or input shaft.

c. Using a piece of pipe, drive the bearing assembly onto the hub of the sprocket until it is resting on the bearing seat of the sprocket.

CAUTION: *Use pipe that closely fits I.D. of bearing assembly but does not contact shaft.*

d. Install sprocket to bearing assembly retaining snap ring into groove in sprocket hub.

3. If necessary intall hook type oil seal ring on turbine shaft.

NOTE: Turbine and/or input shaft may appear not to be pressed fully into the sprocket. Do not attemppt pressing shaft further as a specific length dimension is held during initial assembly.

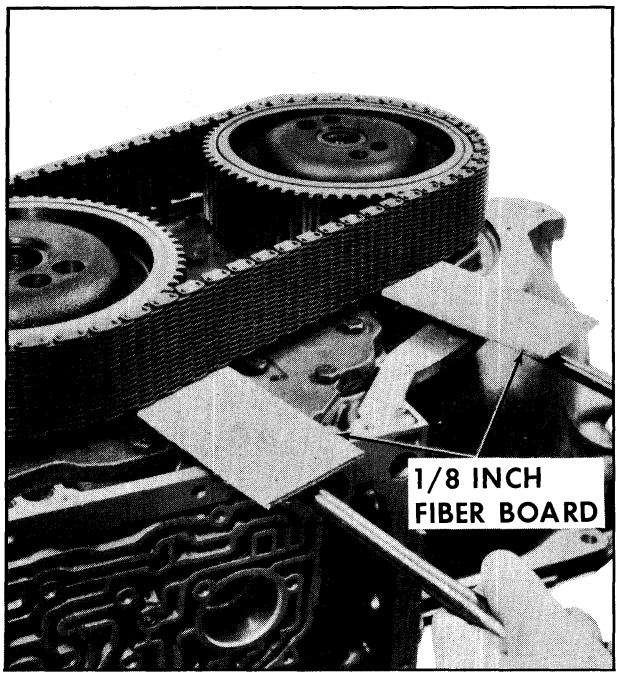


Fig. 7B-25 Removing Tight Sprockets

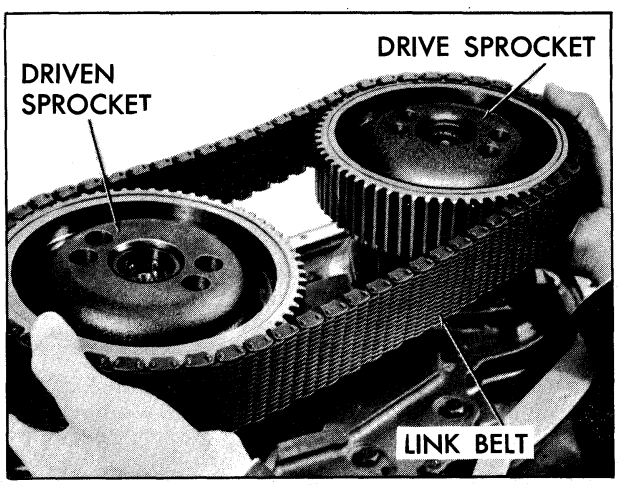


Fig. 7B-24 Removing Sprocket and Link Assembly

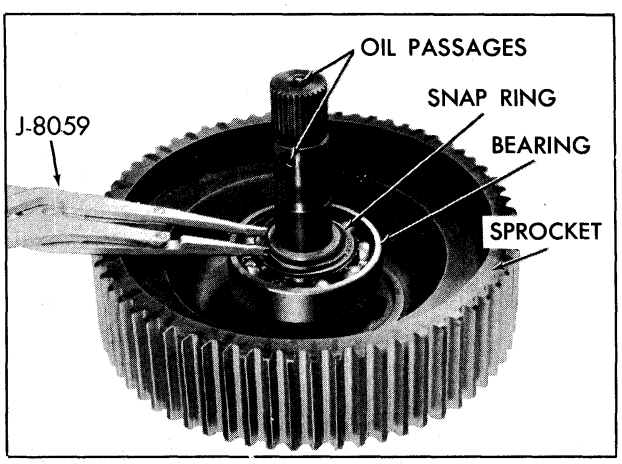


Fig. 7B-26 Removing Sprocket Bearing Snap Ring

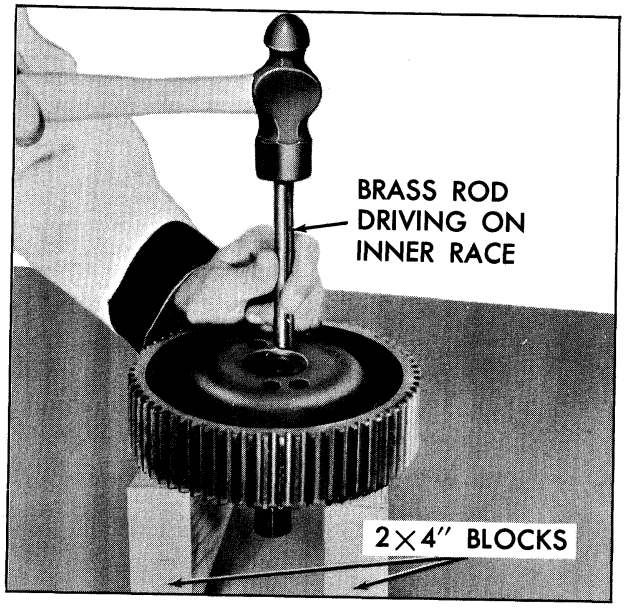


Fig. 7B-27 Removing Sprocket Bearing

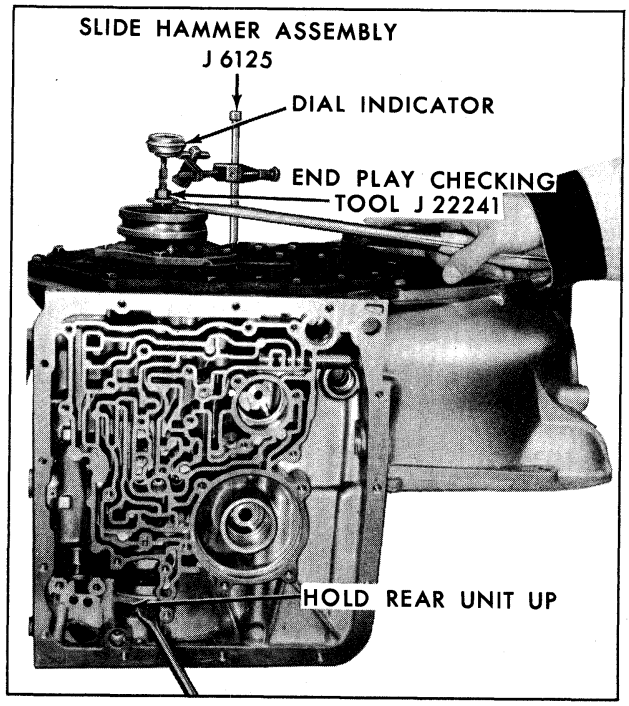


Fig. 7B-28 Checking Front Unit End Play

Front Unit End Play Check

1. Install Front Unit End Play Checking Tool, J-22241, into driven sprocket housing so that the urethane on the tool can engage the splines in the forward clutch housing. Let the tool bottom on the mainshaft and then withdraw it approximately 1/8 inch and tighten nut on tool, Fig. 7B-28.

2. Remove one bolt from the driven support housing, and install Slide Hammer Bolt, J-6125-1, into bolt hole in driven support housing.

NOTE: Do not thread slide hammer bolt deep enough to interfere with forward clutch housing travel.

3. Mount Dial Indicator, J-8001-02, on slide hammer bolt and index indicator to register with the Front Unit End Play Checking Tool, J-22241, Fig. 7B-28 and push tool down to remove slack.

4. Push and hold output flange upward. Place a screw driver in case opening at parking pawl area and push upward on output carrier.

5. Place a screw driver between the metal lip of the end play tool and the driven sprocket housing and push upward on the metal lip of the end play tool and read the resulting end play, which should be between .003" and .024".

The selective washer controlling this end play is the thrust washer located between the driven support housing and the forward clutch housing. If more or less washer thickness is required to bring the end play within specifications, select the proper washer from the chart below:

NOTE: An oil soaked washer may tend to discolor so that it will be necessary to measure the washer with a set of one inch micrometers to determine actual thickness.

6. Remove end play tool from transmission and remove dial indicator and slide hammer bolt from transmission.

Remove Oil Pump

1. Remove two opposite pump attaching bolts from the drive support housing.

2. Install two 5/16-18 x 4" guide pins in holes from previously removed bolts.

3. Remove the remaining pump attaching bolts from the drive support housing.

4. With one hand hold the underside of the pump and gently tap the guide pins until the pump is removed from the case.

THICKNESS	COLOR
.060-.064	Yellow
.071-.075	Blue
.082-.086	Red
.093-.097	Brown
.104-.108	Green
.115-.119	Black
.126-.130	Purple

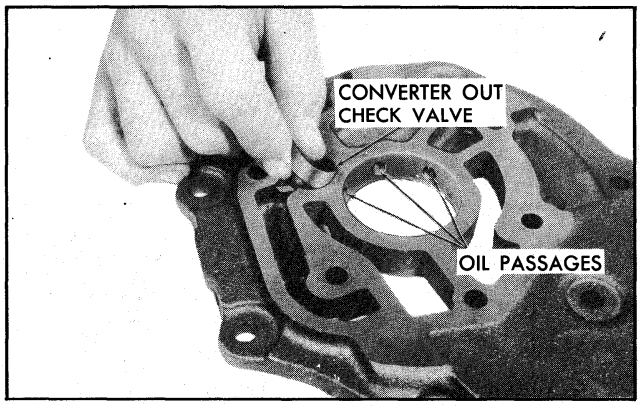


Fig. 7B-29 Removing or Installing Check Valve

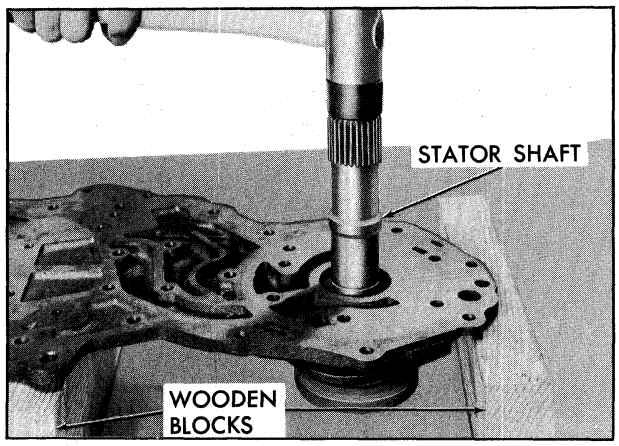


Fig. 7B-30 Removing Drive Sprocket Support

Remove Pump Cover Plate, Converter Out Check Valve and Drive and Driven Support Housing Assemblies

1. Remove the twenty-three pump cover plate-to-case attaching screws and remove pump cover plate. Do not remove sprocket support housing bolts at this time.

2. Remove pump cover plate and plate-to-case face gasket. Discard gasket.

NOTE: Drive and driven support housing assemblies are pressed into and removed with the pump cover plate. Do not remove them unless it is necessary.

3. Remove oil seal rings from the driven support housing if damaged.

4. Remove the front unit end play selective thrust washer from the hub of the driven support housing.

5. If necessary to remove the drive and driven sprocket support housing assemblies, proceed as follows:

a. Remove the remaining sprocket support to pump cover plate attaching bolts.

b. Support cover plate on wooden blocks and using a plastic mallet, vigorously strike the stator shaft of the drive sprocket support, Fig. 7B-30 and the hub of the driven sprocket support, Fig. 7B-31, until they are removed from their pump cover plate bores.

CAUTION: *When driving the housings out of the pump cover plate avoid damaging or distorting the stator shaft or the ring grooves in the hub of the driven housing.*

c. Remove and discard housing to pump cover plate gaskets.

d. Remove converter out check valve, Fig. 7B-29.

e. Install converter out check valve.

f. Install drive sprocket support housing to pump cover plate gasket.

g. Install drive sprocket support housing into pump cover plate by using a plastic mallet to seat the housing. Use bolts for guides, Fig. 7B-32.

h. Install driven sprocket support housing to pump cover plate gasket.

i. Install driven sprocket support housing to pump cover plate attaching bolts for gasket guides.

j. Install driven sprocket support housing into pump cover plate by using a plastic mallet to seat the housing.

k. Install all but one driven support housing to pump cover plate attaching bolts. Torque to 20 ft. lbs.

6. Install proper front unit end play selective thrust washer on the hub of the driven sprocket support housing. Use micrometer to determine the actual thickness of the thrust washer.

7. Install oil seal rings into the grooves in the hub of the driven sprocket support housing Fig. 7B-33.

NOTE: For service the ring is hook type cast iron.

Remove Forward Clutch Assembly, Direct Clutch Assembly, Sun Gear Shaft, and Front Band

1. Remove forward clutch assembly from transmission, Fig. 7B-34, by installing Front End Play Checking Tool, J-22241, into forward clutch and lifting forward clutch straight out.

2. Remove forward clutch hub to direct clutch housing thrust washer if it did not come out with forward clutch assembly.

3. Remove direct clutch and intermediate sprag assembly by lifting straight out. Sun gear shaft may come out

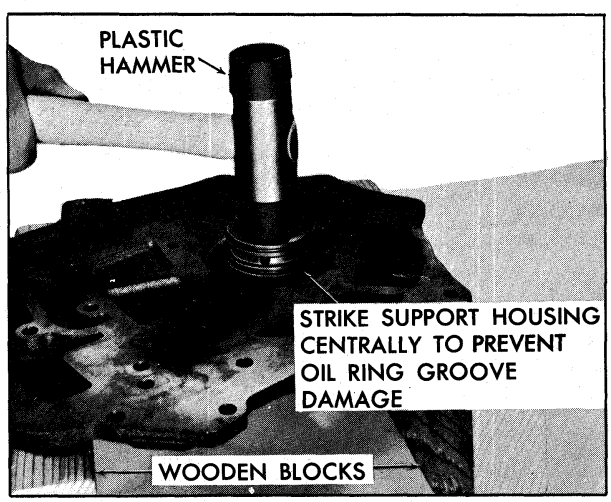


Fig. 7B-31 Removing Driven Sprocket Support

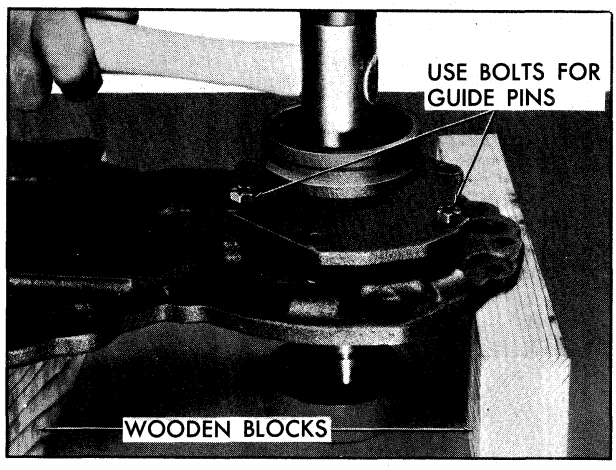


Fig. 7B-32 Installing Deiven Sprocket Support

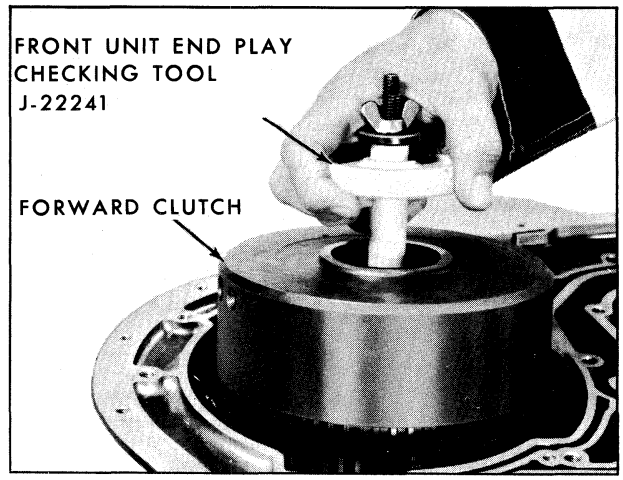


Fig. 7B-34 Removing Forward Clutch

with direct clutch assembly.

4. Remove sun gear shaft if not previously removed.

5. Remove front band assembly.

NOTE: Check rear unit end play at this time. Proceed as described on page 7B-21.

Rear Unit End Play Checking Procedure

1. Rotate transmission in holding fixture base so that forward end of transmission is up.

2. Install Speedometer Puller Bolt, J-21797 or J-21661, in one of the differential mounting bolt holes on end of transmission case.

3. Mount Dial Indicator, J-8001-02, on Bolt J-21797 or J-21661, and index indicator to register with flat surface on end of output flange, Fig. 7B-35.

4. Set dial indicator to zero.

5. Using two screw drivers (180° apart) move output flange in and out. Note resulting travel or end play for selection of washer for use at time of transmission assembly. End play should be .007 inch-.019 inch.

NOTE: Use of two screwdrivers avoids an angled condition and insures greater accuracy.

The selective washer controlling this end play is the steel washer with the three tabs, located between thrust washer and rear face of transmission case. Notches and/or numerals on the tabs serve to identify washer thickness.

If a different washer thickness is required to bring end play within specifications, it can be selected from the following chart. The tabs will show identification notches, numerals or both, on page 7B-22.

6. Remove Dial Indicator, J-8001-02, and Bolt, J-21797, or J-21661, from transmission and rotate transmission so that rear end of transmission is up., Fig. 7-35.

Remove Remaining Components

1. Remove center support bolt from transmission case, Fig. 7B-36 using a 3/8 inch 12-point thin wall deep socket.

2. Remove intermediate clutch backing plate to case snap ring.

3. Remove intermediate clutch backing plate, and three composition faced and three steel clutch plates.

4. Using a needle-nose pliers, or screwdriver, remove center support to case snap ring, Fig. 7B-38

5. Install Gear Assembly Remove and Installer Adapter, J-21795-02, on end of main shaft so that tangs engage groove in shaft. Using Slide Hammer Handle, J-6125, and

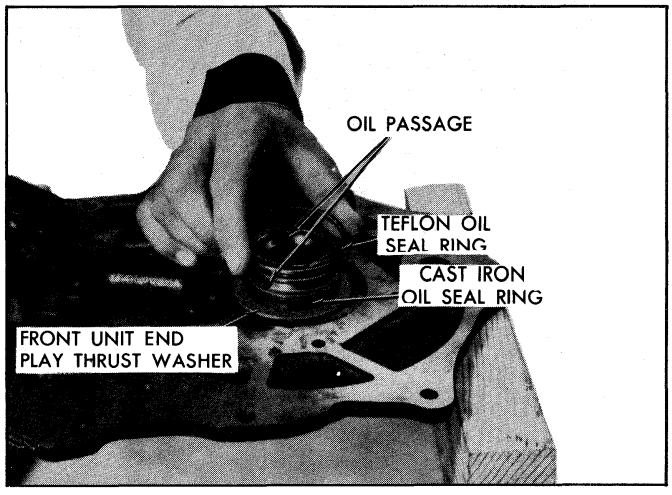


Fig. 7B-33 Installing O-Rings on Sprocket Support

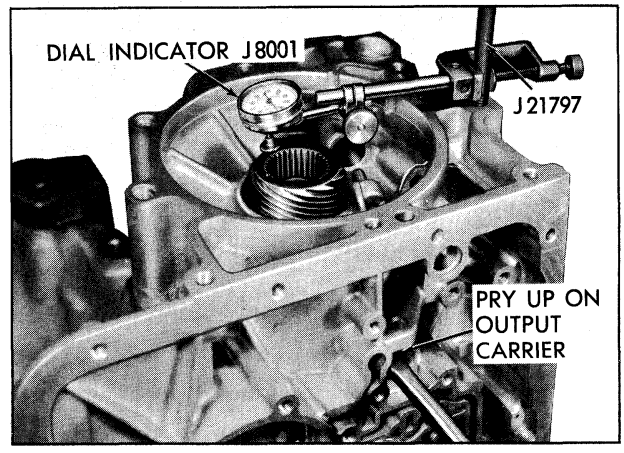


Fig. 7B-35 Checking Rear Unit End Play

Thickness	Identification Notch and/or Numeral	
.074 - .078	None	1
.082 - .086	On Side of 1 Tab	2
.090 - .094	On Side of 2 Tabs	3
.098 - .102	On End of 1 Tab	4
.106 - .110	On End of 2 Tabs	5
.114 - .118	On End of 3 Tabs	6

Speedometer Puller Bolt, J-21797 or J-21661, tighten bolt on tool to secure tool on shaft, Fig. 7B-37.

6. Remove complete gear unit assembly from case, by lifting straight up.

CAUTION: *Be careful not to drop or bump assembly in transmission case during removal.*

7. Remove output flange to case metal thrust washer from output flange or case.

8. Place gear unit assembly on bench with output flange down, Fig. 7B-39. Remove Tool J-21795..

9. Remove support to case spacer, Fig. 7B-61.

10. Remove rear band assembly. To facilitate removal, rotate band lugs away from pins and pull band assembly out of transmission case.

11. Remove rear unit selective washer from transmission case.

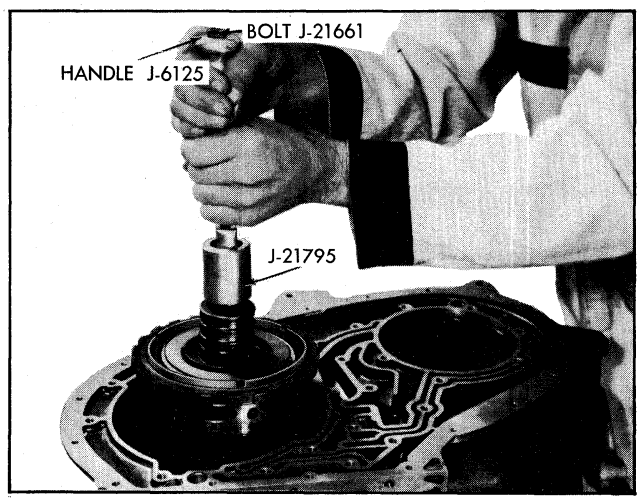


Fig. 7B-37 Removing Gear Unit Assembly

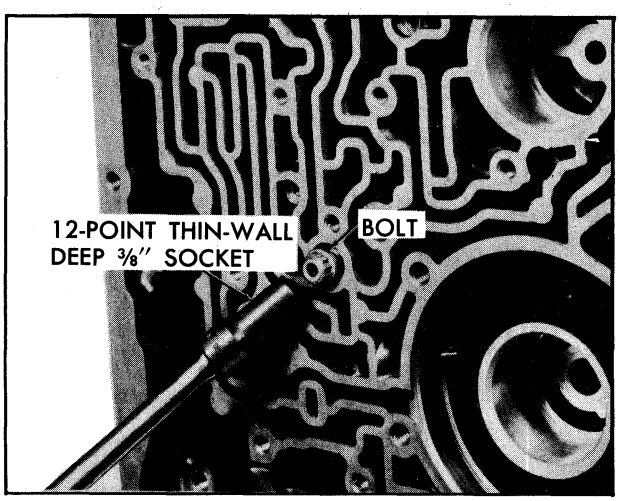


Fig. 7B-36 Removing Center Support Bolt

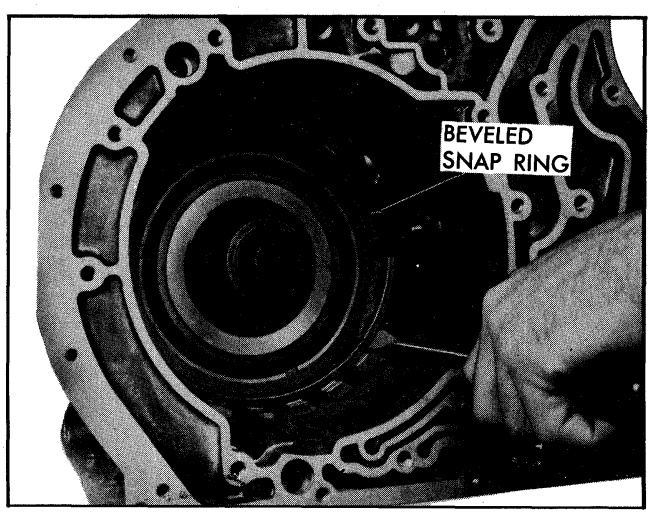


Fig. 7B-38 Removing Snap Ring

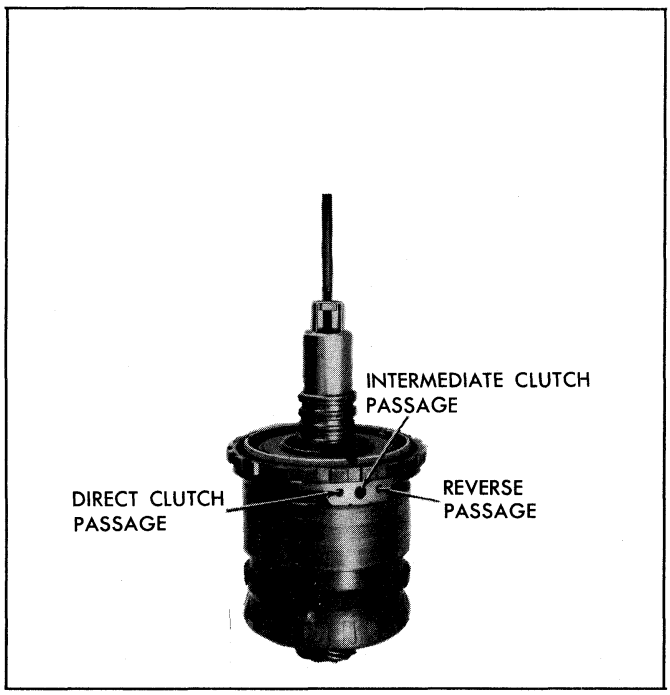


Fig. 7B-39 Gear Unit Bench Position

INDIVIDUAL UNIT DISASSEMBLY, CLEANING, INSPECTION, ASSEMBLY AND INTALLATION OF MAJOR COMPONENTS

Inspection of Transmission Case

1. Inspect case assembly for cracks, porosity or interconnected passages, Fig. 7B-2.
2. Check for good retention of band anchor pins.
3. Inspect all threaded holes for thread damage.
4. Inspect intermediate clutch plate lugs for damage or brinelling.
5. Inspect snap ring grooves for damage.
6. Inspect governor assembly bore for scratches or scoring.
7. Inspect governor pipes screen assemblies (located in governor pipe holes in case) for plugging or damage.
8. Inspect modulator valve bore for scoring or damage.
9. Inspect output flange bushing for wear, galling and open lubrication groove.

Center Support and Gear Unit

a. Disassembly

1. Remove center support assembly from reaction carrier by lifting center support straight up.
2. Remove center support to reaction carrier thrust washer.

NOTE: Thrust washer may have stuck to back of center support. If so, remove from center support.

3. Remove reaction carrier and roller clutch assembly from output carrier, Fig. 7B-40, and remove roller clutch assembly from reaction carrier.
4. Remove center support to sun gear races and thrust bearing from sun gear.

NOTE: One of the races may have stuck to back of center support.

5. Remove front internal gear ring from output carrier assembly, Fig. 7B-41.
6. Remove sun gear from output carrier assembly.
7. Remove reaction carrier to output carrier thrust washer from output carrier.
8. Invert gear unit and place in Rear Unit Holding Fixture, J-6116-01, with main shaft pointing downward.
9. Remove snap ring securing output flange to output carrier and remove output flange.
10. Remove thrust bearing and races from rear internal gear.
11. Lift rear internal gear and main shaft out of output carrier and remove thrust bearing and races from inner face of rear internal gear.
12. Remove snap ring from end of main shaft and remove rear internal gear.
13. Remove output carrier from holding fixture.

b. Inspect Output Flange

1. Inspect bearing and thrust washer surfaces for damage.
2. Inspect drive lugs for damage.
3. Inspect splines for damage.
4. Inspect lubrication passages.

c. Inspect Main Shaft

1. Inspect shaft for cracks or distortion.
2. Inspect splines for damage.
3. Inspect ground bushing journals for damage.
4. Inspect snap ring groove for damage.
5. Inspect lubrication passages.

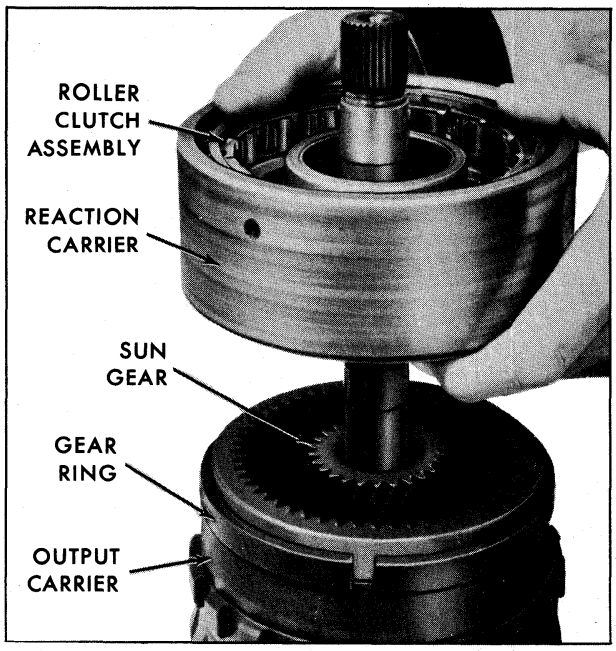


Fig. 7B-40 Removing Reaction Carrier and Roller Clutch

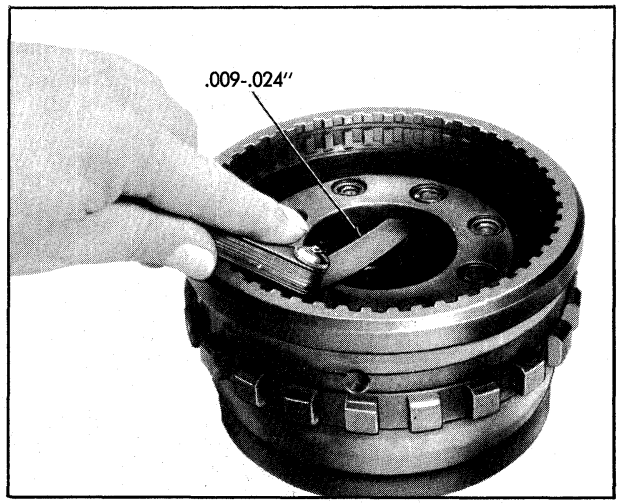


Fig. 7B-42 Checking Pinion End Play

d. Inspect Rear Internal Gear

1. Inspect gear teeth for damage or wear.
2. Inspect splines for damage.
3. Inspect gear for cracks.
4. Inspect bearing and thrust surfaces for wear or galling.

e. Inspect Output Carrier

1. Inspect front internal gear for damaged teeth.
2. Inspect pinion gears for damage, rough bearings or excessive tilt.
3. Check pinion end play. Pinion end play should be .009 inch-.024 inch, Fig. 7B-42.
4. Inspect parking gear lugs for cracks or damage.
5. Inspect output flange locating splines for damage.
6. Inspect front internal gear ring for flaking or cracks.

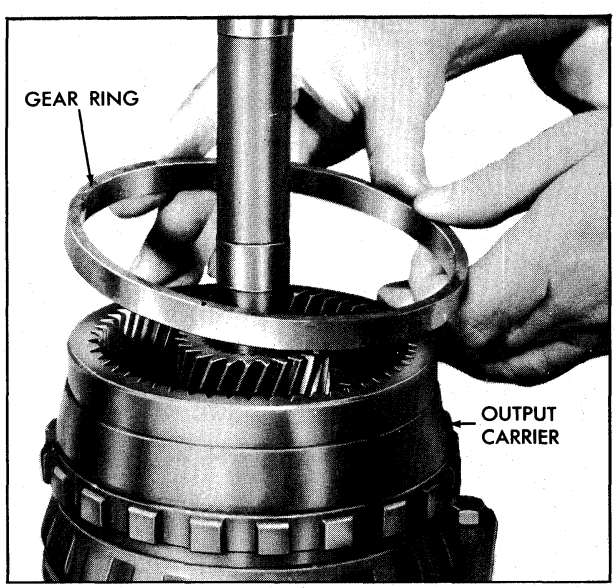


Fig. 7B-41 Removing Front Internal Gear Ring

f. Inspect Reaction Carrier

1. Inspect band surface on reaction carrier for signs of burning or scoring.
2. Inspect roller clutch outer cam for scoring or wear.
3. Inspect thrust washer surfaces for signs of scoring or wear.
4. Inspect bushing for damage. If bushing is damaged, carrier must be replaced.
5. Inspect pinion gears for damage, rough bearings or tilt.
6. Check pinion end play. Pinion end play should be .009 inch-.024 inch.

g. Pinion Gear Replacement - Reaction and Output Carrier Assemblies

1. Support carrier assembly on its FRONT face.
2. Using a 1/2 inch diameter drill remove the stake marks from the end of the pinion pin, or pins, to be replaced. This will reduce the probability of cracking the carrier when the pinion pins are pressed out.

CAUTION: *Do not allow drill to remove any stock from the carrier, as this will weaken the part, and could result in a cracked carrier.*

3. Using a tapered punch, drive or press pinion pins out of carrier.
4. Remove pinion gears, thrust washers, and roller needle bearings.
5. Inspect pinion pocket thrust faces for burrs and remove if present.
6. Install eighteen needle bearings into each pinion gear using petrolatum to hold bearings in place. Use a pinion pin as a guide.
7. Place a bronze and steel thrust washer on each side of pinion gear with steel washers against gear, Fig. 7B-43. Hold washers in place with petrolatum.

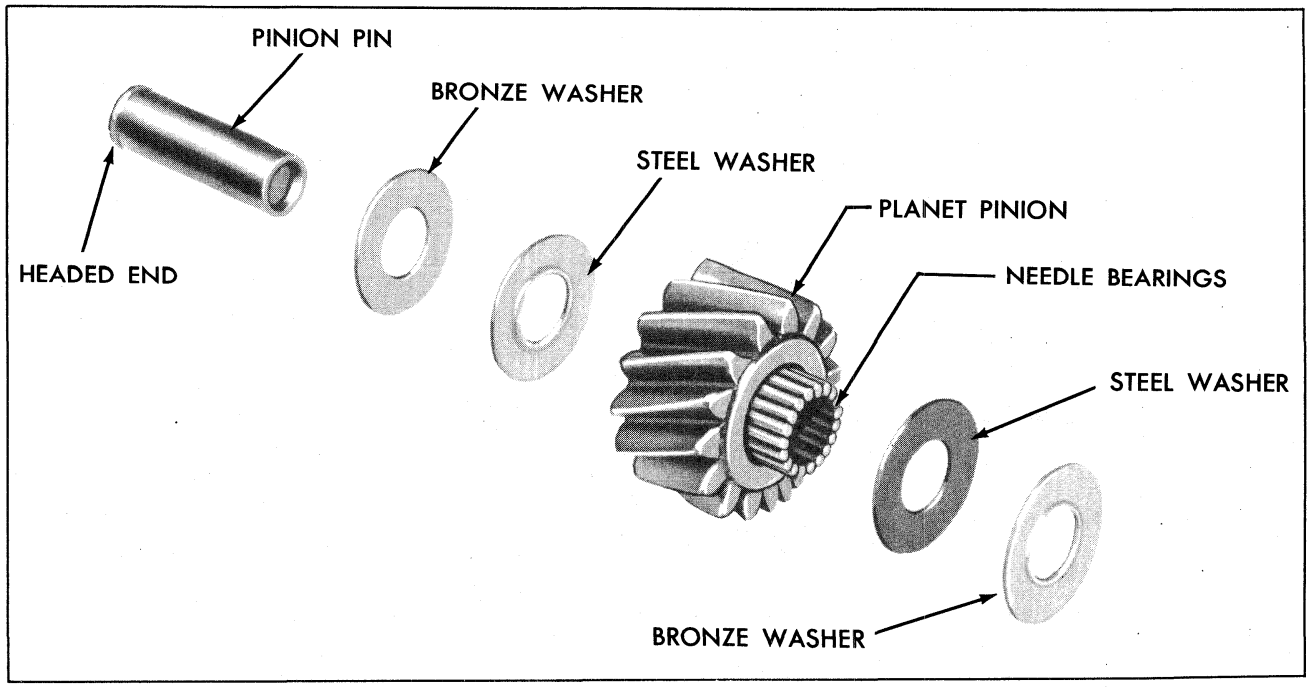


Fig. 7B-43 Planet Pinion - Disassembled View

8. Place pinion gear assembly in position in carrier and install a pilot shaft through rear face of assembly to hold parts in place.

9. Drive a new pinion pin into place from the front, while rotating pinion gear. Be sure that headed end is flush or below face of carrier.

10. Using a punch in bench vise for an anvil, stake opposite end of pinion pin in three places with a blunt radius chisel, Fig. 7B-44.

NOTE: Both ends of pinion pins must lie below face of carrier or interference may occur.

11. Repeat installation procedure for each pinion gear.

h. Inspect Roller Clutch

1. Inspect roller clutch for damaged rollers or springs.
2. Inspect roller clutch cage for damage.

i. Inspect Sun Gear

1. Inspect gear teeth for damage or wear.
2. Inspect splines for damage.
3. Be sure oil lubrication hole is open.

j. Inspect Sun Gear Shaft

1. Inspect shaft for cracks or splits.
2. Inspect splines for damage.
3. Inspect bushings for scoring or galling.
4. Inspect ground bushing journals for damage.
5. Be sure oil lubrication hole is open.

k. Assemble Gear Unit (Fig. 7B-45)

1. Install rear internal gear on end of main shaft that has snap ring groove and install snap ring.

2. Install races and thrust bearing on inner face of rear internal gear, retaining races and bearing with petrolatum. Proceed as follows:

a. Install large diameter race first, with flange facing up, Fig. 7B-46.

b. Install thrust bearing in race.

c. Install small diameter race on bearing with inner flange facing down.

3. Lubricate pinion gears in output carrier with transmission fluid and install output carrier on main shaft so that pinion gears mesh with rear internal gear.

4. Place assembly in a Rear Unit Holding Fixture, J-6116, with main shaft pointing downward. Be careful not to damage shaft.

5. Install races and thrust bearing on outer face of rear internal gear, retaining races and bearing with petrolatum. Proceed as follows:

a. Install small diameter (flanged I.D.) race first, with

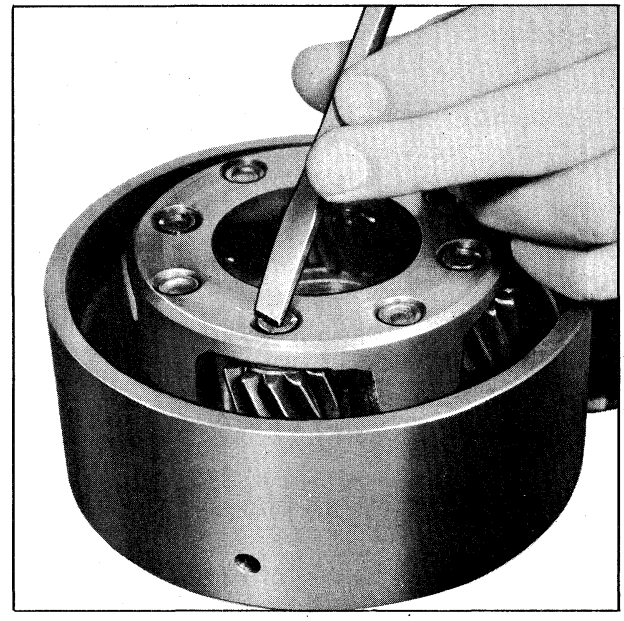


Fig. 7B-44 Staking Pinion Pin

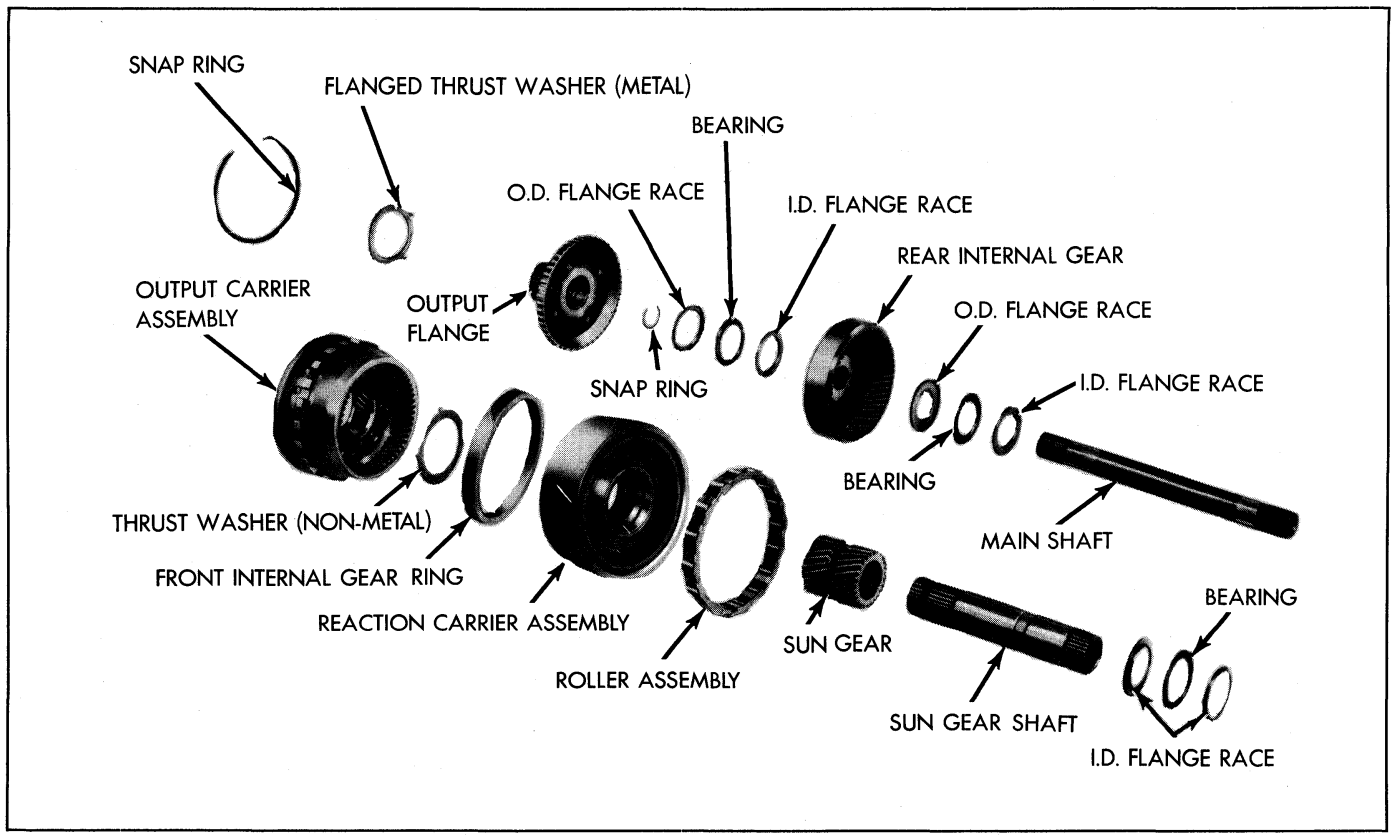


Fig. 7B-45 Gear Unit - Disassembled View

flange facing up, Fig. 7B-47.

b. Install thrust bearing in race.

c. Install large diameter (flanged O.D.) race on bearing with flange cupped over bearing.

6. Install output flange into output carrier and install snap ring.

7. Invert assembly and place on bench with output flange downward.

8. Lubricate tab side of reaction carrier to output carrier non-metal or metal thrust washer with petrolatum and install thrust washer in output carrier with tabs in tab pockets.

9. Install sun gear with end having chamfered I.D. facing down.

10. Install sun gear shaft with longer splined end down.

11. Install gear ring over output carrier.

12. Lubricate pinion gears in reaction carrier with transmission fluid and install reaction carrier on output carrier so that pinion gears mesh with front internal gear.

NOTE: When a new output carrier and/or reaction carrier is being installed, and if the front internal gear ring prevents assembly of the carriers, replace the front internal gear ring with the service ring. The front internal gear ring is a selective fit at the factory, but not in service.

13. Install large diameter O.D. race on sun gear with flange facing up against sun gear shaft.

14. Install thrust bearing on race.

15. Lubricate small diameter race with petrolatum and install race on center support with flange facing toward tower end, Fig. 7B-48.

16 Install rollers that may have come out of roller clutch cage, by compressing energizing spring with forefinger and inserting roller from outer side, Fig. 7B-49.

NOTE: Make certain that energizing springs are not distorted, and that curved end leaf of springs are positioned against rollers.

17. Install roller clutch assembly in reaction carrier, Fig. 7B-50.

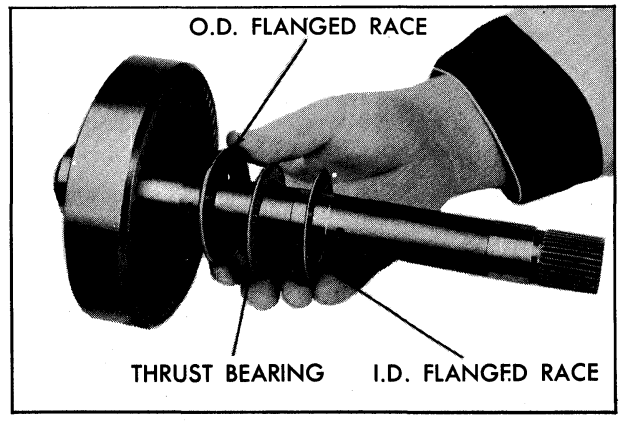


Fig. 7B-46 Installing Thrust Bearing on Inner Face of Rear Internal Gear

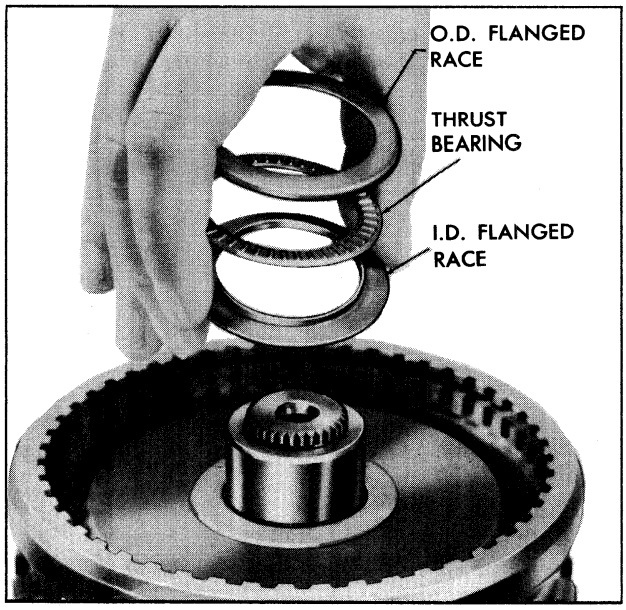


Fig. 7B-47 Installing Thrust Bearing on Outer Face of Rear Internal Gear

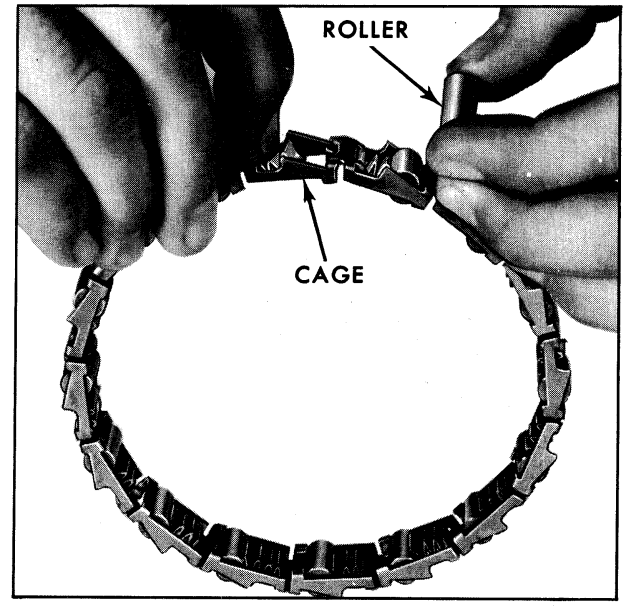


Fig. 7B-49 Installing Rollers in Cage

l. Disassemble Center Support and Intermediate Clutch Piston

1. Remove center support to reaction carrier thrust washer from recess in center support.

2. Remove four oil seal rings from the center support, Fig. 7B-51.All **service** center support oil seal rings are hook type cast iron.

3. Using Clutch Spring Compressor, J-4670-01, and Rear Clutch Spring Compressor, J-6129, Fig. 7B-52, compress spring retainer and remove snap ring with Snap Ring Pliers, J-8059 or J-5586.

4. Remove spring retainer, six intermediate clutch release springs, and spring guide.

5. Remove intermediate clutch piston from center support.

6. Remove inner and outer seals from clutch piston.

NOTE: Do not remove the three screws retaining roller clutch inner race to center support.

m. Inspect Center Support

1. Inspect roller clutch inner race for scratches or indentations. Be sure lubrication hole is open.

2. Inspect bushing for scoring, wear or galling.

3. Check oil ring grooves for damage.

4. Air check oil passages to be sure they are open and not interconnected.

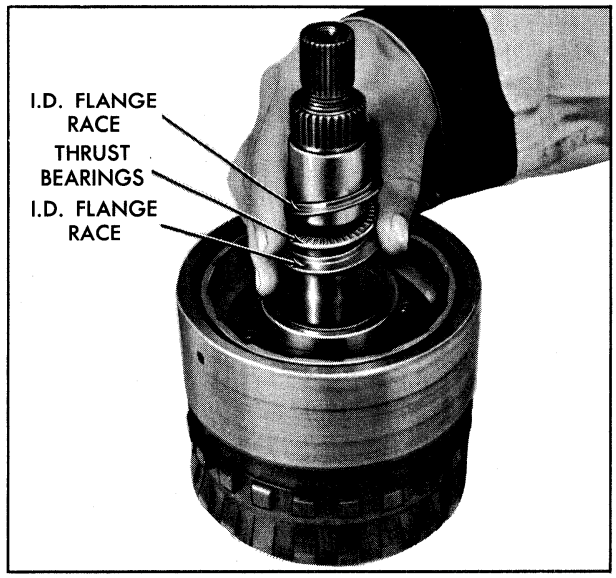


Fig. 7B-48 Installing Thrust Bearing Over Sun Gear Shaft

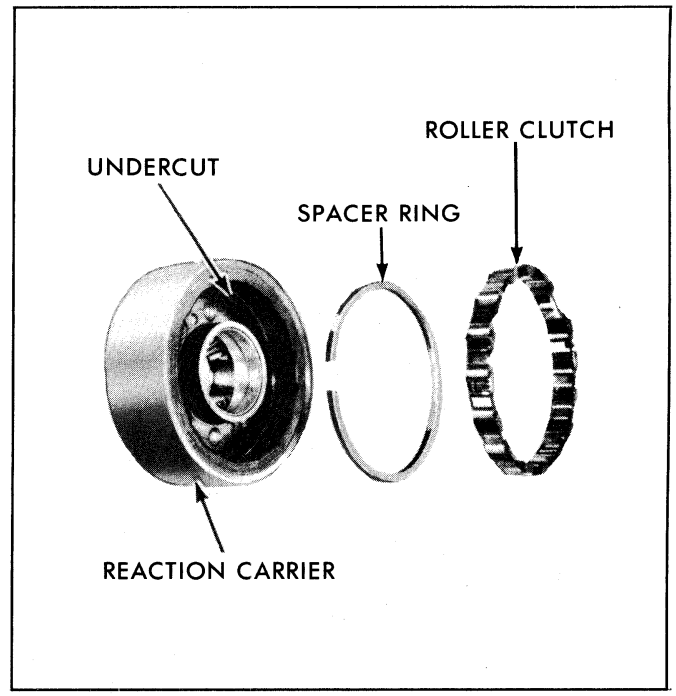


Fig. 7B-50 Installing Spacer Ring and Roller Clutch Assembly

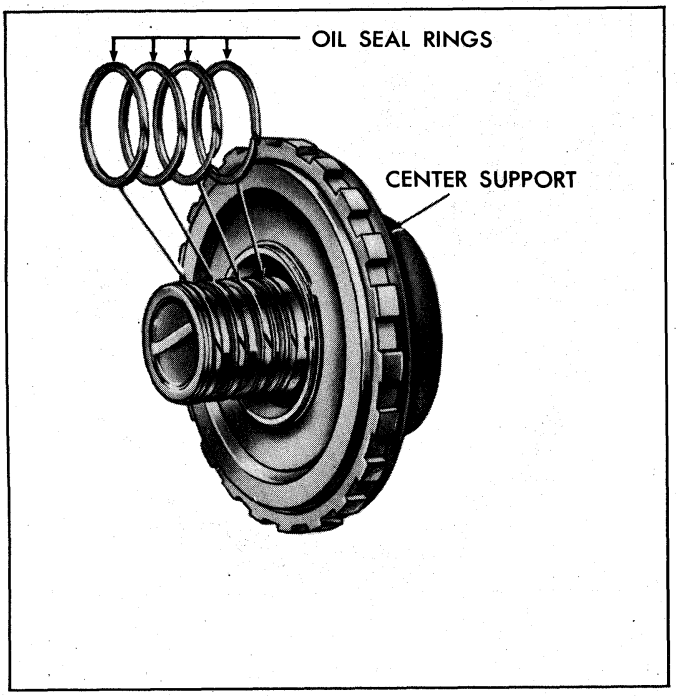


Fig. 7B-51 Center Support Oil Seal Rings

5. Inspect piston sealing surfaces for scratches.
6. Inspect piston seal grooves for nicks or other damage.
7. Inspect piston for cracks.
8. Inspect springs for collapsed coils or signs of distortion.
9. Inspect oil seal rings for damage.

NOTE: All service center support oil seal rings are hook type cast iron.

n. Assemble Center Support and Intermediate Clutch Piston Assembly (Fig. 7B-53)

1. Lubricate new inner and outer clutch piston seals with transmission fluid. Lubricate seal grooves in intermediate clutch piston and install seals with lips facing away from spring guide, Fig. 7B-54.

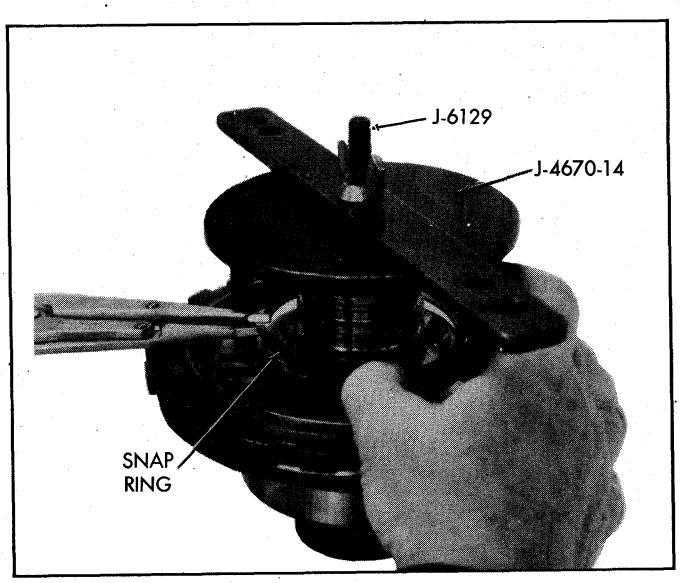


Fig. 7B-52 Removing Intermediate Clutch Snap Ring

2. Place Intermediate Clutch Inner Seal Protector, J-21363, over center support hub, Fig. 7B-55, and install intermediate clutch piston.
3. Install plastic spring guide, Fig. 7B-56.
4. Install six clutch release springs equally spaced into spring holes in spring guide, Fig. 7B-57.
5. Place spring retainer and snap ring over springs.
6. Using Clutch Spring Compressor, J-4670-06, and Rear Clutch Spring Compressor, J-6129, Fig. 7B-52, compress spring retainer, being careful that retainer does not get caught in snap ring groove, and install snap ring with Snap Ring Pliers, J-8059 or J-5586. Remove tools.
7. Install four oil seal rings on the center support.
8. Air check operation of intermediate clutch piston. Apply air through center oil feed hole to actuate clutch piston, Fig. 7B-58.
9. Lubricate center support to reaction carrier thrust washer with petrolatum and install washer in recess of center support, Fig. 7B-59. Check to make sure sun gear thrust bearing race is on center support.
10. Install center support assembly into roller clutch in reaction carrier, Fig. 7B-60.

NOTE: With reaction carrier held, center support should turn clockwise only.

11. Install Gear Assembly Remover and Installer Adapter, J-21795-02, on end of main shaft so that tangs engage groove in shaft. Using Slide Hammer Handle, J-6125, and Speedometer Puller Bolt, J-21797 or J-21661, tighten bolt on tool to secure tool on shaft and prevent movement of the roller clutch during installation of the gear unit assembly, Fig. 7B-37.

o. Install Rear Band and Complete Gear Unit Assembly

1. Inspect rear band for cracks or distortion and band ends for damage to anchor lugs and apply lug. Also inspect lining for cracks, flaking, burning and looseness.
2. Install rear band assembly in transmission case so that band lugs index with anchor pins.
3. Inspect support to case spacer for burrs or raised edges. If present, remove with a stone or fine sandpaper.
4. Install the support case spacer against the shoulder at the bottom of case splines and the gap located adjacent to the band anchor pin, Fig. 7B-61.

CAUTION: *Do not confuse this spacer (.040" thick and both sides flat) with either the center support to case snap ring (one side beveled) or the intermediate clutch backing plate to case snap ring (.093" thick and both sides flat).*

5. Install previously selected rear unit selective washer into slots provided inside rear of transmission case. Retain washer with petrolatum.

NOTE: Proper washer size was determined at time of rear unit end play check.

6. Laying gear unit on its side, install metal thrust washer on output flange with bent tabs in tab pockets. Retain thrust washer with petrolatum.

CAUTION: *This must be a metal thrust washer.*

CAUTION: *Be careful not to drop or bump gear unit assembly in transmission case during installation.*

7. Install gear unit, with center support and reaction carrier, by lining up center support bolt hole with hole in case and carefully guiding complete assembly into transmission case.

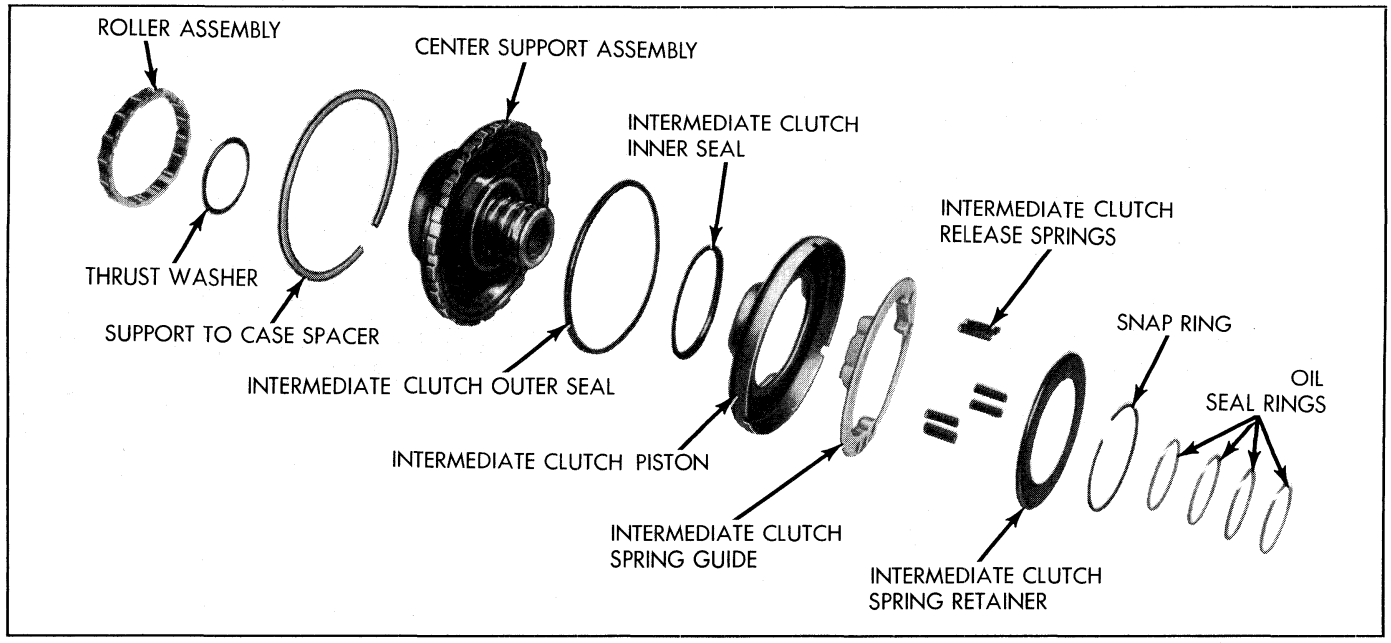


Fig. 7B-53 Center Support Assembly - Disassembled View

8. Lubricate center support to case snap ring with transmission fluid and install snap ring in transmission case with beveled side up, (flat side against center support) locating gap adjacent to front band anchor pin. Expand snap ring until center support is against shoulder of case.

9. Install case to center support bolt.

NOTE: To correctly perform this operation it will be necessary to make the tool shown in Fig. 7A-102. Then follow procedure outlined below:

Place center support locating tool into the case direct clutch passage, with the handle of the tool pointing to the left, as viewed from the front of transmission and parallel to the bell housing mounting, Fig. 7B-62.

Lift **upward** on the tool which will tend to rotate the center support counterclockwise as viewed from the front of transmission. While holding the center support firmly counterclockwise against case splines, torque case to center support bolt to 23 ft. lbs., using a 3/8" 12-point thin-wall deep socket.

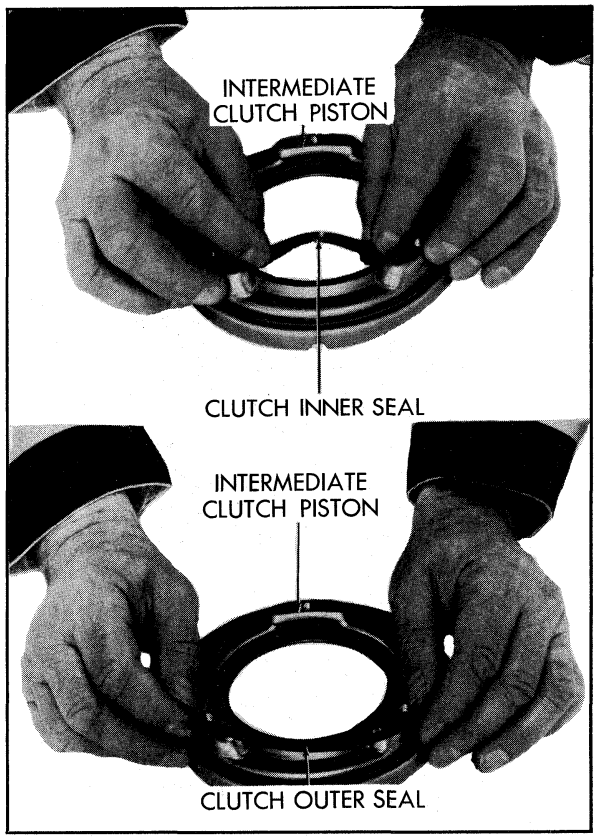


Fig. 7B-54 Installing Intermediate Clutch Piston Seals

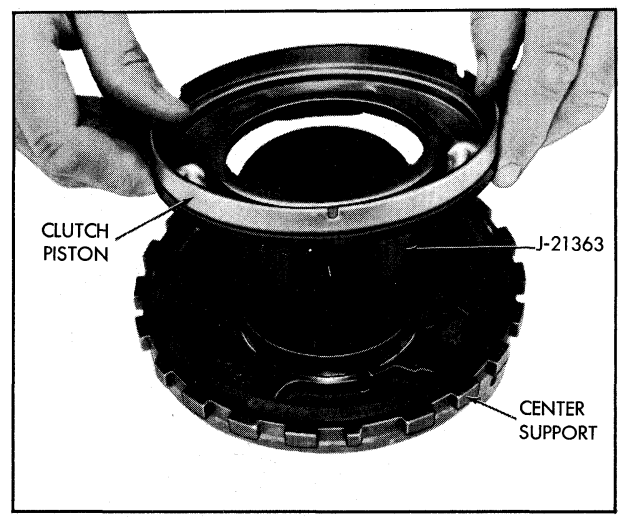


Fig. 7B-55 Installing Intermediate Clutch Piston

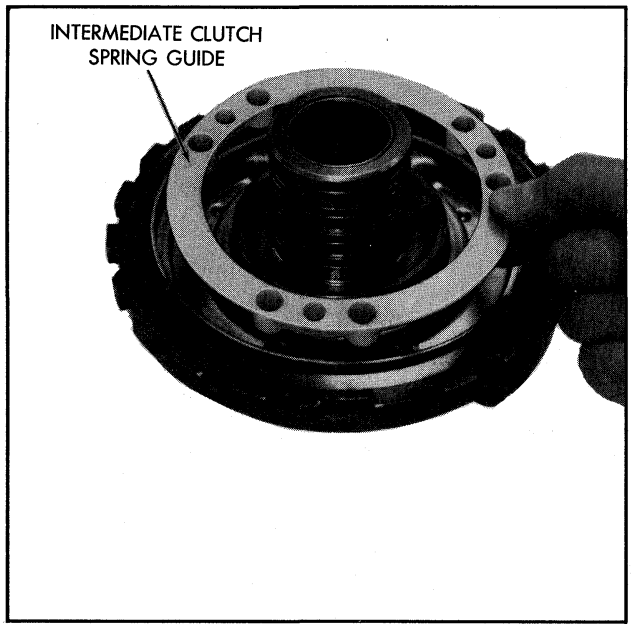


Fig. 7B-56 Installing Spring Guide

CAUTION: *When using the locating tool, care should be taken not to raise burrs on the case valve mounting face.*

10. Before installing intermediate clutch plates, inspect plates for signs of burning, scoring, and wear.

11. Lubricate three steel and three composition faced intermediate clutch plates with transmission fluid and install clutch plates in transmission case, Fig. 7B-63. **Start with steel plate and alternate composition faced and flat steel plates.**

12. Install intermediate clutch backing plate with flat machine surface against clutch plates.

13. Install backing plate to case snap ring with snap ring gap on side of case opposite front band anchor pin.

NOTE: Both sides of this snap ring are flat, and it is approximately .093" thick.

14. Recheck rear unit end play as described on page 7B-21.

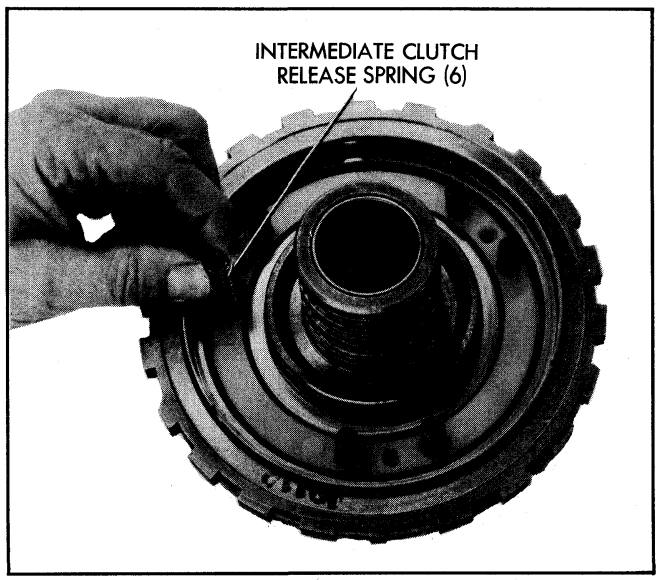


Fig. 7B-57 Installing Clutch Spring Release Springs

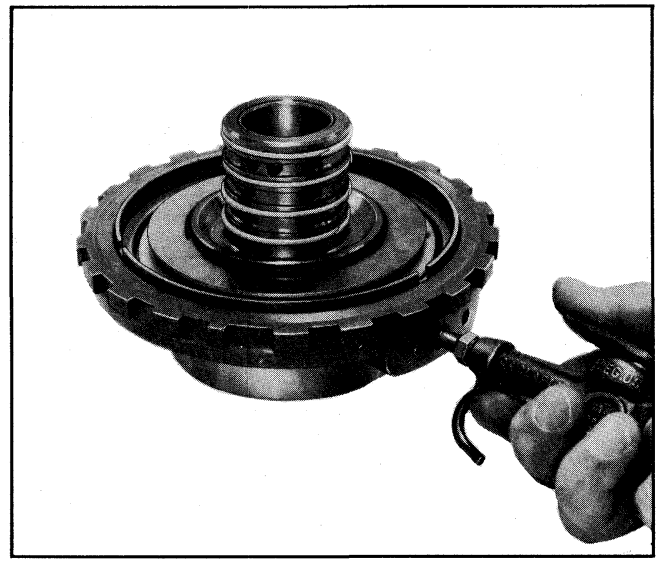


Fig. 7B-58 Air Checking Intermediate Clutch

Direct Clutch and Intermediate Sprag Assembly (Fig. 7B-64)

a. Disassembly

1. Remove sprag retainer snap ring, and remove clutch retainer.

2. Remove sprag outer race and bushings, and remove sprag assembly from outer race.

3. Turn unit over and remove direct clutch backing plate to clutch housing snap ring.

4. Remove direct clutch backing plate and five composition and four steel clutch plates, Fig. 7B-65.

5. Using Clutch Spring Compressor, J-4670-01, Rear Clutch Spring Compressor, J-6129, or an arbor press, and Adapter, J-21664, Fig. 7B-66 compress spring retainer and

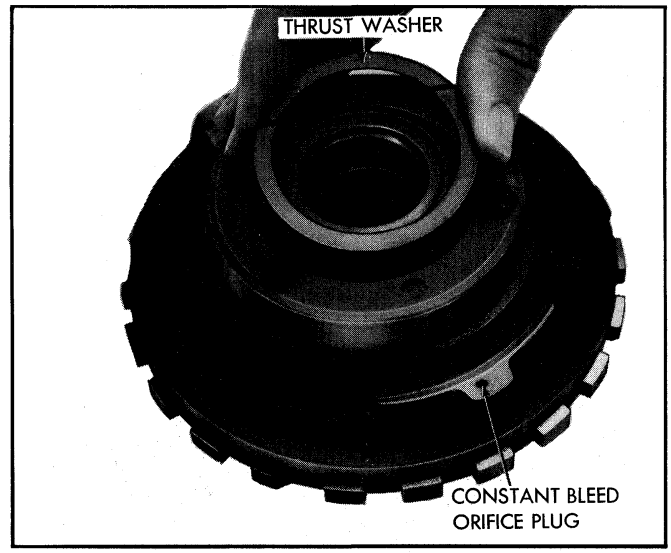


Fig. 7B-59 Installing Center Support-to-Reaction Carrier Thrust Washer

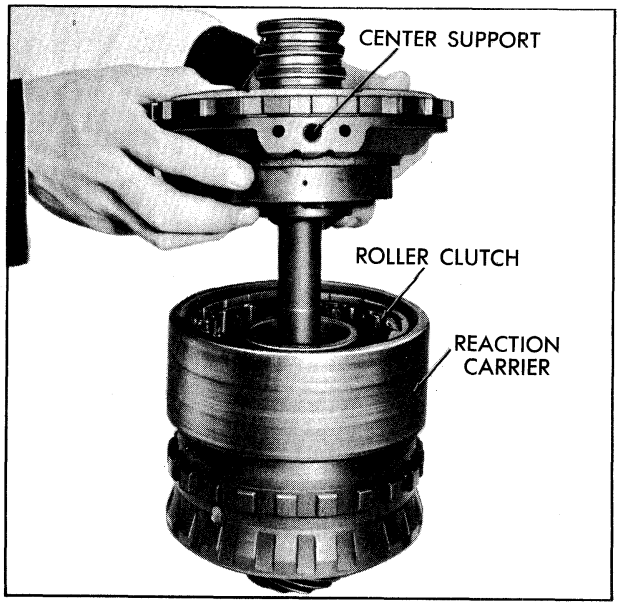


Fig. 7B-60 Installing Center Support to Reaction Carrier

remove snap ring with Snap Ring Pliers, J-8059 or J-5586.

6. Remove tools, spring retainers, and fourteen clutch release springs. Keep springs separate from forward clutch springs.

7. Remove direct clutch piston from direct clutch housing.

8. Remove inner and outer seals from clutch piston.

9. Remove center piston seal from direct clutch housing.

b. Inspection

1. Inspect sprag assembly for popped or loose sprags.
2. Inspect sprag bushing for wear or distortion.
3. Inspect inner and outer races for scratches or wear.
4. Inspect clutch housing for cracks, wear, proper openings of oil passages and wear on clutch plate lugs.
5. Inspect composition faced and steel clutch plates for sign of wear or burning.
6. Inspect backing plate for scratches or other damage.
7. Inspect piston for cracks and free operation of ball check.
8. Inspect springs for collapsed coils or signs of distortion.
9. Inspect housing for free operation of check ball, Fig. 7B-67.

NOTE: The 14 direct clutch release springs are not serviced individually. If one or more of these springs require replacement, discard all of them and install the 16 service direct clutch release springs.

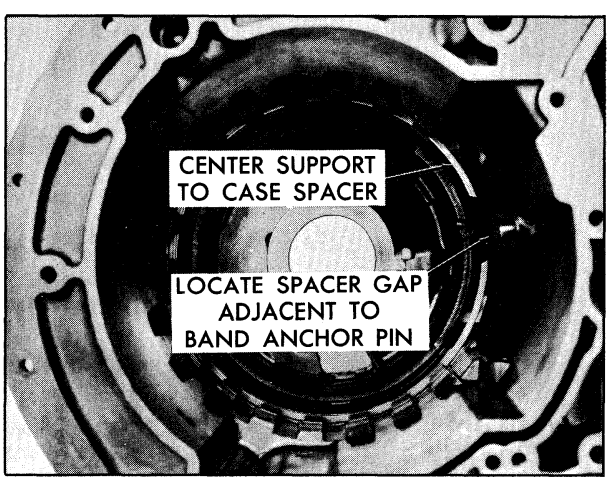


Fig. 7B-61 Installing Support-to-Case Spacer

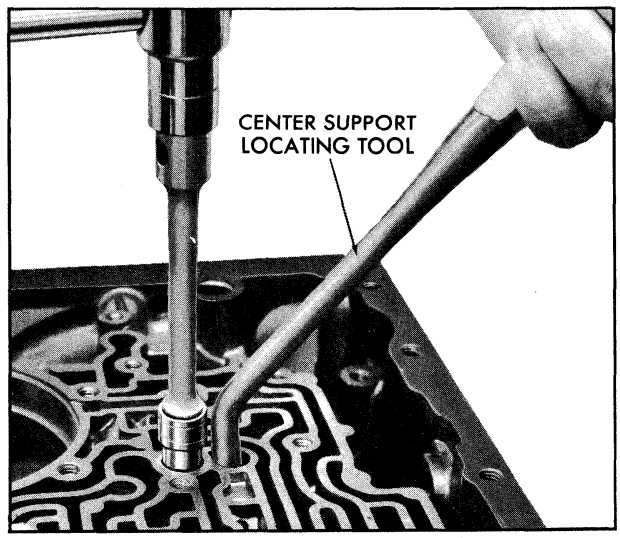


Fig. 7B-62 Locating Center Support

c. Assembly

1. Lubricate new inner and outer clutch piston seals with transmission fluid. Lubricate seal grooves in direct clutch piston and install seals with lips facing away from spring pockets.

2. Lubricate new center seal with transmission fluid. Lubricate seal groove in direct clutch housing and install seal in clutch housing with lip facing up.

3. Place Forward and Direct Clutch Inner Seal Protector, J-21362, over direct clutch hub. Install clutch piston inside Forward and Direct Clutch Piston Installer, J-21409, insert assembly in direct clutch housing Fig. 7B-68 and install clutch piston by rotating it slightly, in a clockwise direction.

4. Install 14 clutch release springs into spring pockets in clutch piston (16 if service springs).

5. Place spring retainer and snap ring over springs.

6. Using Clutch Spring Compressor, J-4670-01, Rear Clutch Spring Compressor, J-6129, or an arbor press, and Adapter, J-21664, Fig. 7B-66, compress spring retainer, being careful that retainer does not get caught in snap ring groove, and install snap ring with Snap Ring Pliers, J-8059 or J-5586. Remove tools.

NOTE: Make certain clutch release springs are not leaning. If necessary, straighten springs with a small screwdriver.

7. Lubricate the five flat and five composition faced

Model AJ-AK Clutch Parts (Eldorado)

Clutch	No. of Flat Steel Clutch Plates	No. of Waved Steel Clutch Plates
Forward Clutch	5	*1
Direct Clutch	4	1
Intermediate Clutch	3	—

*Clutch Plate Dished

Clutch	No. of Clutch Composition Plates	No. of Piston Release Springs
Forward Clutch	5	16
Direct Clutch	5	14
Intermediate Clutch	3	6

clutch plates with transmission fluid and install clutch plates in direct clutch housing. Alternate composition and flat steel clutch plates. Fig. 7B-69.

8. Install direct clutch backing plate over clutch plates and install backing plate snap ring.

9. Invert clutch housing and install one sprag bushing, cup side up, around sprag inner race.

10. Install sprag assembly into clutch outer race.

11. With ridge on inner cage of sprag facing up install sprag and outer race on inner race with counterclockwise turning motion.

NOTE: When installed, outer race should turn only counterclockwise, Fig. 7B-70.

12. Install sprag bushing, cup side down, over sprag assembly.

13. Install sprag retainer and snap ring.

d. Install Front Band and Direct Clutch Assembly

1. Inspect front band for cracks or distortion and band ends for damage at anchor lug and apply lug. Also inspect lining for cracks, flaking, burning, and looseness.

2. Install front band with band anchor hole over band anchor pin, and apply lug facing servo hole, Fig. 7B-71.

3. Install direct clutch housing and intermediate sprag assembly. Make certain that clutch housing hub bottoms on sun gear shaft and splines on forward end of sun gear shaft are flush with splines in direct clutch housing.

NOTE: It will be necessary to rotate clutch housing to allow sprag outer race to index with intermediate composition clutch plates. Removal of direct clutch composition-faced and steel plates may be helpful, and applying air pressure through the center support screw to apply the intermediate clutch plates may facilitate assembly.

4. Check operation of direct clutch by applying air pressure through direct clutch passage next to center support bolt, Fig. 7A-74.

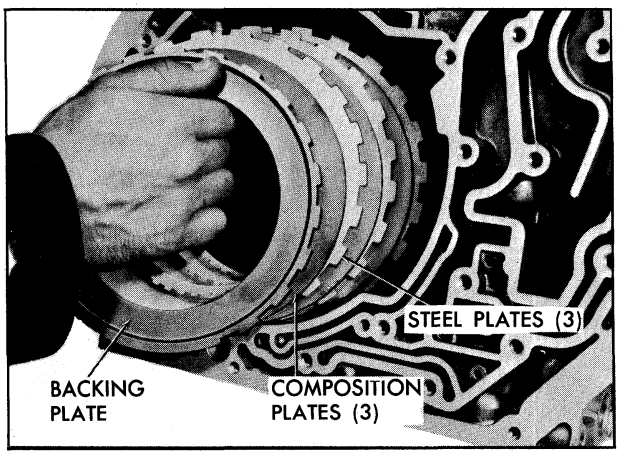


Fig. 7B-63 Installing Intermediate Clutch Plates

Forward Clutch Assembly

a. Disassembly (Fig. 7B-72)

1. Remove forward clutch housing to direct clutch hub snap ring.

2. Remove direct clutch hub.

3. Remove forward clutch hub and one thrust washer from inner side of hub.

4. Remove five composition and five flat and one dished steel clutch plates.

5. Using Clutch Spring Compressor, J-4670, and Adapter, J-21664, compress spring retainer with arbor press and remove snap ring using Snap Ring Pliers, J-8059 or J-5586, Fig. 7B-73.

6. Remove tools, spring retainer and 16 clutch release springs. Keep springs separate from direct clutch springs.

7. Remove forward clutch piston from forward clutch housing.

8. Remove inner and outer seals from clutch piston.

9. Remove center piston seal from forward clutch housing.

b. Inspection

1. Inspect composition-faced and steel clutch plates for signs of burning, scoring or wear.

2. Inspect sixteen release springs for collapsed coils or signs of distortion.

3. Inspect clutch hubs for worn splines, proper lubrication holes, and thrust faces.

4. Inspect piston for cracks.

5. Inspect clutch housing for wear, scoring, cracks and open oil passages, also check for free operation of check ball.

c. Assembly (Fig. 7B-73)

1. Lubricate new inner and outer clutch piston seals with transmission fluid. Lubricate seal grooves in forward clutch piston with petrolatum and install seals with lips facing away from spring pockets.

2. Lubricate new center piston seal with transmission fluid. Lubricate seal groove in forward clutch housing with petrolatum and install seal into clutch housing with lip facing up.

3. Place forward and Direct Clutch Inner Seal Protector, J-21362, over forward clutch hub. Install clutch piston inside Forward and Direct Clutch Piston Installer, J-21409, insert assembly in forward clutch housing, Fig. 7B-74 and install clutch piston by rotating it slightly in a clockwise direction until seated, Fig. 7B-75.

4. Install sixteen clutch release springs into spring

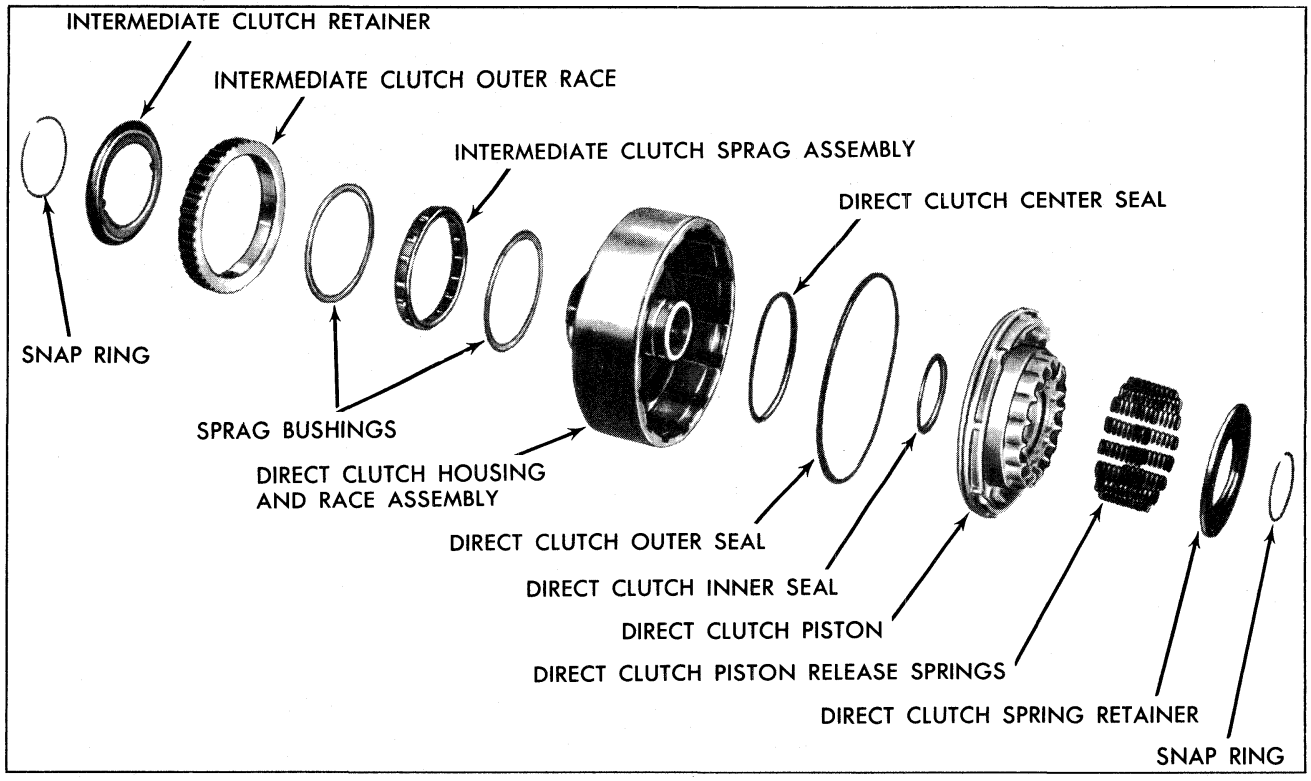


Fig. 7B-64 Direct Clutch and Piston - Disassembled View

pockets in clutch piston.

5. Using Clutch Spring Compressor, J-4670, and Adapter, J-21664, compress spring retainer with arbor press, being careful that retainer does not catch in snap ring groove, and install snap ring using Snap Ring Pliers, J-8059 or J-5586, Fig. 7B-73 and remove tools.

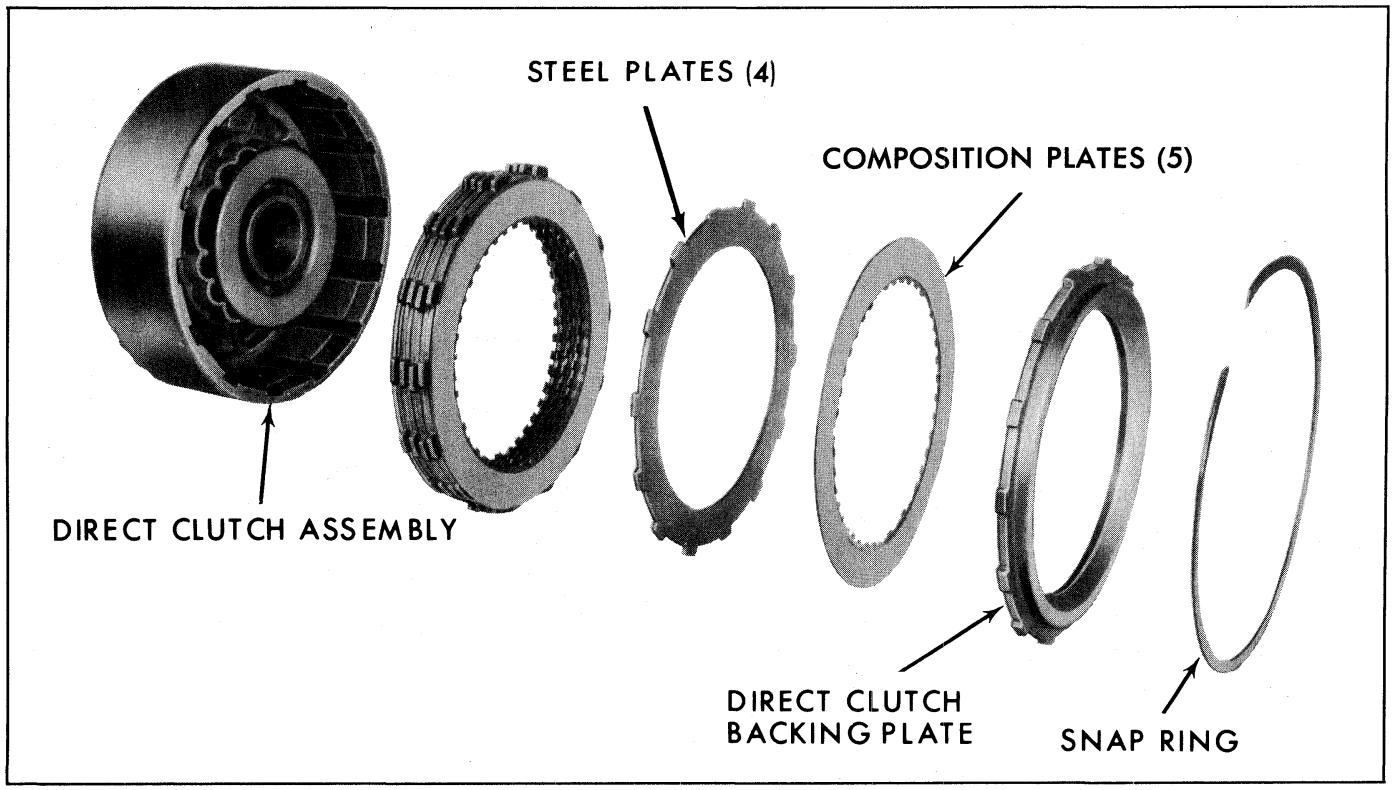


Fig. 7B-65 Direct Clutch - Disassembled View - Eldorado

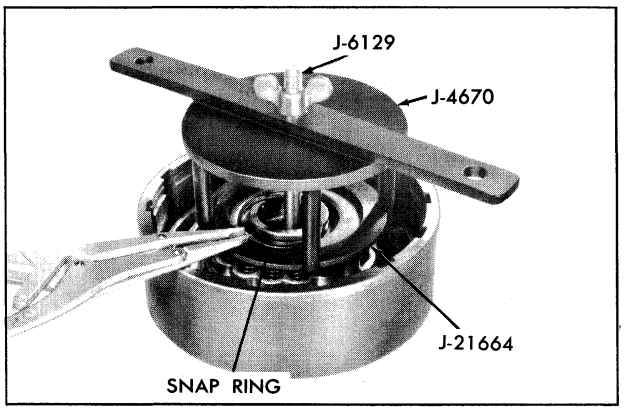


Fig. 7B-66 Removing Direct Clutch Snap Ring

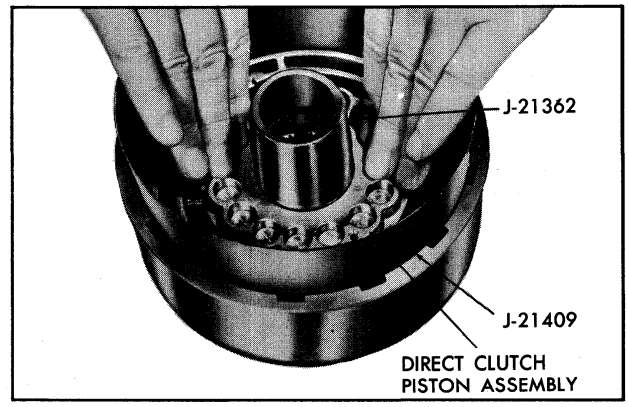


Fig. 7B-68 Installing Direct Clutch Piston

CAUTION: *Make certain clutch release springs are not leaning. If necessary, straighten with a small screwdriver.*

6. Remove forward clutch assembly from arbor press and place on work bench.

7. Install the forward clutch hub thrust washers on the forward clutch hub making sure bronze washer is installed on side of hub facing forward clutch housing. Retain with petrolatum.

8. Install forward clutch hub in forward clutch housing.

9. Lubricate the dished and five flat steel and five composition clutch plates with transmission fluid and install clutch plates in forward clutch housing. Start with dished steel plate (O.D. up) and place a flat steel plate on top of the dished steel plate. Then alternate composition faced and flat steel clutch plates.

10. Install direct clutch hub in forward clutch housing over clutch plates, and install snap ring.

11. Air check forward clutch and piston operation, Fig. 7B-76.

d. Install Forward Clutch

1. Install Front Unit End Play Checking Tool, J-22241 into forward clutch, Fig. 7B-28.

2. Install forward clutch assembly into transmission, making certain main shaft goes into forward clutch hub. It will be necessary to rotate clutch housing to allow direct clutch driving hub to index with direct clutch composition-faced plates.

3. Remove Front Unit End Play Checking Tool, J-22241.

Install Pump Cover Plate

1. Install new pump cover plate gasket on transmission.

2. Install pump cover plate on transmission and install attaching bolts per bolt chart, Fig. 7B-77.

NOTE: Do not install pump attaching bolts (F) or single bolt (E) in pump cover plate at this time.

3. Using the driven sprocket as a driver rotate the forward clutch.

NOTE: If the forward clutch housing cannot be rotated as the pump cover plate is being pulled into place, the forward or direct clutch housings have not been properly installed to index with all the clutch plates. This condition must be corrected before the pump cover plate is pulled fully into place.

4. Torque all bolts to 20 foot-pounds.

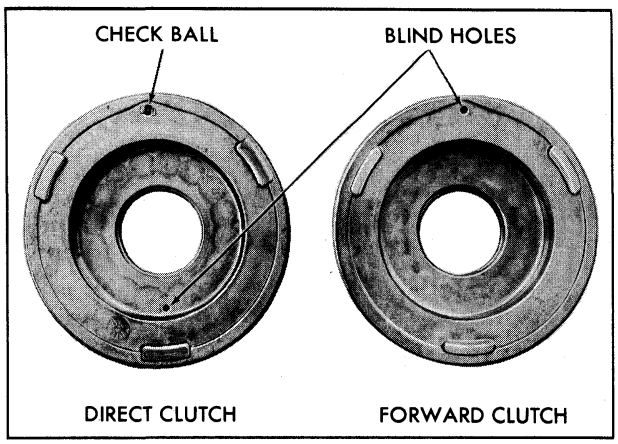


Fig. 7B-67 Direct Clutch Identification

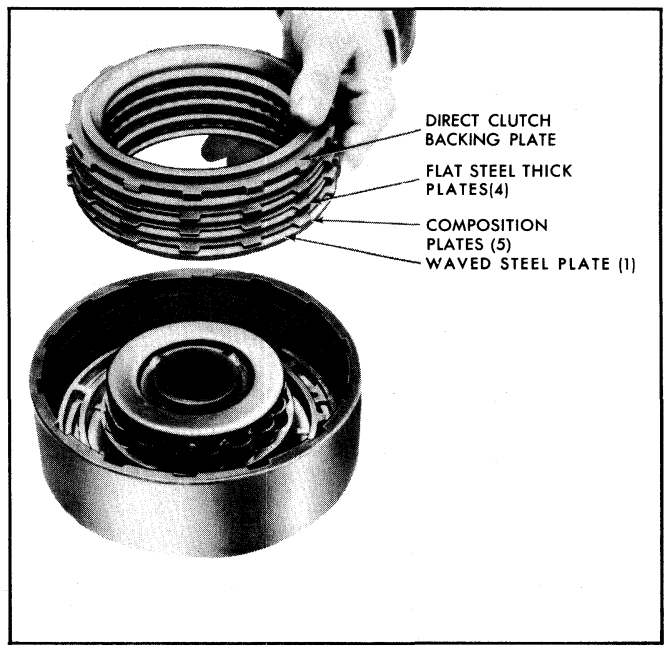


Fig. 7B-69 Installing Direct Clutch Plates

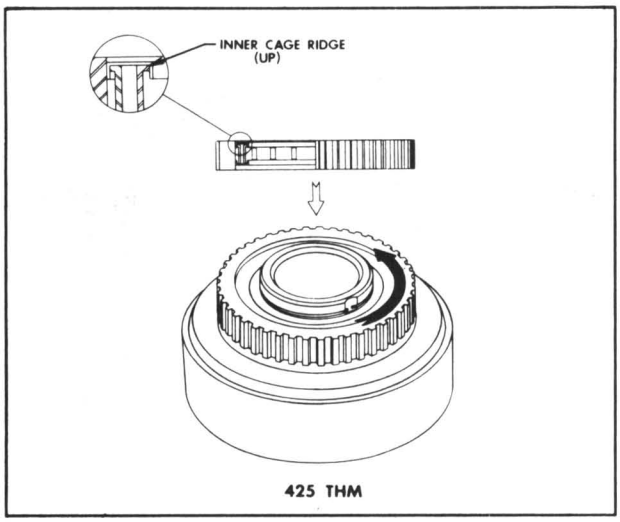


Fig. 7B-70 Sprag Rotation

5. Repeat front unit end play check as described on page 7B-19.

6. Install remaining bolt (E) in driven support housing, tightening to 20 foot-pounds.

Oil Pump

a. Disassembly

1. Mark drive and driven gears for reassembly in same position and remove the pump body.

NOTE: Installing the gears in the same position as removed will assure the quietest operation, as the gear teeth will mesh in the established wear pattern.

2. Remove drive and driven gears from pump body.

3. Remove and discard pump body to case square-cut O-ring seal.

b. Inspection

1. Using tip of finger, inspect gear pocket and crescent for nicks, burrs, scoring or galling.

2. Inspect drive gear for nicks, burrs, scoring, or galling.

3. Inspect driven gear for nicks, burrs, scoring, or galling.

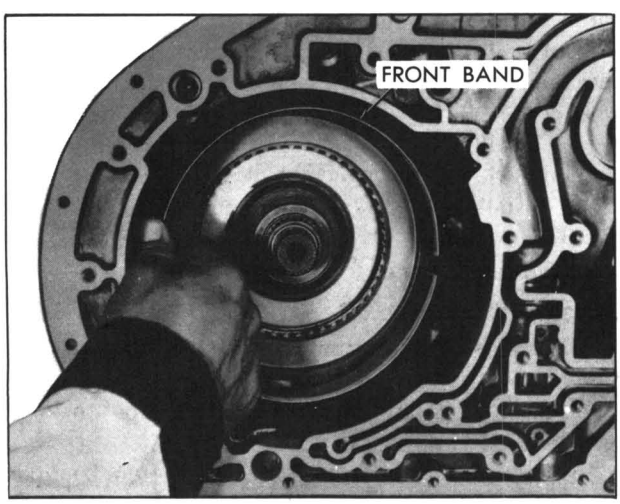


Fig. 7B-71 Installing Front Band

4. Place pump gears in pump body and check pump body face to gear face clearance. Clearance should be .0013"-.0035".

5. Check face of pump body for nicks, burrs, scoring, or galling.

6. Check pump body face flatness. Overall flatness should be .000" to .002".

7. Inspect bushing for nicks, burrs, scoring, galling, out-of-round, or excessive wear.

NOTE: To check for out-of-round, install pump body on the converter hub and look for eccentricity between pump bushing and converter hub.

8. Check for damaged pump cover plate bolt holes.

9. Inspect front seal for damage. If replacement of front seal is necessary, use a standard 3/4" cold chisel and pry front seal pump body, Fig. 7B-78.

c. Assembly

1. If necessary, install a new front seal, using Pump Oil Sel Installer, J-21359, to drive seal into place. Use a non-hardening sealer on outside of seal before installing into pump, Fig. 7B-79

2. Install new pump to case square-cut O-ring seal, Fig. 7B-80.

3. Install driven gear into pump body with alignment mark up.

4. Install drive gear into pump body with drive tangs up, Fig. 7B-81.

NOTE: Drive gear should always be installed with counterbore down.

d. Installation

1. Rotate transmission in holding fixture base so that cored oil passages are up.

2. Install pump assembly over stator shaft and position to drive support housing, rotating pump as necessary to align holes in pump cover plate with pump attaching bolt holes.

3. Install six retaining bolts (F), finger tight, Fig. 7B-77.

4. Rotate transmission in holding fixture base so that pump cover plate is up.

5. Tighten pump attaching bolts to 20 ft.lbs.

Install Sprockets, Link Assembly and Sprocket Cover

1. Rotate transmission in holding fixture base so that cored oil passages are up.

2. Position drive and driven sprockets on work-bench with shafts up, and drive sprocket closest to transmission.

3. Install link assembly over drive and driven sprockets with colored guide link, which has etched numerals, down.

4. Lift sprockets and link assembly and rotate assemblies 90° so that drive sprocket is up.

5. Allowing driven sprocket to hang down freely, start turbine shaft onto pump support housing until it will support weight of assembly.

6. Start input shaft into driven support housing, and alternately push shafts inward until sprockets are installed.

7. Rotate transmission in holding fixture base so that sprockets are up.

8. Using a plastic mallet, gently tap sprockets to seat sprocket bearing assemblies into support housing.

9. Install Snap Ring Pliers, J-4646, into sprocket bearing retainer snap rings, located under the drive and driven sprockets, and install snap rings into retaining grooves on support housings, Fig. 7B-82.

10. Install new sprocket cover to case gasket on

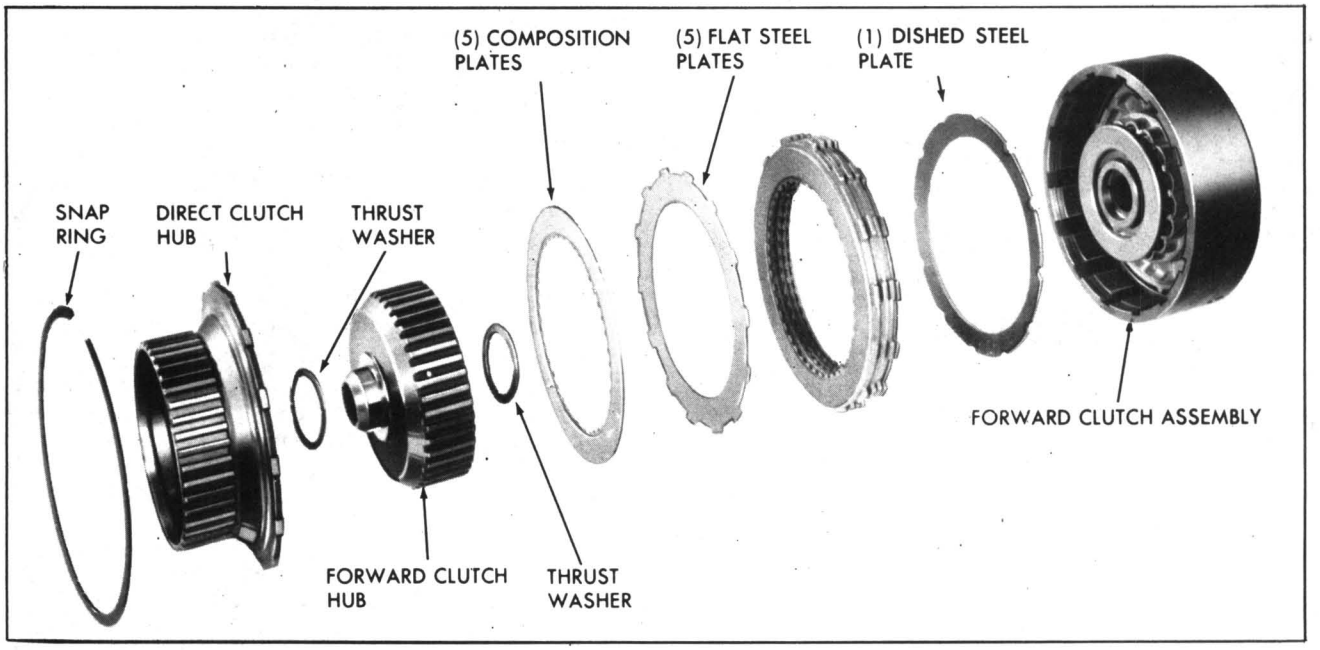


Fig. 7B-72 Forward Clutch Assembly - Disassembled View

transmission case.

11. Position sprocket cover to transmission case and install 18 attaching bolts, tightening bolts to 8 ft.lbs.

NOTE: One sprocket cover attaching bolt is 1/4 inch longer. This bolt must be installed in the tapped hole directly over the cooler fittings on the transmission case.

Detent Lever, Manual Shaft, Parking Linkage, Rear Servo, Front Servo, Check Balls, and Control Valve Spacer

a. Inspect Detent Lever, Manual Shaft, and Parking Linkage

1. Inspect parking actuator rod for cracks, or broken spring retainer lugs.
2. Inspect actuator spring for damage.
3. Inspect actuator for a free fit on actuator rod.

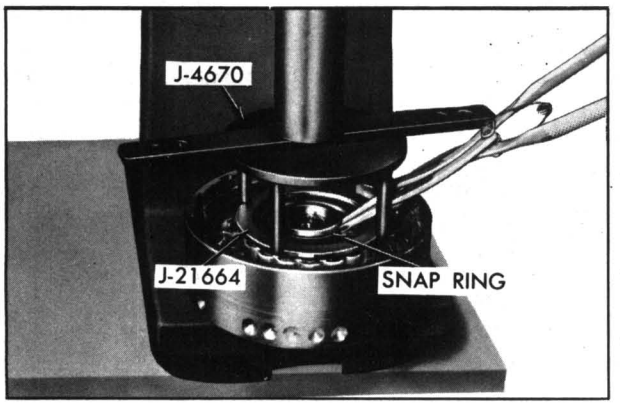


Fig. 7B-73 Installing Forward Clutch Snap Ring

4. Inspect parking pawl for cracks or wear.
5. Inspect manual shaft for damaged threads.
6. Inspect inside detent lever for cracks or a loose pin.
7. Inspect parking pawl return spring for deformed coils or ends.
8. Inspect parking bracket for cracks or wear.
9. Inspect detent spring and roller assembly.

b. Install Detent Lever, Manual Shaft and Parking Linkage

1. Install parking pawl (tooth toward inside of case), pawl return spring and parking pawl shaft into case, Fig. 7B-83.
2. Install parking pawl shaft retaining pin into case hole.
3. Install parking bracket into case, tightening attaching screws to 18 ft.lbs.
4. Install a new manual shaft O-ring seal on manual shaft.
5. Install the actuator rod plunger under the parking bracket and over the parking pawl and through hole in detent lever. Position detent lever in transmission case.
6. Install the manual shaft assembly through the retaining lock nut on manual shaft, Fig. 7B-84.
7. Install manual shaft retaining pin into case, long smooth end first.
8. Torque lock nut to 18 ft.lbs.

c. Disassemble Rear Servo Assembly (Fig. 7B-85)

1. Remove rear accumulator piston from rear servo piston.
2. Remove E-ring retaining rear servo piston to band apply pin.
3. Remove rear servo piston and seal from band apply pin.
4. Remove washer, spring and retainer.

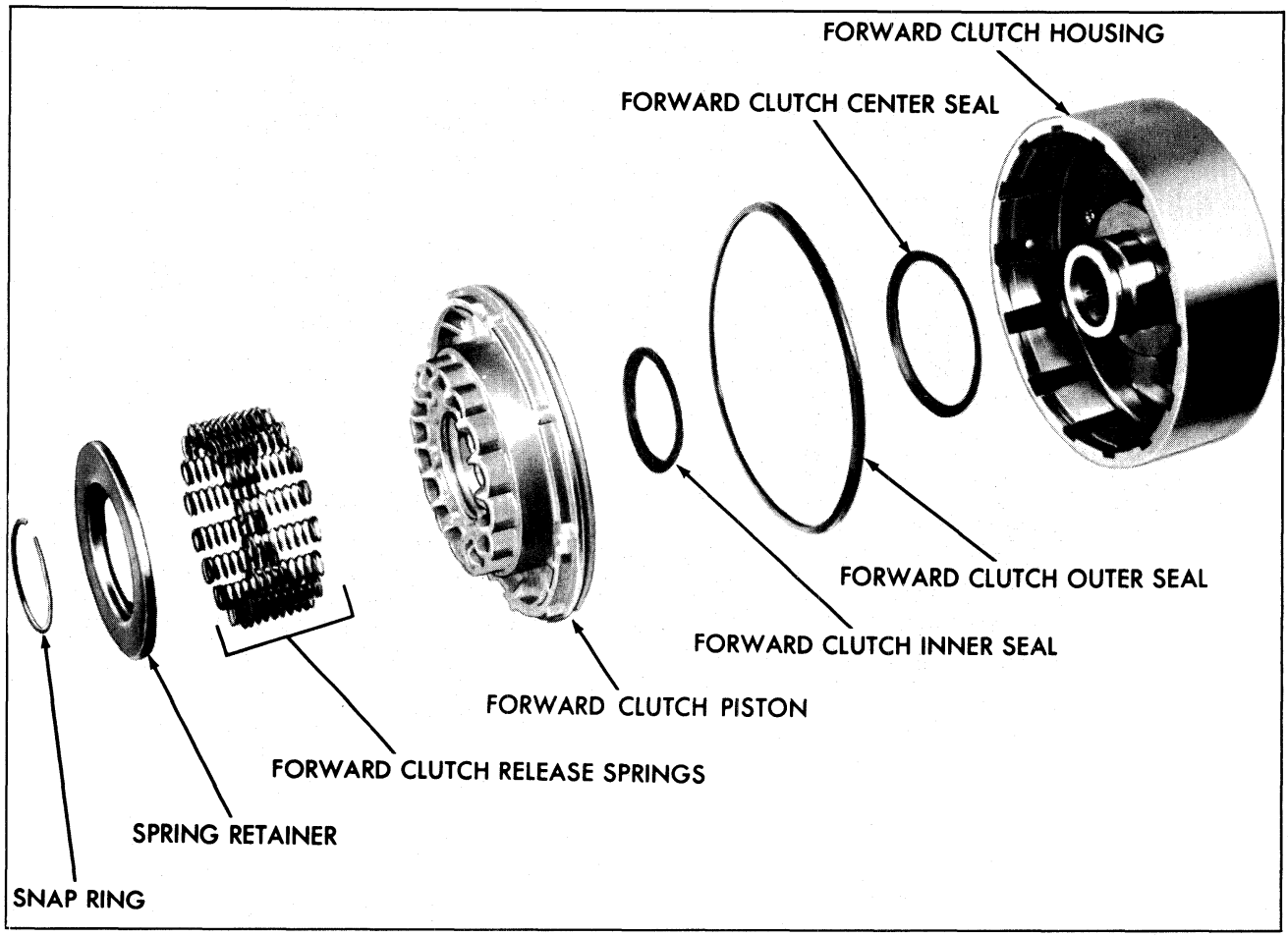


Fig. 7B-74 Forward Clutch - Disassembled View

d. Inspect Rear Servo

1. Check freeness of oil seal rings in accumulator piston grooves.

NOTE: See Fig. 7B-85. Do not remove the oil seal rings from the rear accumulator piston, unless the oil seal rings require replacement.

If the teflon inner oil seal ring, (small diameter) requires replacement, for service, use the aluminum oil seal ring.

The rear accumulator piston, large diameter ring groove depth, is machined shallower to take the large teflon oil seal ring; if this requires replacement, use **only** the teflon oil seal ring.

2. Inspect fit of band apply pin in servo piston.

3. Inspect band apply pin for scores or cracks.

4. Inspect band apply pin for proper size as determined by pin selection check on page 7B-15.

e. Assemble Rear Servo

1. Install spring retainer, cup side first, servo pin spring and washer on servo pin.

2. Install servo piston on pin and secure with E-ring retainer.

3. If removed, install oil seal ring on servo piston.

4. If removed, install inner and outer oil rings on accumulator piston.

5. Install accumulator piston into bore of servo piston.

f. Install Rear Servo

NOTE: If transmission is in the vehicle, a sheet metal bracket will be required to hold the rear servo assembly, front servo assembly, check balls, valve body to spacer plate gasket and valve body spacer plate, until the control valve assembly is installed. See Fig. 7B-93.

1. Lubricate inner and outer rear servo bores in transmission case with transmission fluid and install rear accumulator spring in servo inner bore.

NOTE: Before installing rear servo assembly, make certain that rear band apply lug is aligned with servo pin bore in transmission case. Otherwise servo pin will not apply band.

2. Position rear servo assembly in transmission case bore.

3. Press down on rear servo assembly, making certain oil seal ring is properly seated in case bore.

g. Inspect Front Servo

NOTE: See Fig. 7B-86. Do not remove the oil seal ring from the front servo piston unless the oil seal ring requires replacement. For service, the oil seal ring will be aluminum.

CAUTION: *The spring retainer, servo pin, retaining ring and servo piston for 1971 thru 1975 are not interchangeable with the pre-1971 parts.*

1. Inspect servo pin for damage.

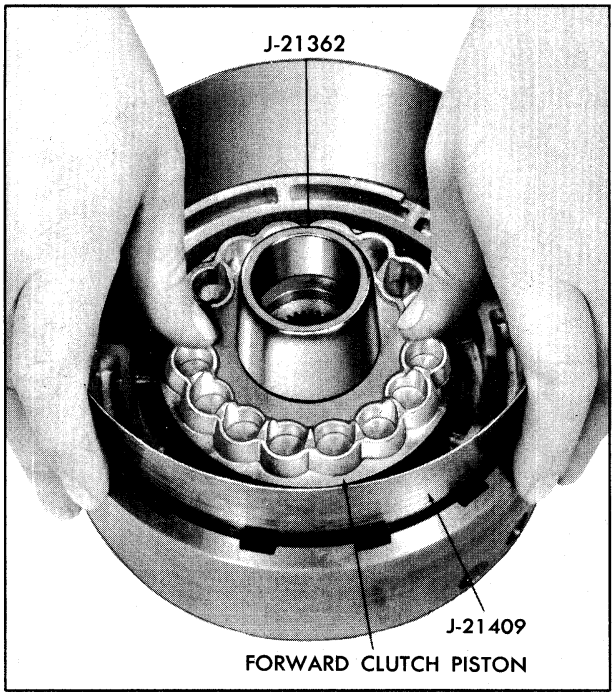


Fig. 7B-75 Installing Forward Clutch Piston

2. Inspect piston oil ring for damage.
3. Inspect piston for cracks or porosity.
4. Check fit of servo pin in piston and case.

h. Install Front Servo Assembly

Reassemble parts of front servo, Fig. 7B-86, making sure tapered end of servo pin is pointed through the spring and spring retainer, and install in bore in case. Make sure the retainer ring is installed in the servo pin groove.

NOTE: The teflon ring allows the front servo piston to slide very freely in the case. The free fit of the ring in the bore is a normal characteristic and does not indicate leakage during operation. The teflon ring should only be replaced if it shows damage or if evidence of leaking during operation exists.

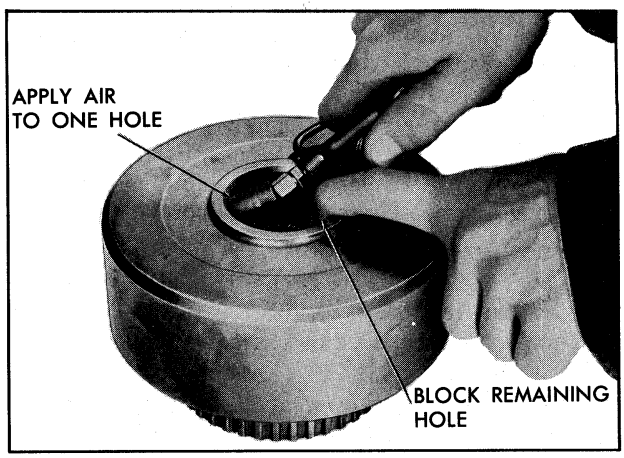


Fig. 7B-76 Air Checking Forward Clutch

i. Install Check Balls and Control Valve Spacer

1. Install seven check balls in cored passages, Fig. 7B-87.

NOTE: If transmission is in vehicle, place check balls into ball seat pockets on spacer plate.

2. Install valve body spacer to case gasket on transmission case.
3. Install valve body spacer on transmission.

NOTE: Valve body spacer to case gasket should extend approximately 1/8 inch beyond the spacer plate, at the void case channel, Fig. 7B-88. If service gaskets are being installed, the valve body spacer to case gasket has an extension which will cover the void case channel.

4. Install valve body to spacer gasket.
5. Install guide pins.

Control Valve Assembly (Fig. 7B-89)

a. Disassembly

When disassembling control valve, make certain that springs are accurately identified so that they can be properly reassembled.

1. Position control valve assembly with gasket surface down.
2. Remove two screws securing detent solenoid to control valve body and remove detent solenoid and gasket.
3. Position control valve assembly with gasket surface up and accumulator pocket on bottom.
4. Remove manual valve from upper bore.
5. Install Control Valve Accumulator Piston Installer, J-21885 or J-22269-01, on accumulator piston, compress piston and remove E-ring retainer, Fig. 7B-90.
6. Remove Installer, J-21885 or J-22269-01, and remove accumulator piston and spring.
7. Using pin punch, remove retaining pin from lower left bore, pressing on pin from outer side of valve body. Remove 2-3 modulator bushing, 2-3 shift valve spring, 2-3 modulator valve, 3-2 intermediate spring and 2-3 shift valve from lower left bore.

NOTE: 2-3 modulator valve will be inside of 2-3 modulator bushing.

8. Using pin punch, remove retaining pin from lower center left bore, pressing on pin from outer side of valve body. Remove 1-2 modulator bushing, 1-2 regulator valve and spring, 1-2 detent valve and 1-2 shift valve from lower left center bore.
9. Using pin punch, remove retainer pin from upper left center bore by pressing on outer side of valve body.

WARNING: HOLD HAND OVER BORE WHEN REMOVING RETAINER PIN AS DETENT REGULATOR VALVE SPRING MAY FORCE OTHER COMPONENTS OUT OF BORE.

10. Remove bore plug, detent valve, detent regulator valve, spacer and detent regulator valve spring from upper left center bore.
11. Remove retaining pin from bottom bore on left side by prying out with a pair of long nose pliers.

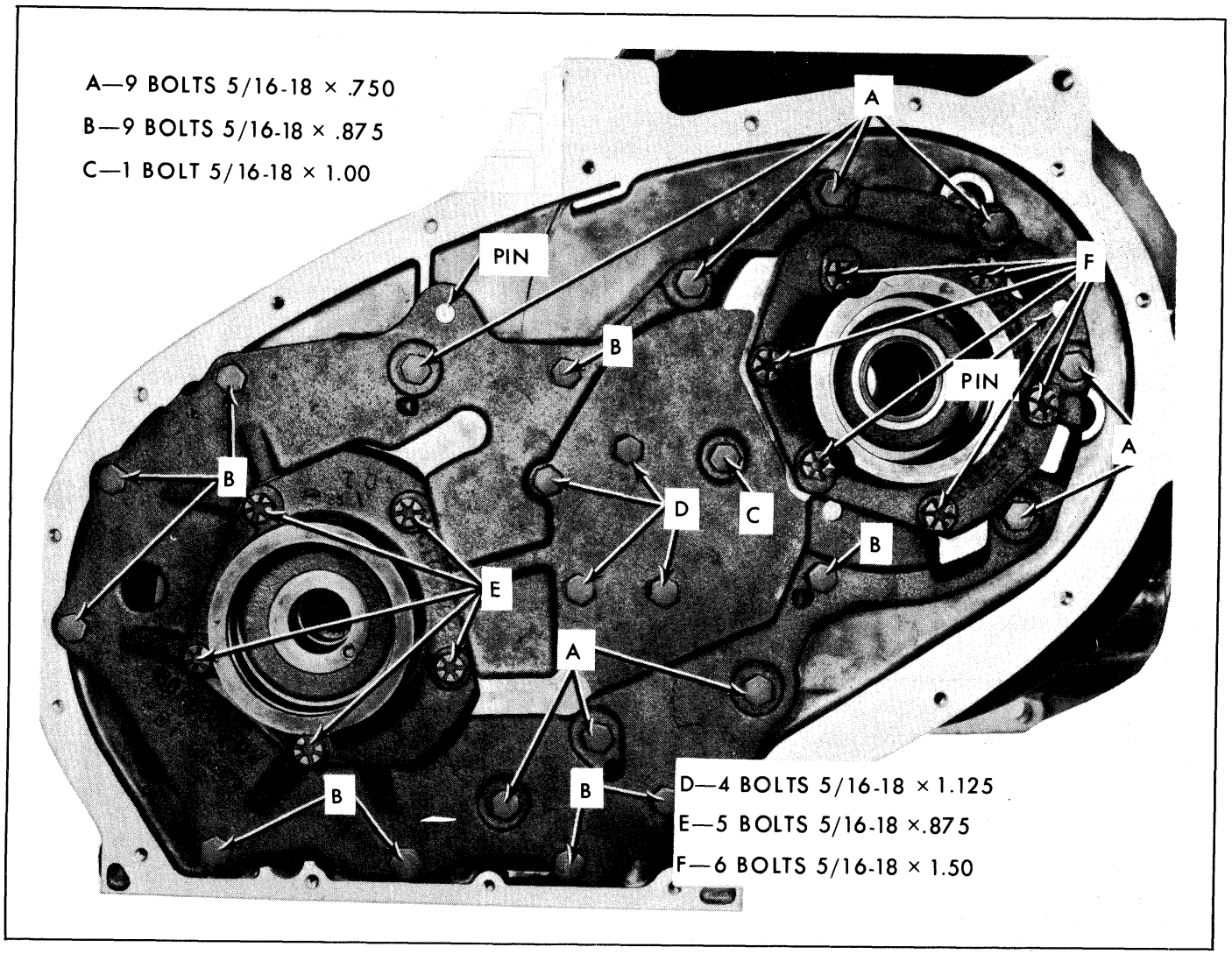


Fig. 7B-77 Pump Cover Plate Screws

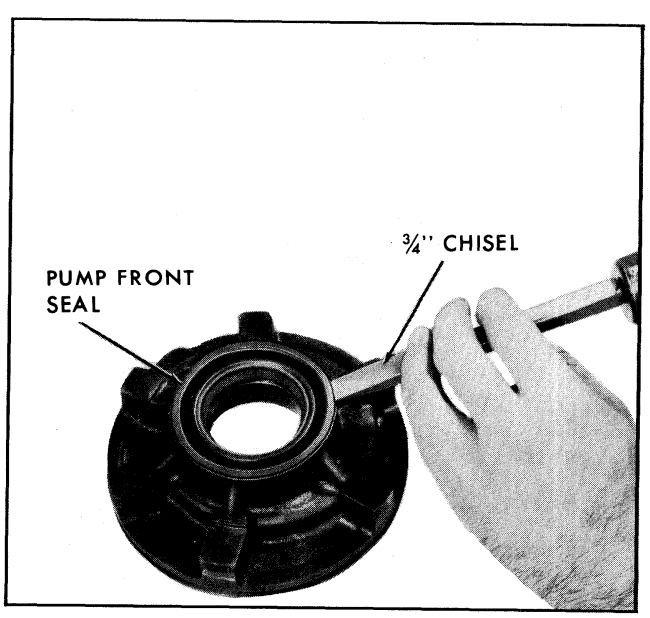


Fig. 7B-78 Removing Pump Front Seal

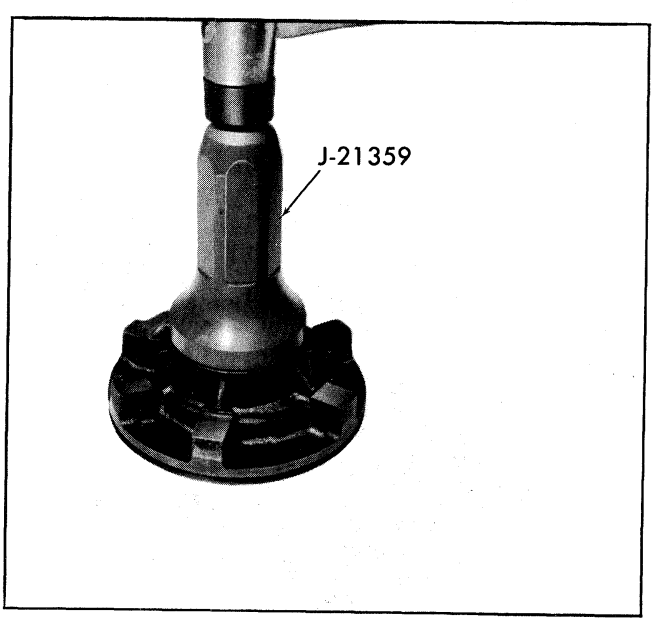


Fig. 7B-79 Installing Pump Front Seal

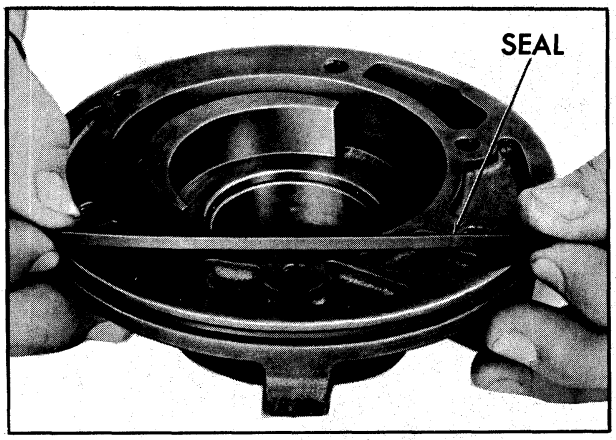


Fig. 7B-80 Installing Pump-to-Case Seal

WARNING: HOLD HAND OVER BORE WHEN REMOVING RETAINER PIN AS 3-2 VALVE SPRING MAY FORCE BORE PLUG OUT.

12. Remove bore plug, 3-2 valve, spring and spacer from bottom left bore.

13. Remove retaining pin from top bore by prying out with long nose pliers from outer side of valve body.

WARNING: HOLD HAND OVER BORE WHEN REMOVING RETAINER PIN AS ACCUMULATOR SPRINGS MAY FORCE OTHER COMPONENTS OUT OF BORE.

14. Remove bore plug, 1-2 accumulator valve and 1-2 accumulator primary spring.

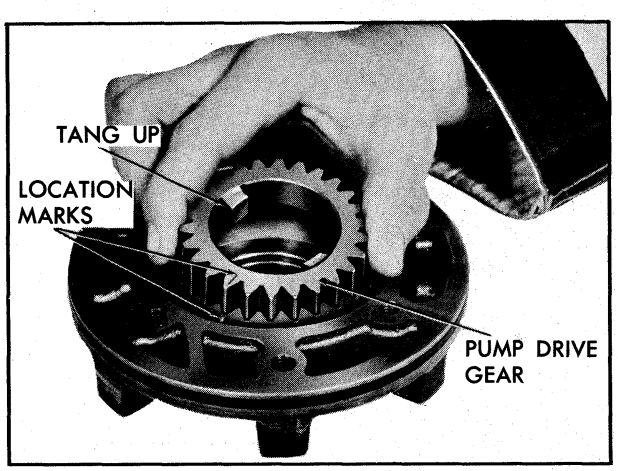


Fig. 7B-81 Installing Pump Drive Gear

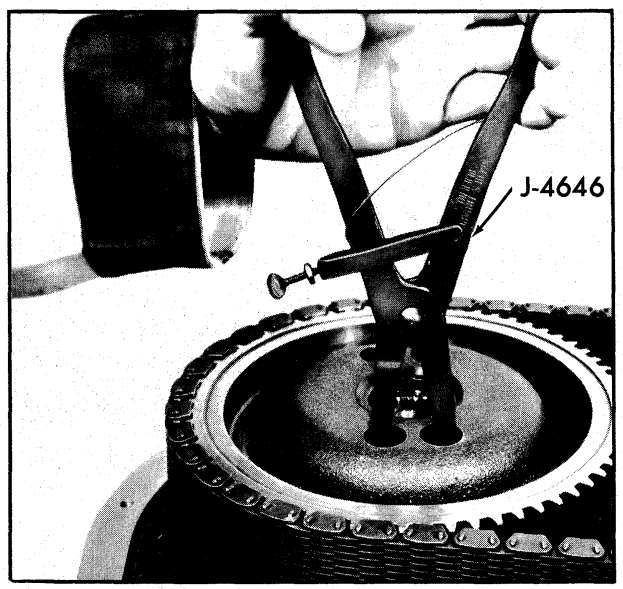


Fig. 7B-82 Installing Sprocket Snap Ring

b. Inspection

NOTE: See Fig. 7B-86. Do not remove the oil seal ring from the front accumulator piston unless the oil seal ring requires replacement. For service, the oil seal ring will be aluminum.

CAUTION: *The front accumulator piston for 1971 thru 1975 transmissions is not interchangeable with the pre-1971 parts.*

1. Wash control valve body, valves, and other parts in clean solvent.

CAUTION: *Do not allow valves to bump together, as this might cause nicks and burrs.*

2. Inspect all valves and bushings carefully to make sure that they are free from dirt and are not damaged in any respect. If burrs are present, they should be removed with a fine stone or fine grade of crocus cloth and light oil. Be careful not to round off shoulders of valves.

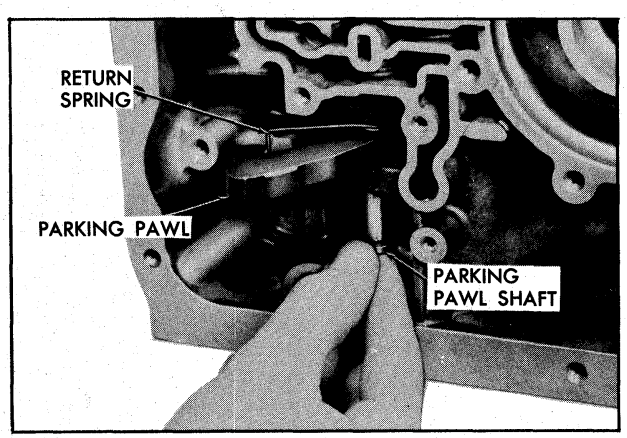


Fig. 7B-83 Installing Parking Pawl

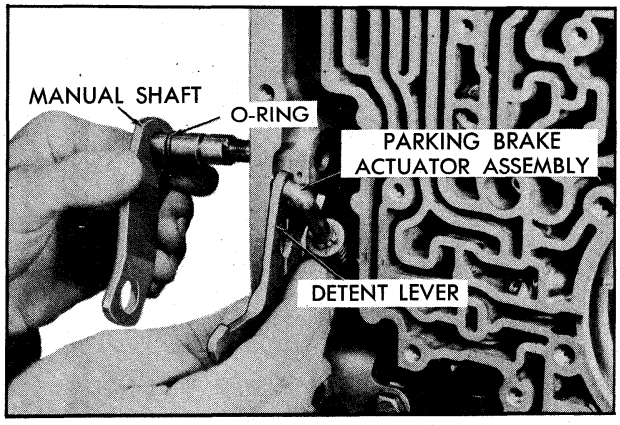


Fig. 7B-84 Installing Manual Shaft

3. All valves and bushings should be tested in their individual bores to make certain that free movement can be obtained. All valves should fall freely of their own weight with a slight tapping action on the body. In checking be careful to prevent valve damage in any way.

4. The manual valve is the only valve that can be serviced separately. If other valves are damaged beyond repair, a new control valve assembly should be installed.

5. Inspect body for cracks or scored bores.

6. Check all springs for distortion or collapsed coils.

7. Inspect piston and oil ring for damage.

c. Assembly (Fig. 7B-89)

1. Position control valve body with gasket surface up and accumulator pocket on bottom.

2. Install the 1-2 primary accumulator spring into top bore.

3. Install the 1-2 accumulator valve, stem end out into top bore.

4. Install the 1-2 bore plug into top bore.

5. Install grooved retaining pin, grooved end entering hole last from outer side of valve body, pressing pin flush with valve body.

6. Insert spacer inside of 3-2 valve spring and install spring and spacer in bottom left bore.

7. Install 3-2 valve in bottom left bore.

8. Compressing 3-2 valve spring, install bore plug, hole end out, and secure with grooved retaining pin from cored side of valve body.

9. Insert spacer inside of detent regulator valve spring and install spring and spacer into upper left center bore, making certain spring seats in bottom of bore.

10. Compress detent regulator valve spring and hold with a small screwdriver placed between end of spring and wall on cored side of valve body.

11. Install detent regulator valve, stem end out, and detent valve, small land first, into upper left center bore.

12. Insert bore plug, hole out, into upper left center bore and, pressing inward on bore plug, remove screwdriver and install remaining pin from cored side of valve body.

13. Install 1-2 shift valve, longer stem end first, in lower left center bore, making certain valve seats in bottom of bore.

14. Install 1-2 regulator valve, larger stem first, spring and detent valve, hole end first, into 1-2 modulator bushing, aligning spring in bore of 1-2 detent valve.

15. Compress bushing against spring and secure with retaining pin from cored side of control valve body.

16. Install 3-2 intermediate spring in open end of 2-3 shift valve and install valve and spring, valve first, into lower left bore. Make certain valve seats in bottom of bore.

17. Install 2-3 modulator valve, hole end first, into 2-3 modulator bushing and install both parts in lower left bore.

18. Install 2-3 shift valve spring into hole in 2-3 modulator valve, and compressing spring, secure with retaining pin from cored side of control valve.

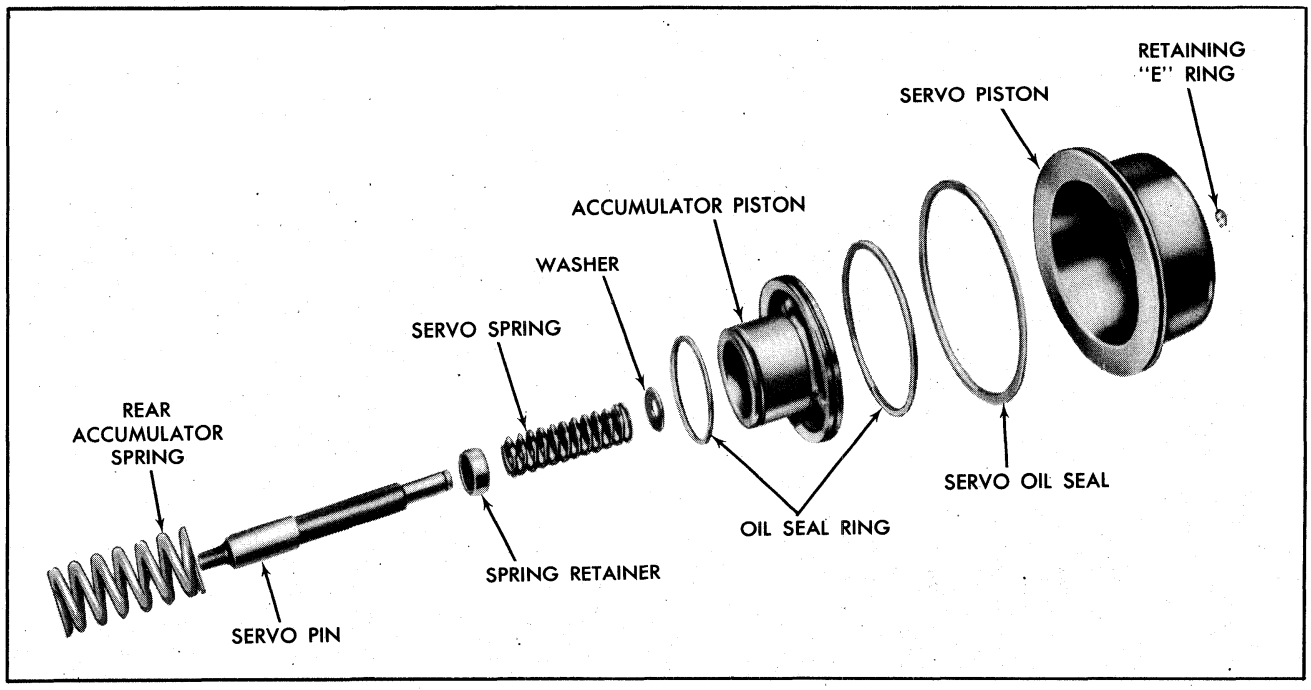


Fig. 7B-85 Rear Servo and Accumulator - Disassembled View

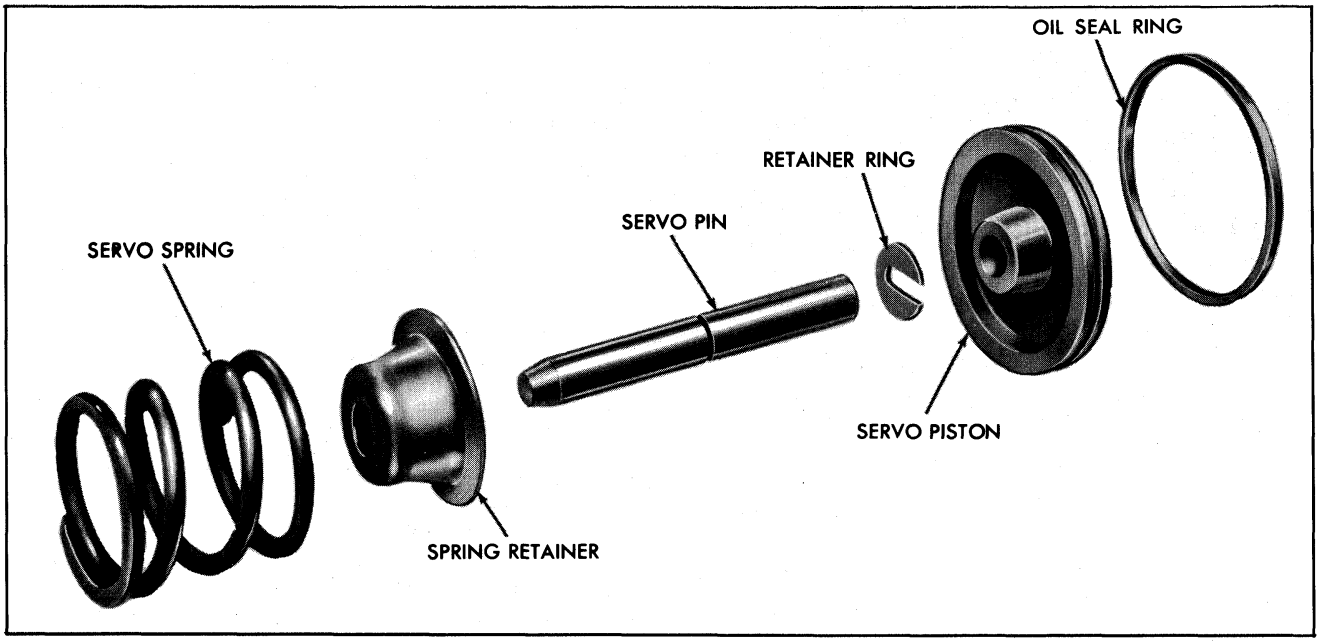


Fig. 7B-86 Front Servo - Disassembled View

19. Position front accumulator spring and piston into valve body and install Control Valve Accumulator Piston Installer, J-21885 or J-22269-01 on piston. Compress spring and piston, aligning spring and piston with bore, Fig. 7B-90.

CAUTION: *Make certain that piston pin is correctly aligned with hole in piston and that oil seal ring does not catch on lip of bore when installing piston.*

20. Secure piston and spring with E-ring retainer and remove installer, J-21885 or J-22269-01.

21. Install manual valve into top bore.

22. Placing control valve assembly on gasket surface, position detent solenoid gasket and detent solenoid on valve body.

23. Install downshift solenoid attaching screws.

24. Install governor drive pipe into control valve body in bore by rear servo cover.

25. Install two governor screen assemblies with open end up, Fig. 7B-91.

d. Install Control Valve Assembly (Fig. 7B-93)

1. Using two guide pins, Fig. 7B-92, install control valve assembly and governor pipe on transmission. Make certain gaskets and spacer do not become mispositioned.

NOTE: Check manual valve to make sure it is indexed

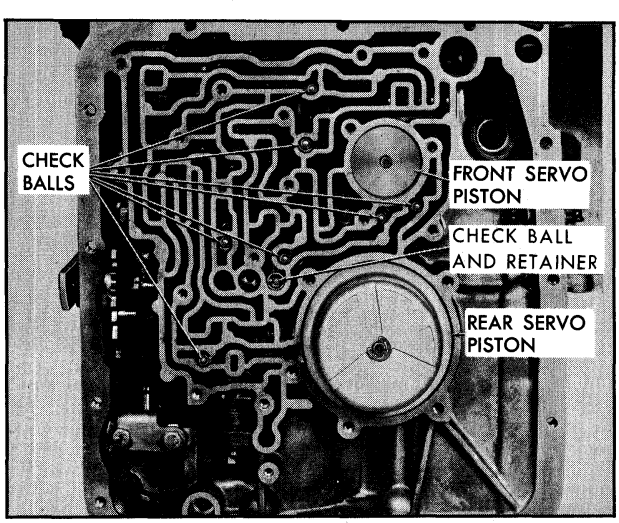


Fig. 7B-87 Location of Check Balls

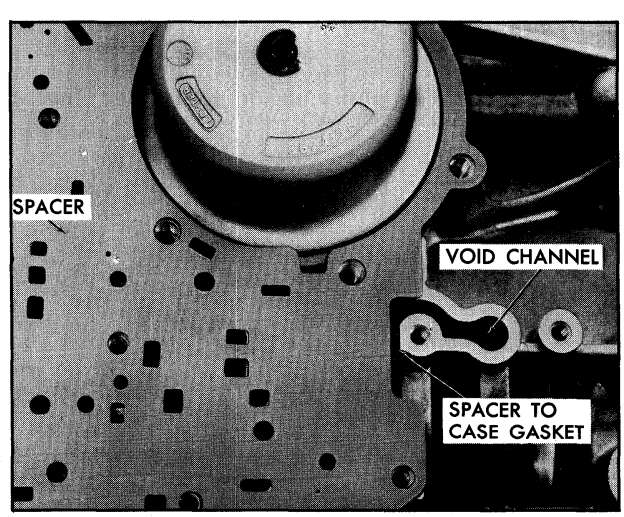


Fig. 7B-88 Valve Body Spacer-to-Case Gasket

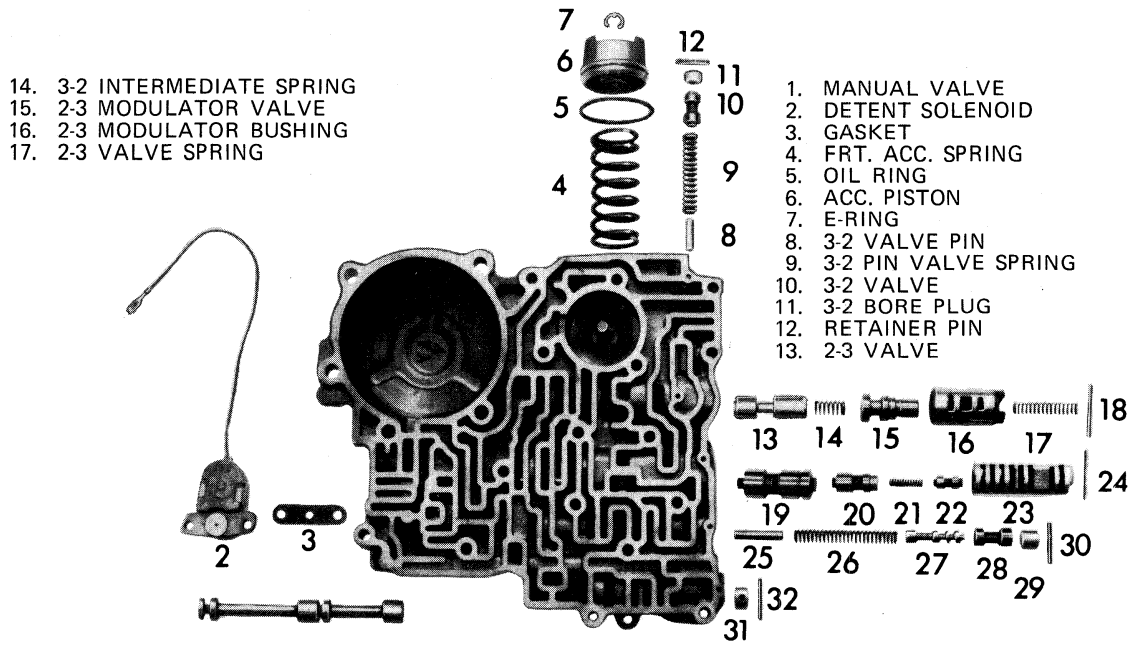


Fig. 7B-89 Control Valve - Disassembled View

properly with pin on detent lever and governor pipe to make certain it is properly seated in case hole.

2. Remove guide pins and install control valve assembly attaching screws, eliminating detent roller and spring assembly attaching screw. Torque bolts to 8 foot-pounds, Fig. 7B-94.

3. Install detent roller and spring assembly and attaching screw. Tighten screw to 8 foot-pounds.

4. Install detent solenoid wire to electrical connector.

5. Install governor feed pipe in transmission case and control valve body.

NOTE: Make certain that governor feed pipe is seated in bores in case and valve body.

Pressure Regulator Valve, Intake Pipe and Filter Assembly, Bottom Pan, Modulator Valve and Modulator

a. Install Pressure Regulator Valve

1. Install spring retainer on pressure regulator spring. Also install spacers if previously removed, Fig. 7B-95.

2. Install pressure regulator valve on spring, stem end first.

3. Install boost valve into bushing, stem end out, and stack parts so that pressure regulator spring is against valve bushing.

4. Install complete assembly, pressure regulator valve first, into pressure regulator valve bore, being careful not to drop parts during installation.

5. Using a screwdriver or steel rod, compress regulator boost valve bushing against pressure regulator spring until it is beyond snap ring groove, and install snap ring using Snap Ring Pliers, J-5403 (#21), Fig. 7B-96.

NOTE: To facilitate installation of snap ring, encircle

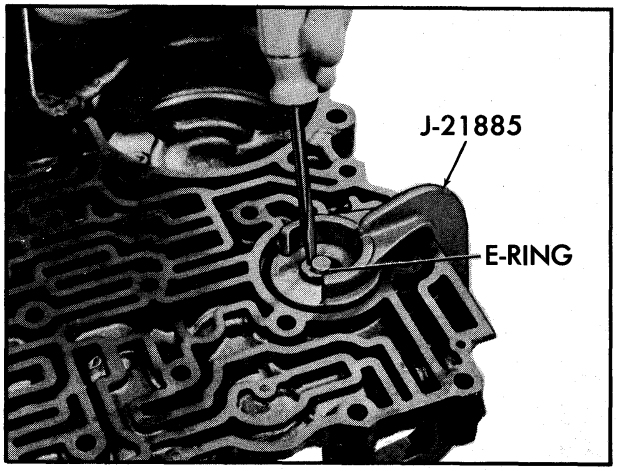


Fig. 7B-90 Removing Front Accumulator

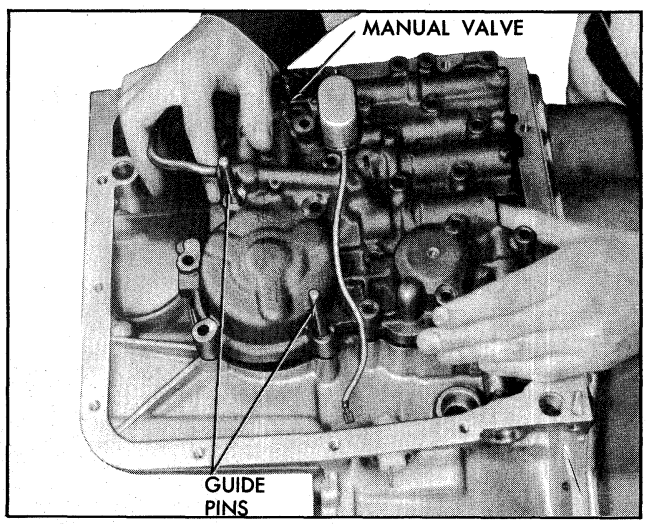


Fig. 7B-92 Installing Control Valve Assembly

it around screwdriver or steel rod, compress tangs with snap ring pliers, and slide snap ring into ring groove in valve bore.

b. Install Intake Pipe and Filter Assembly and Bottom Pan

1. Install new intake pipe O-ring into pipe bore in transmission case and install intake pipe and filter assembly.
2. Install new bottom pan gasket on transmission case and install bottom pan.
3. Install 13 bottom pan attaching screws. Tighten screws to 12 foot-pounds.

c. Inspect Vacuum Modulator and Valve

1. Inspect vacuum modulator for any signs of bending or distortion.
2. Inspect O-ring seat for damage.
3. Inspect modulator valve for nicks or damage.
4. Check freeness of valve operation in case bore.
5. Check modulator for damaged bellows. Modulator plunger is under approximately 16 pounds pressure. If bellows is damaged, plunger will have very little pressure. Use procedure outlined on page 7B-13.

d. Install Modulator Valve and Vacuum Modulator

1. Install modulator valve into case with stem end out.
2. Install new O-ring on vacuum modulator.
3. Install vacuum modulator into case with vacuum hose pipe facing case connector.
4. Install modulator retainer with curved side of tangs inboard and install attaching screw. Tighten screw to 18 foot-pounds.

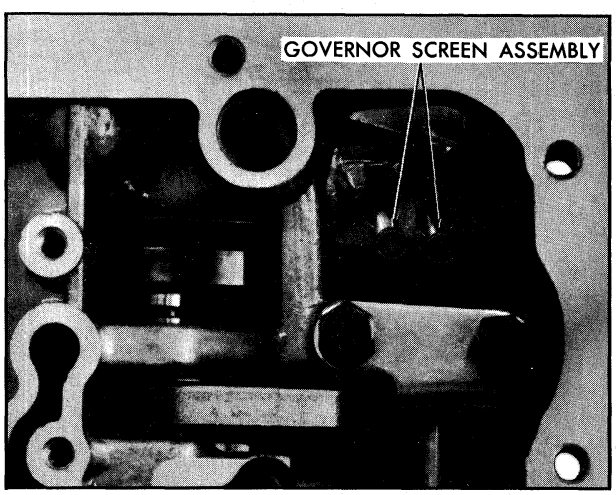


Fig. 7B-91 Installing Governor Screens

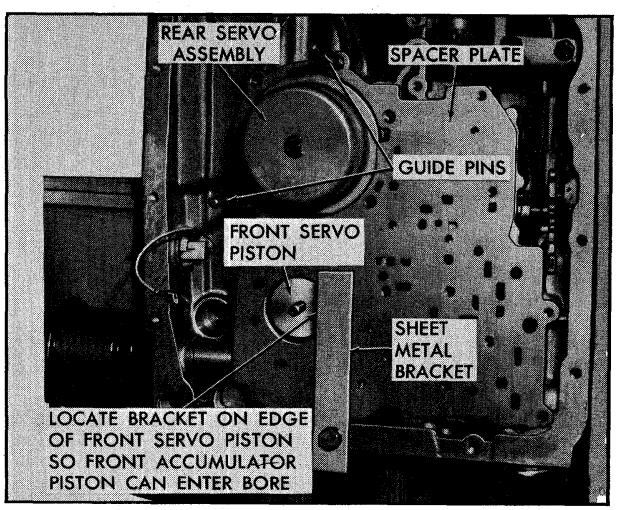


Fig. 7B-93 Installing Control Valve Assembly - (On Car)

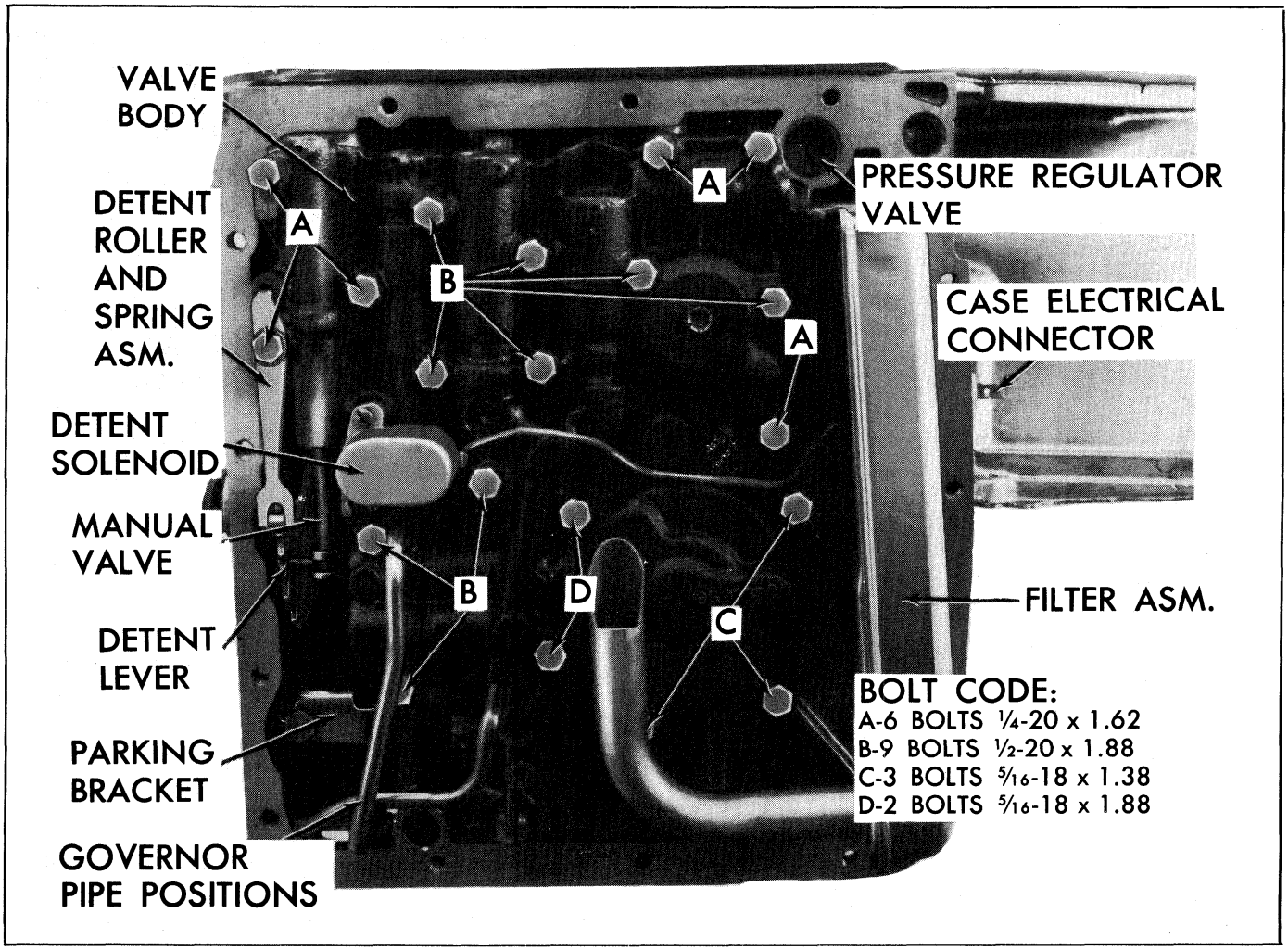


Fig. 7B-94 Control Valve Assembly Screws

Governor Assembly

NOTE: All components of the governor assembly, with the exception of the driven gear, are a select fit and each assembly is factory calibrated. The governor, including the driven gear, is serviced as a complete assembly. However, the driven gear can also be serviced separately.

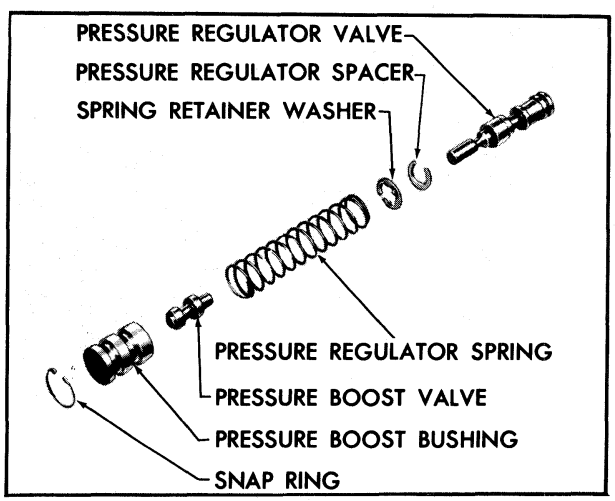


Fig. 7B-95 Pressure Regulator Valve - Disassembled View

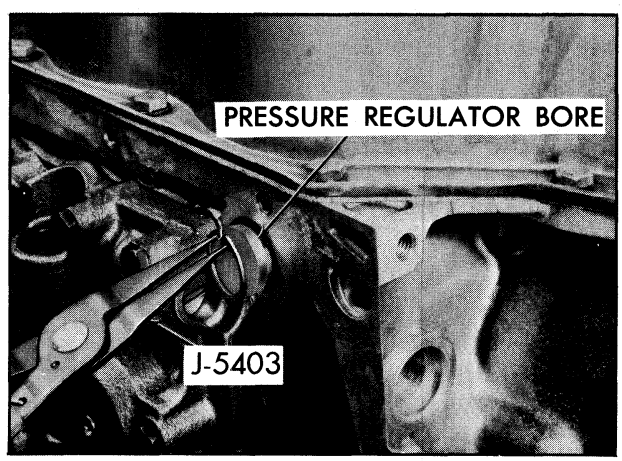


Fig. 7B-96 Installing Pressure Regulator Valve

a. Governor Inspection

1. Wash in cleaning solvent, and blow out all passages.
2. Inspect governor sleeve for nicks, burrs, scoring or galling.
3. Check governor sleeve for free operation in bore of transmission case.
4. Check governor valve for free operation in bore of governor sleeve.
5. Inspect governor driven gear for nicks, burrs, or damage.
6. Check governor driven gear for looseness in governor sleeve.
7. Inspect speedometer drive gear for nicks, burrs, or damage.
8. Check speedometer drive gear for looseness on governor sleeve.
9. Inspect governor springs for distortion or damage.
10. Check governor weights for free operation in their retainers.
11. Check valve opening at entry and exhaust (.020" minimum).

b. Governor Driven Gear Replacement

To facilitate governor repair in the field, governor driven gear and replacement pins are available for service use. The service package contains a nylon driven gear, two governor weight retaining pins and one governor gear retainer split pin. Replacement of gear must be performed with care in the following manner:

1. Place governor sleeve on a block of wood and drive retaining pin out, using a small punch or 1/8" drill rod.
2. Remove governor driven gear as follows:
a. insert governor driven gear in a vice.
b. Firmly grip governor sleeve with hands and twisting and pulling at the same time, pull governor sleeve away from the governor driven gear.
c. Discard governor driven gear.
3. Remove governor valve and wash all parts in cleaning solvent and blow off parts.
4. Install governor valve, end with holes last, into governor sleeve.
5. Support governor on 7/64" plates, installed in exhaust slots of sleeve, position new gear in sleeve and with a 7/16" socket, press gear into sleeve until seated. See Fig. 7B-97.
6. Place governor sleeve on a block of wood and with a 1/8" drill, drill half way through each side of gear; drill through existing hole. See Fig. 7B-98.
7. Install split retaining pin, making sure each end is slightly below top of hole.

CAUTION: *Extreme care must be taken to prevent damaging the parts.*

8. Stake both ends of pin hole, two places.
9. Thoroughly wash governor assembly in cleaning solvent and blow out all passages.

c. Install Governor

1. Rotate transmission in Holding Fixture Base so that governor bore is up.
2. Install new square cut O-ring seal on governor assembly and install assembly into transmission case, Fig. 7B-99.
3. Position retaining clip on top of governor assembly.

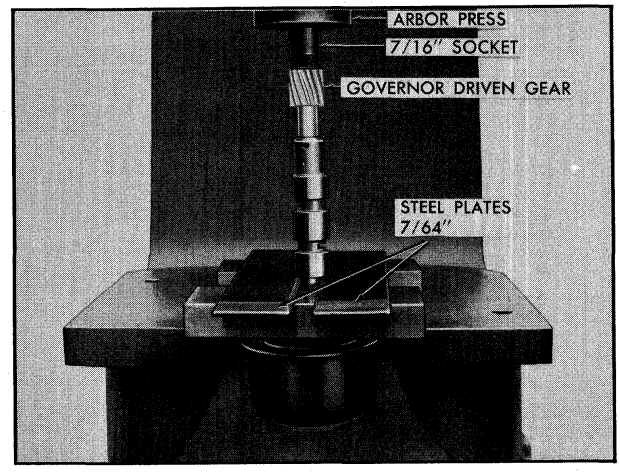


Fig. 7B-97 Installing Governor Gear in Sleeve

Converter

a. Inspect Torque Converter

1. Check converter for leaks as described on page 7A-33.
2. Check converter hub surfaces for signs of scoring or wear.

b. Install Torque Converter

1. Position transmission jack with adapter plate to transmission and install transmission on jack using brace and safety chain.
2. Carefully position converter on turbine shaft, making certain converter is properly aligned. Long screws or eyebolts can be threaded into the weld nuts on the converter and used as handles.
3. Rotate converter until the shafts are piloted and the converter lugs are indexed in the pump gear.
4. If difficulty is experienced in alignment, tap on outer diameter of converter with plastic-headed hammer, while turning converter.
5. Install Converter Holding Clamp, J-21366, on transmission case.

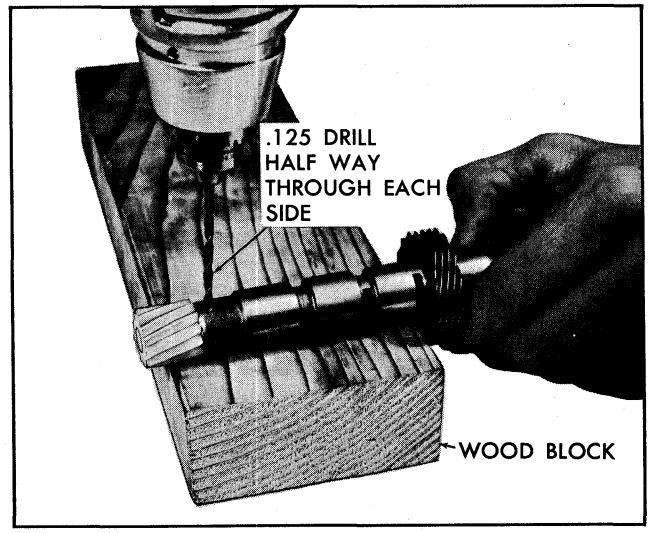


Fig. 7B-98 Drilling into Side of Gear

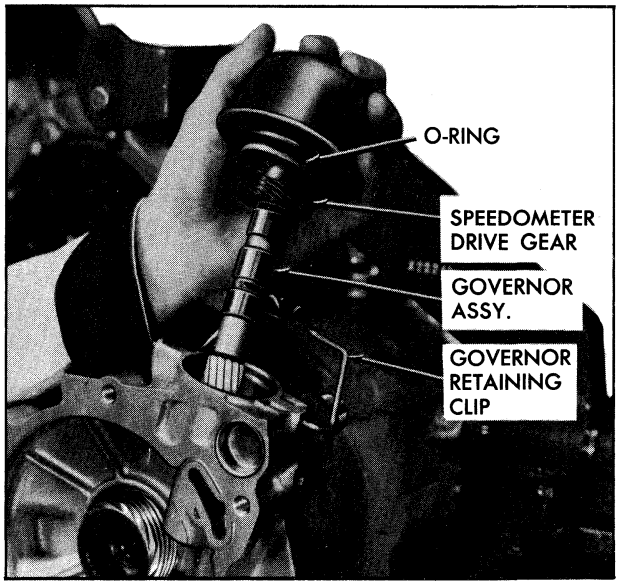


Fig. 7B-99 Installing Governor Assembly

6. Remove Transmission Holding Fixture, J-22240, from transmission.

Bushing Service - Eldorado (Refer to pages 7A-72 thru 7A-77.)

TORQUE CHART

Material Number	Application	Thread Size	Foot Pounds
280M	Transmission to Engine Screws	3/8–16	35
300M	Torque Converter to Flywheel Screws	3/8–16	30
1010	Flywheel Housing Cover to Transmission Screws	1/4–20	5
300M	Final Drive to Transmission Screws	3/8–16	25
280M	Solenoid to Case Screw	1/4–20	10
Special	Line Pressure Plug	1/8 Pipe	10
260M	Vacuum Modulator Retainer	5/16–18	18
260M	Control Valve Body to Case Screw	1/4–20	8
300M	Center Support to Case	3/8–16	23
286M	Manual Shaft to Inside Lever	3/8–24	18
280M	Pump Body to Cover Plate	5/16–18	20
280M	Parking Brake Bracket to Case	5/16–18	18
1010–1020	Oil Pan to Case Screw	5/16–18	12
280M	Sprocket Housing Screw	1/4–20	8
260M	Support Housing to Cover Plate	5/16–18	20
260M	Speedometer Driven Gear Retainer to Case	5/16–18	8-12
280M	Rear Engine Mount to Transmission Bracket	3/8–16	25
280M	Support Bracket to Transmission Bolt	7/16–14	42
275M	Rear Engine Mount to Frame Screw & Washer Assembly	3/8–16	25

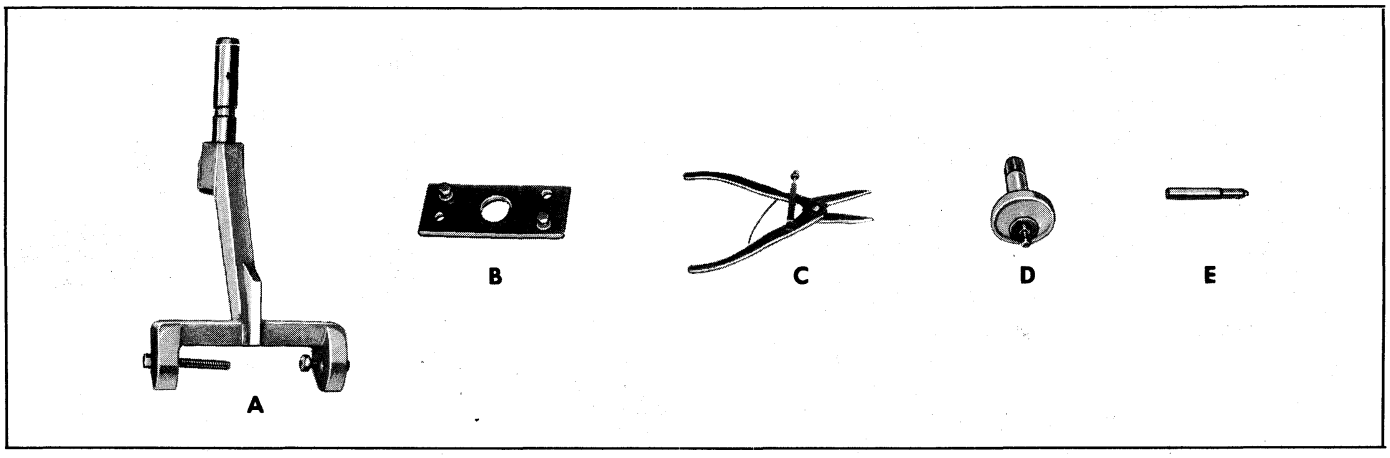


Fig. 7B-100 Special Tools

Key	Tool No.	Name	Key	Tool No.	Name
A	J-22240	Transmission Holding Fixture	C	J-4646	Snap Ring Pliers
B	J-21370-8	Band Apply Adapter Plate	D	J-22241	Front Unit End Play Checking Tool
			E	J-21370-7	Band Apply Adapter Pin

NOTE: The above Special Tools are required in addition to most tools shown in Fig. 7-114 to properly overhaul the Turbo Hydra-matic transmission used on the Eldorado.

CHASSIS ELECTRICAL

TABLE OF CONTENTS

Instrument Panel
- Except Eldorado and Seville 8-1
  - General Description 8-1
  - On Car Service 8-2
  - Specifications 8-17
- Eldorado 8-21
  - General Description 8-21
  - On Car Service 8-21
  - Specifications 8-35
- Seville 8-40
  - General Description 8-40
  - On Car Service 8-41
  - Specifications 8-53

Lighting Systems
- General Description 8-60
- Diagnosis 8-60
- On Car Service 8-66
- Specifications
  - Except Eldorado and Seville 8-70
  - Eldorado 8-74
  - Seville 8-79

Wiring and Circuit Protection
- General Description 8-80
- Diagnosis 8-85
- On Car Service 8-85
- Specifications 8-87

Electrical Instruments
- General Description 8-90
- Diagnosis 8-90
- On Car Service 8-108

Lamp Monitor System
- General Description 8-111
- Diagnosis 8-111
- On Car Service 8-112

Windshield Wiper Systems
- General Description 8-112
- On Car Service 8-116

Washer Fluid Low Level Indicator (Except Seville)
- General Description 8-117
- Diagnosis 8-117

Washer Fluid Low Level Indicator (Seville)
- General Description 8-118
- Diagnosis 8-119

INSTRUMENT PANEL (Except Eldorado and Seville)

GENERAL DESCRIPTION

The instrument panel for DeVille, Brougham, Limousine, formal Limousine and Commercial Chassis is shown in Fig. 8-1. The two major parts of the panel are the top cover and the lower instrument panel assembly. Service procedures for subassemblies are covered in this section and include the following:

Top Cover - Radio speakers and grilles and defroster grilles.

Lower Instrument Panel Assembly - Wiper control, cruise control, speedometer cluster , radio, automatic climate control head, accessory switch, in-car sensor for climate control, left and right hand inserts and appliques, center insert applique, right, left and center air conditioner adapters, headlamp, guidematic and twilight sentinel switches, control for right hand mirror, map lights, right telltale housing, telltale assembly including fuel gage and clock, ash tray and lighter, glove box assembly, power trunk release switch and lower steering column cover.

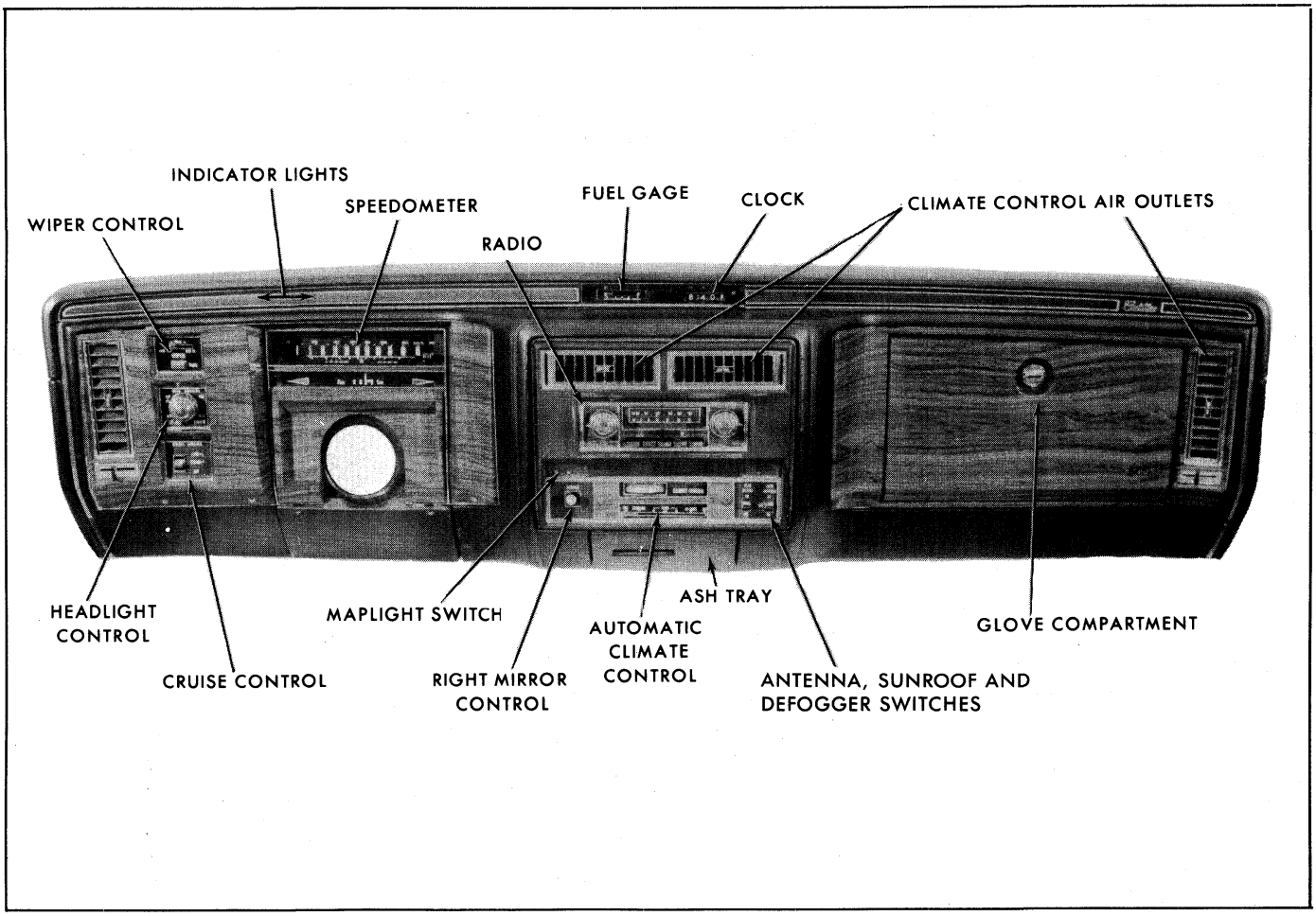


Fig. 8-1 Instrument Panel Assembly (Except Eldorado and Seville)

ON-CAR SERVICE

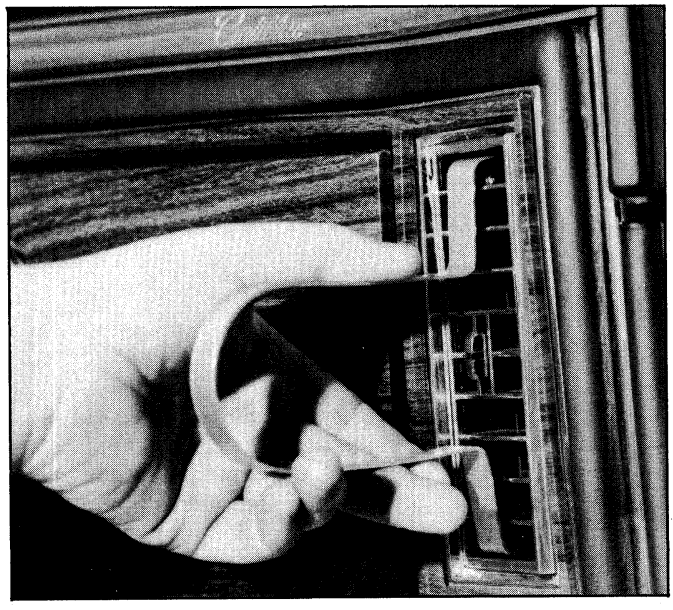


Fig. 8-2 Removing Air Conditioner Air Outlet Grille (Except Eldorado and Seville)

Air Conditioner Air Outlet Grilles (Fig. 8-2)

a. Removal

1. Using Remover and Installer Tool J-24612-01 compress release tabs.
2. Rotate grille upward and remove grille.

b. Installation

1. Using Remover and Installer Tool J-24612-01 compress release tabs and position grille as shown in Fig. 8-2.
2. Remove tool and position grille so that tabs snap into retaining holes.

INSTRUMENT PANEL TOP COVER (Fig. 8-3)

a. Removal

1. Remove screw securing top cover to left and right side of instrument panel.
2. Remove screw securing top cover to instrument panel through access hole in top of speedometer cluster bezel.
3. Remove screw securing top cover to instrument panel through access hole in top of glove box liner.
4. Remove 4 screws securing top cover to cowl, located at the ends of the defroster grilles.
5. Remove top cover by pulling panel rearward off of

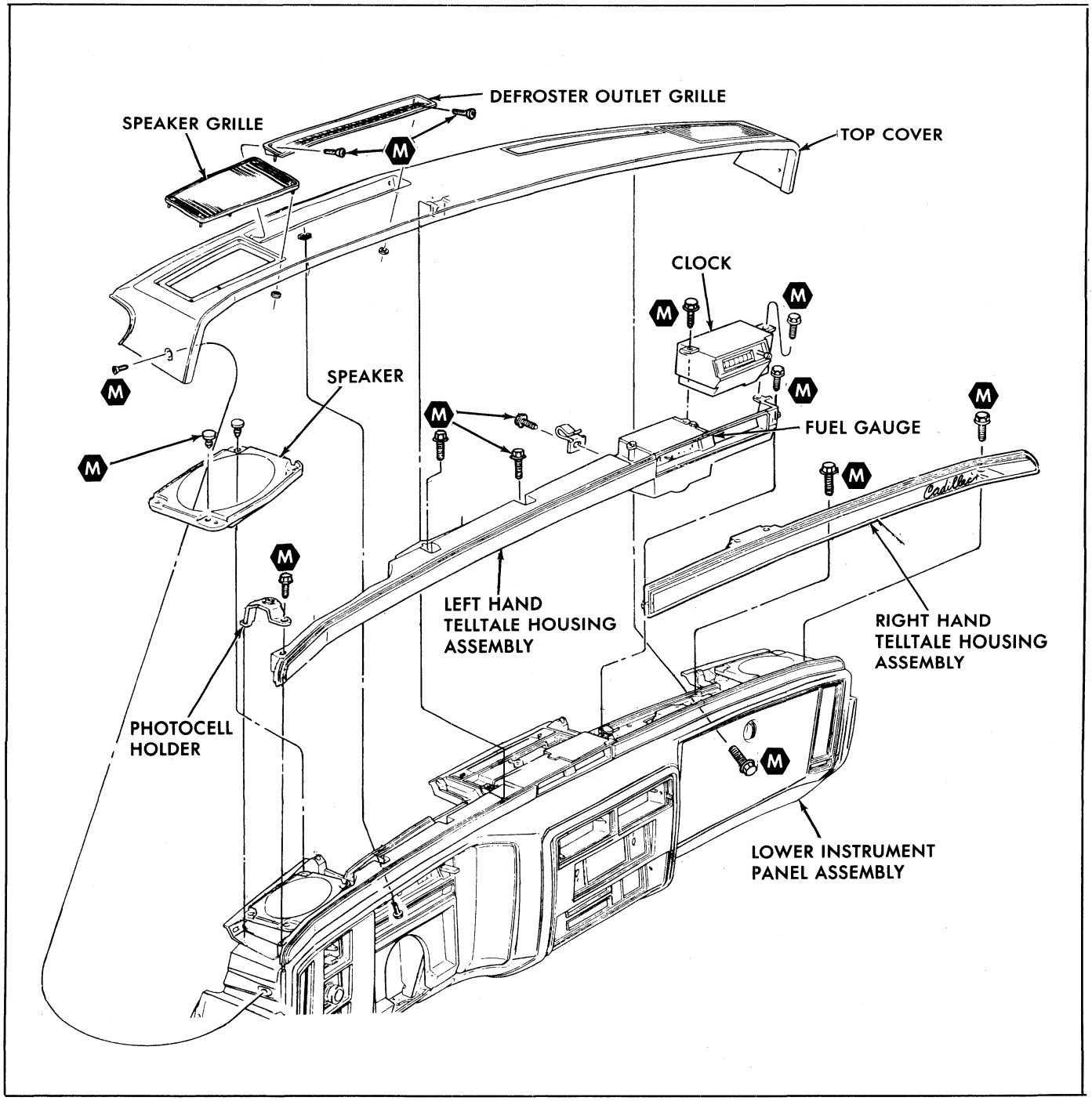


Fig. 8-3 Instrument Panel Top Cover (Except Eldorado and Seville)

spring clips located near center of panel.

b. Installation

1. Position top cover and secure to cowl with 4 screws.

2. Install screw securing top cover to instrument panel through access hole in top of glove box liner.

3. Install screw securing top cover to instrument panel with access through hole in speedometer cluster bezel.

4. Install screw securing left and right side of top cover to instrument panel.

FUEL GAGE (Fig. 8-3)

a. Removal

1. Remove instrument panel top cover as described above.

2. Remove 3 nuts and light socket securing telltale printed circuit to fuel gage.

3. Remove 2 screws securing fuel gage to telltale housing.

b. Installation

1. Position fuel gage on telltale housing and secure with 2 screws.

2. Install 3 nuts and light socket securing telltale printed circuit to fuel gage.

3. Install instrument panel top cover as described above.

DIGITAL CLOCK (Fig. 8-3)

a. Removal

1. Disconnect negative battery cable.
2. Remove instrument panel top cover as described on Page 8-2.
3. Remove 2 screws securing clock to telltale housing.
4. Roll clock out of instrument panel and remove 2 nuts and light socket securing telltale printed circuit to clock.
5. Remove clock.

b. Installation

1. Install telltale printed circuit and secure with 2 nuts and light socket.
2. Position clock on instrument panel and secure with 2 screws.
3. Install instrument panel top cover as described on Page 8-2.
4. Connect negative battery cable.

Twilight Sentinel Photocell (Fig. 8-3)

NOTE: Should it be necessary to replace an amplifier, both amplifier and photocell must be replaced as a matched set.

Access to the photocell unit can be gained by removing the instrument panel top cover as described on Page 8-2.

The photocell can be removed by pulling it straight out of its holder and can be installed by pushing it straight into its holder.

Twilight Sentinel Amplifier

NOTE: Should it be necessary to replace the photocell, both photocell and amplifier must be replaced as a matched set.

a. Removal

1. Remove 1 screw securing left hand air conditioner extension duct.
2. Remove 2 screws securing amplifier to lower instrument panel assembly.
3. Disconnect electrical connector and remove amplifier.

Installation

1. Connect electrical connector.
2. Position amplifier to lower instrument panel assembly and secure with 2 screws.
3. Install left hand air conditioner outlet duct extension and secure with 1 screw.

LEFT-HAND TELLTALE ASSEMBLY COMPONENTS AND LENSES (Fig. 8-3)

a. Removal

1. Disconnect negative battery cable.
2. Remove instrument panel top cover as described on Page 8-2.
3. Disconnect telltale harness.
4. Disconnect theft-deterrent harness on cars so equipped.
5. Remove 5 screws securing assembly to instrument panel.
6. Remove assembly.

b. Installation

1. Position telltale assembly to instrument panel and secure with 5 screws.
2. Connect telltale harness.
3. Connect theft deterrent harness on cars so equipped.
4. Install intrument panel top cover as described on Page 8-2.
5. Connect negative battery cable.

TELLTALE CLUSTER PRINTED CIRCUIT (Fig. 8-74)

a. Removal

1. Disconnect negative battery cable.
2. Remove instrument panel top cover as described on Page 8-2.
3. Disconnect telltale harness.
4. Disconnect theft deterrent harness on cars so equipped.
5. Remove all bulb and socket assemblies from telltale housing.

NOTE: Bulbs must be reinstalled in correct locations for proper functioning of telltale circuits.

6. Remove 2 hex nuts securing printed circuit to clock.
7. Remove 3 hex nuts securing printed circuit to fuel gage.
8. Remove printed circuit.

b. Installation

1. Position printed circuit on telltale housing and secure by connecting telltale harness and theft deterrent harness if so equipped.
2. Install all telltale bulbs and sockets.
3. Install 2 hex nuts securing printed circuit to clock.
4. Install 3 hex nuts securing printed circuit to fuel gage.
5. Install top cover as described on Page 8-2.
6. Connect negative battery cable.

RIGHT HAND TELLTALE ASSEMBLY (Fig. 8-3)

a. Removal

1. Remove instrument panel top cover as described on Page 8-2.
2. Remove four screws securing telltale to instrument panel.
3. Gently lift left hand telltale at clock and slide right hand telltale from beneath.
4. Disconnect in-car sensor electrical connector and aspirator hose.
5. Remove telltale.

b. Installation

1. Connect in-car sensor electrical connector and aspirator hose.
2. Gently lift left hand telltale and slide right hand telltale into position.
3. Secure telltale with four screws.
4. Install instrument panel top cover as described on Page 8-2.

Air Conditioning In-Car Sensor

Refer to Page 1-59 for this procedure.

Lower Steering Column Cover (Fig. 8-4)

a. Removal

1. Remove four screws securing cover to lower instrument panel.
2. Remove lower cover.

b. Installation

1. Place lower cover in position.
2. Install four screws securing cover to lower instrument panel.

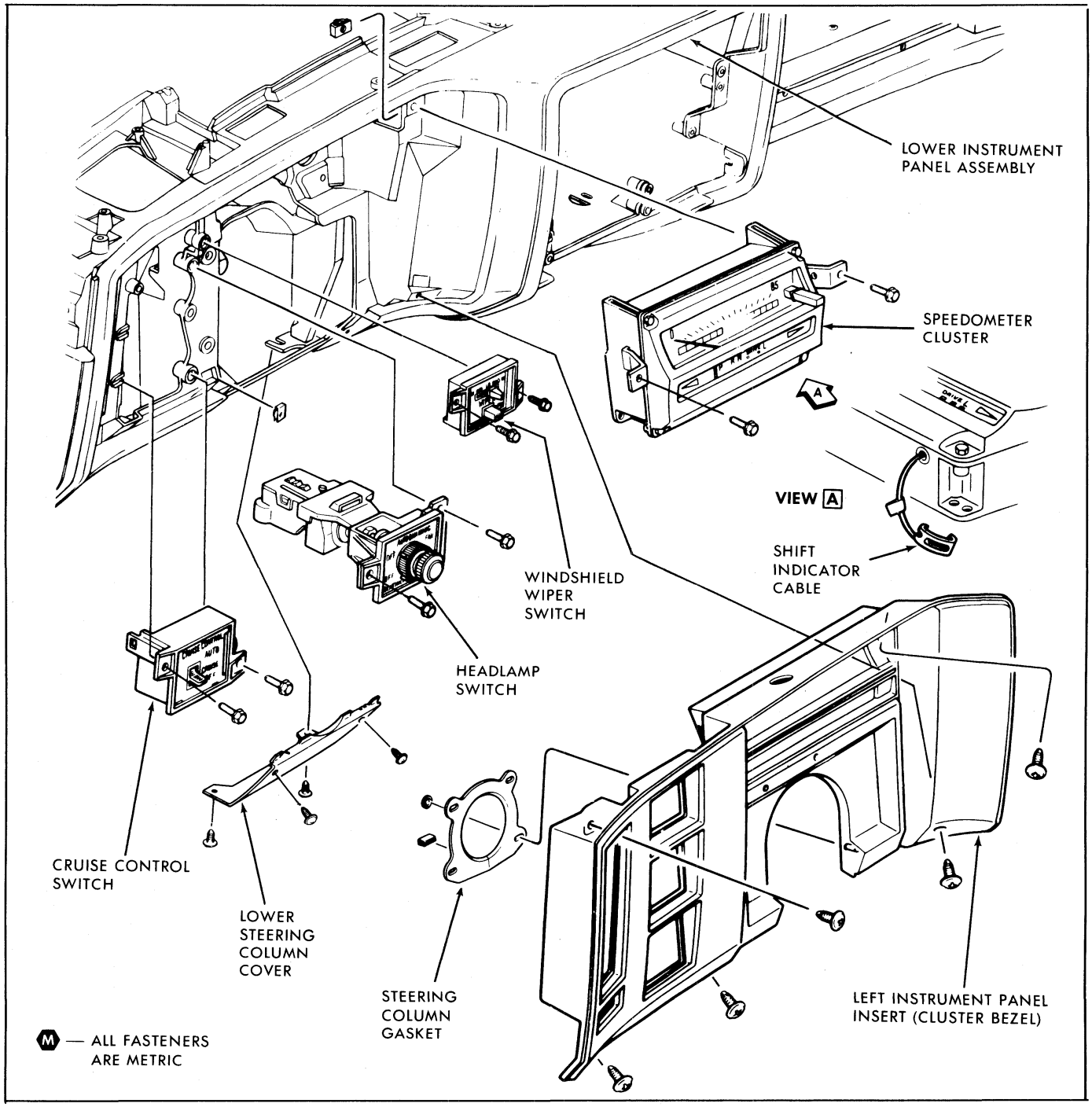


Fig. 8-4 Speedometer Cluster Left Hand Insert and Applique (Except Eldorado and Seville)

SPEEDOMETER CLUSTER LEFT HAND INSERT AND APPLIQUE (Fig. 8-4)

a. Removal

1. Loosen set screw in left climate control outlet door knob and remove knob.
2. Remove left climate control air outlet grille using Tool J-24612-01.
3. Remove 6 screws securing bezel to instrument panel.

NOTE: One screw is located inside of climate control outlet.

4. Remove 2 upper and 2 lower screws in lower steering column cover.
5. Disconnect steering column seal on lower surface and remove bezel.

b. Installation

1. Position bezel against instrument panel and secure with 6 screws.
2. Connect steering column seal on lower surface.
3. Install 2 upper and 2 lower screws in lower steering column cover.
4. Install left climate control outlet door knob and tighten set screw.
5. Install left climate control outlet grille using Tool J-24612-01.

SPEEDOMETER CLUSTER (Fig. 8-4)

a. Removal

1. Disconnect negative battery cable.
2. Remove left hand insert and applique as described above.
3. With shift lever in "P" (Part) remove 1 screw securing shift indicator cable to steering column.
4. Remove 2 upper screws securing cluster assembly to instrument panel horizontal support.
5. Remove 2 lower inboard screws securing cluster to horizontal support. The 2 outboard screws remain in place for rear speedometer cable mounting.
6. Remove 1 screw located directly above steering column securing cluster to speedometer mounting plate.
7. Pull cluster outward to disengage from speedometer cable.

CAUTION: *On vehicles so equipped, disconnect speed control sensor electrical connector from cluster with a small screwdriver (Fig. 9-39) prior to completely removing cluster assembly. This will prevent connector from damaging cluster as cluster assembly is being removed from car.*

8. Remove cluster.

NOTE: Removal or installation can be facilitated by placing shift lever in low range and on cars equipped with tilt wheel, placing the wheel in lowest position.

b. Installation

1. Connect printed circuit connector to cluster.
2. Connect cruise control speed sensor, if so equipped.
3. Place cluster into position in the instrument panel and engage speedometer cable.
4. Install 5 screws securing cluster to instrument panel.
5. With column in "P" (Park) loosely install screw securing shift indicator cable to steering column and align pointer with column in Neutral. Tighten screw.
6. Install left hand insert and applique as described above.
7. Connect negative battery cable.

CLUSTER PRINTED CIRCUIT (Fig. 8-76)

a. Removal

1. Remove cluster as described above.
2. Remove all sockets and bulbs from cluster case.
3. Remove printed circuit.

NOTE: No attempt should be made to repair this circuit. If inoperative it should be replaced.

b. Installation

1. Position printed circuit on back of cluster case.
2. Install all sockets and bulbs into cluster case.

NOTE: Black socket should contain a No. 161 bulb specific to shift indicator illumination on Eldorado and Seville. All other sockets are gray with No. 194 bulbs.

3. Install cluster as described above.

SPEEDOMETER HEAD (Fig. 8-5)

a. Removal

1. Remove speedometer cluster as described above.
2. Remove 4 screws securing speedometer cluster lens to cluster housing.
3. Remove lens and face plate.
4. Remove selector quadrant assembly from cluster housing by pulling straight out.
5. Remove 2 rubber mounted screws securing speedometer head assembly and remove from cluster housing.
6. Remove 2 screws securing dial to speedometer head and remove dial. Use care not to damage pointer.

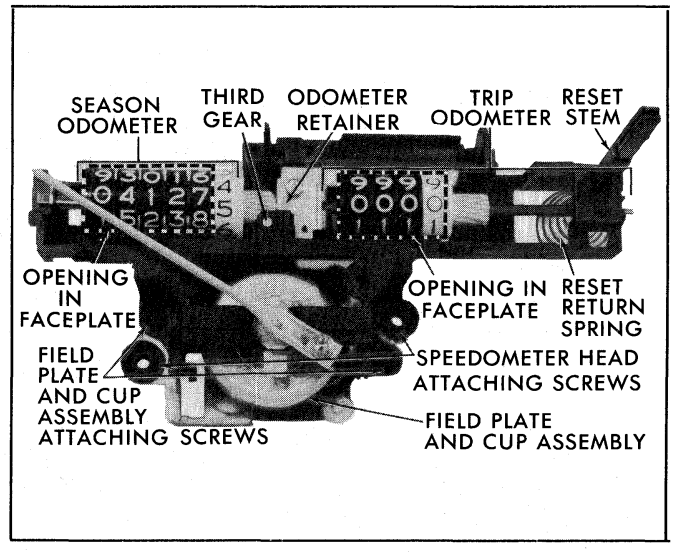


Fig. 8-5 Speedometer Head

b. Installation

1. Install 2 screws securing dial to speedometer head. Use care not to damage pointer.
2. Install 2 screws through rubber bushings in speedometer head assembly and secure to cluster housing.
3. Install selector quadrant assembly to cluster housing.
4. Install face plate and lens. Secure with 4 screws.
5. Install speedometer cluster and speedometer cluster bezel as described above.

SPEEDOMETER HEAD COMPONENT SERVICE (Fig. 8-5)

a. Disassembly

1. Remove screw and odometer retainer plate.
2. Remove trip odometer assembly (trip odometer assembly is serviced only as a complete unit).
3. Remove season odometer assembly (season odometer assembly is serviced only as a complete unit.)
4. Remove jack gear.
5. Remove trip reset spring retainer by pinching upper and lower clips together.
6. Remove reset rack and spring assembly.

NOTE: Further disassembly requires removal of field plate and speed cup assembly and subsequent recalibration of speedometer. If speedometer tester is not available for recalibration, repairs requiring disassembly beyond this point should be referred to your designated speedometer service station.

7. Carefully remove orange painted pointer assembly (press fit). Turn against zero stop and lightly lift pointer assembly at hub.
8. Remove 2 screws securing speed cup assembly to frame and remove.

NOTE: On cars equipped with Cruise Control be sure to keep magnet shaft and speed cup free of contaminants to avoid improper speed signals to speed sensor.

9. Remove third gear.
10. Inspect second gear for signs of damage. Do not

remove unless necessary. Remove from frame assembly if necessary.

NOTE: Further disassembly, such as removal of the magnet shaft from frame and speed cup assembly is not recommended.

b. Assembly

1. If removed, position second gear in frame assembly with gear end contacting worm gear magnet shaft.

NOTE: On cars equipped with Cruise Control be sure to keep field plate and cup assembly free of contaminants to avoid improper speed signals to speed sensor.

2. If removed, position third gear with bevel gear end engaging worm gear end on second gear.

3. If removed, position speed cup assembly to frame and secure with 2 screws.

NOTE: Make sure speed cup stop tab is on correct side of field plate so as to permit needle rotation. Hairspring coil on speed cup must be evenly spaced when in wound position. It may be necessary to use tweezers to adjust coils. Move regulator arm to horizontal position, if necessary, so that maximum adjustment may be made in either direction during calibration.

4. Install reset rack and spring assembly and spring retainer.

5. Install jack gear.

6. Rotate trip odometer wheels until all zeros are opposite slotted ears (zeros facing forward).

7. Wipe odometers clean of fingerprints with a lint free cloth or soft chamois.

8. Install odometers, making sure slotted ears of pinion carriers fit in locating slots.

9. Install retainer plate and secure with screw.

10. Mount pointer on tapered spindle so that it points at approximately 30 mph. Twist pointer back to, and in line with "0" graduation while pressing down lightly.

11. Check for secure pointer to spindle contact by inserting a short piece of speedometer cable with proper tip in drive end of speedometer. An initial fast spin of test cable should swing pointer to approximately 30 mph and then briskly return to "0". Perform this test several times. If pointer becomes loose on spindle, repeat Step 10.

12. If during the performance of Step 11, pointer returns to "0" intermittently or not at all, this indicates a speed cup and magnet assembly malfunction.

13. If field plate and speed cup assembly were removed, calibrate speedometer assembly, following the instructions furnished by the manufacturer for the speed meter tester.

SPEEDOMETER CABLE AND CABLE HOUSING

a. Removal

1. Remove left hand instrument panel insert as described on Page 8-5

2. Remove speedometer cluster as described on Page 8-6.

3. Disconnect cable housing from locking spring on mounting plate and pull through firewall from underhood.

4. Raise car on hoist.

5. Disconnect cable at transmission.

6. Remove cable assembly.

b. Installation

1. Raise car on hoist.

2. Install cable to transmission.

3. Route cable up through engine compartment using retaining clips.

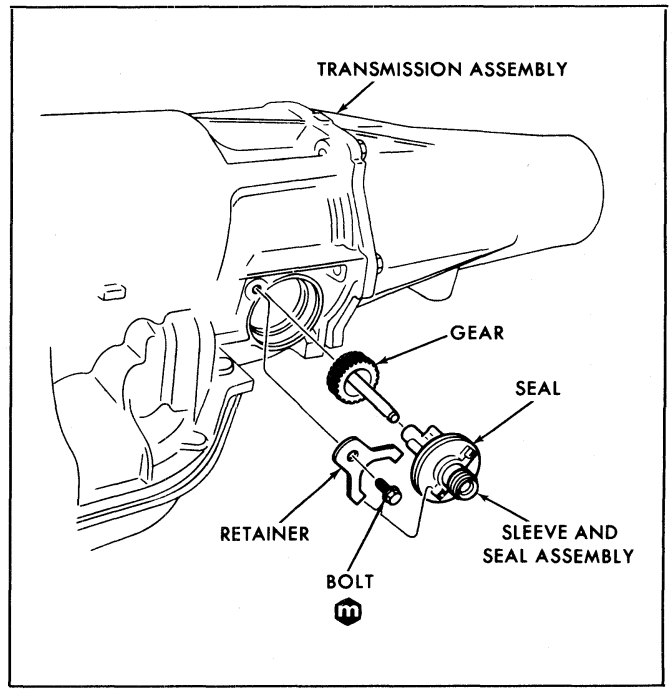


Fig. 8-6 Speedometer Driven Gear (Except Eldorado)

4. Lower car.

5. Route cable assembly through grommet. Cable end must be protected with tapered end cap to force through grommet.

6. Install speedometer cluster as described on Page 8-6.

7. Install left hand instrument panel insert as described on Page 8-5.

SPEEDOMETER DRIVEN GEAR (Fig. 8-6)

Refer to Figure 8-6 for the removal and installation of speedometer driven gears for all cars except Eldorado.

HEADLAMP SWITCH (GUIDE MATIC OR TWILIGHT SENTINEL SWITCH) (Fig. 8-7)

a. Removal

1. Disconnect negative battery cable.

2. Remove left hand instrument panel insert as described on Page 8-5.

3. Remove 3 screws securing headlamp switch to instrument panel.

4. On cars equipped with cruise control and twilight sentinel options remove two screws securing cruise control switch to instrument panel.

5. Slide cruise control switch forward to remove headlamp switch.

6. Disconnect two-piece connector from headlamp switch.

7. Disconnect guidematic, if so equipped, under instrument panel.

8. Remove switch.

b. Installation

1. Connect two-piece connector to switch.

2. Route GuideMatic Connector through panel and connect.

3. Position switch to instrument panel and secure with 3 screws.

4. Slide cruise control switch into position (on cars

SPEEDOMETER GEAR APPLICATION CHART

Series	Axle Ratio	Tire Size	Transmission Type And Model	Speedo-Meter Drive Gear No. of Teeth	Color of Driven Gear	Driven Gear No. of Teeth
DeVille	2.28	GR78-15	THM400	36	White	21
DeVille	2.73	GR78-15	THM400	37	Red	18
DeVille	3.08	GR78-15	THM400	42	Green	18
Brougham	2.28	HR78-15	THM400	36	White	21
Brougham	2.73	HR78-15	THM400	37	Red	18
Brougham	3.08	HR78-15	THM400	42	Green	18
Limousine	3.08	HR78-15	THM400	41	Yellow	18
Commercial	3.08	HR78-15	THM400	41	Yellow	18
Eldorado	2.73	LR78-15	THM425	27	Black	14
Eldorado	3.07	LR78-15	THM425	31	White	14
Seville	2.56	GR78-15	THM400	35	Pink	18
Seville	3.08	GR78-15	THM400	42	Green	18

equipped with Cruise control and twilight sentinel) and secure with two screws.

5. Install left hand instrument panel insert as described on Page 8-5.

Connect negative battery cable.

Windshield Wiper - Cruise Control Switches (Fig. 8-4)

Access to these switches is gained by removing the instrument panel left hand insert and applique as described on Page 8-5.

CENTER INSTRUMENT PANEL INSERT (Fig. 8-8)

a. Removal

1. Remove radio knobs and anti-rattle springs.
2. Remove two hex nuts securing bezel to radio.
3. Remove two center air conditioner outlet grilles using Tool J-24612-01 to gain access to one screw located in each outlet. Remove screws.
4. Remove lower left and lower right screws securing maplights and insert to instrument panel and remove insert.
5. Disconnect electrical connectors from map lights.

b. Installation

1. Reconnect electrical connectors to maplights.
2. Position insert to instrument panel and secure with four screws.
3. Install two hex nuts securing insert to radio.
4. Install radio knobs and anti-rattle springs.
5. Install air conditioner outlet grilles using Tool J-21612-01.

Accessory Switch (Fig. 8-8)

Access to this switch is gained by removing the center instrument panel insert as described above.

Air Conditioning Control Head (Fig. 8-8)

Refer to Page 1-59 for this procedure.

THEFT DETERRENT CONTROLLER

a. Removal

1. Unlock door with key.
2. Disconnect negative battery cable.
3. Remove center instrument panel insert as described above.
4. Remove radio receiver unit as described on Page 9-23.
5. Disconnect controller wiring connections.

NOTE: Controller is located directly behind the right hand remote mirror control.

6. Remove 2 screws securing controller to lower instrument panel and remove controller.

b. Installation

1. Position controller to lower instrument panel assembly and secure with 2 screws.
2. Connect controller wiring connectors.
3. Install radio receiver as described on Page 9-23.
4. Install center instrument panel insert as described above.
5. Connect negative battery cable.

MAP LAMPS - LEFT AND RIGHT (Fig. 8-9)

Removal and Installation

To remove either left or right map lamp assemblies, remove one screw in lens and pull assembly away from center insert. Disconnect electrical connector. Replace bulb if necessary.

To install, connect electrical connector, position lamp assembly to center insert and secure with one screw.

RIGHT HAND REAR VIEW MIRROR

a. Removal

1. Remove right hand door upper and lower trim panels as described in the body service manual.
2. Remove center instrument panel insert as described above.
3. Remove two screws securing control head and lens to instrument panel.
4. Loosen set screw and remove control head from lens.
5. Remove remote control cable from clips at glove box and front door outer panel reinforcement.
6. Remove cable from front door conduit.
7. Remove two nuts securing mirror to door and pull mirror and cable out of door outer panel.

b. Installation

1. Insert mirror in door outer panel feeding remote control cable through large center hole.
2. Secure mirror to door outer panel with two nuts.
3. Feed cable through front door conduit and over glove box to support bracket.

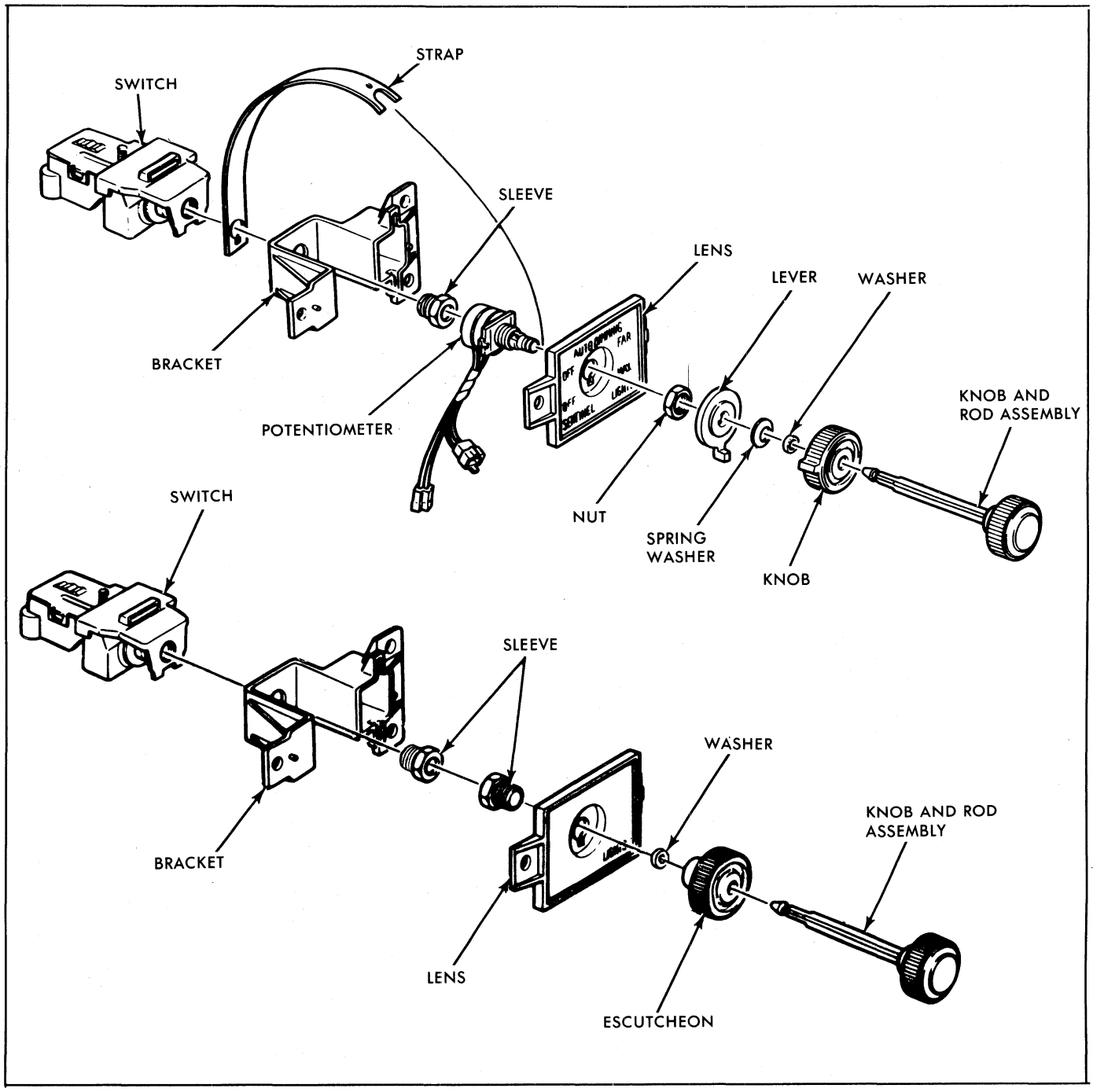


Fig. 8-7 Headlamp Switches Disassembled (Except Eldorado and Seville)

4. Secure cable to glove box and front door inner panel reinforcement clips.

5. Position control head to lens and tighten set screw.

6. Position control head and lens to instrument panel and secure with two screws.

7. Install center instrument panel insert as described on Page 8-8.

8. Install upper and lower front door trim panels as described in the body service manual.

ASH TRAY GUIDE - HOUSING ASSEMBLY (Fig. 8-10)

a. Removal

1. Disconnect cigar lighter harness located behind instrument panel.

2. Open ash tray door and remove two top screws directly forward of leading edge of ash tray door.

3. Loosen two screws at lower edge of instrument panel.

4. Remove housing.

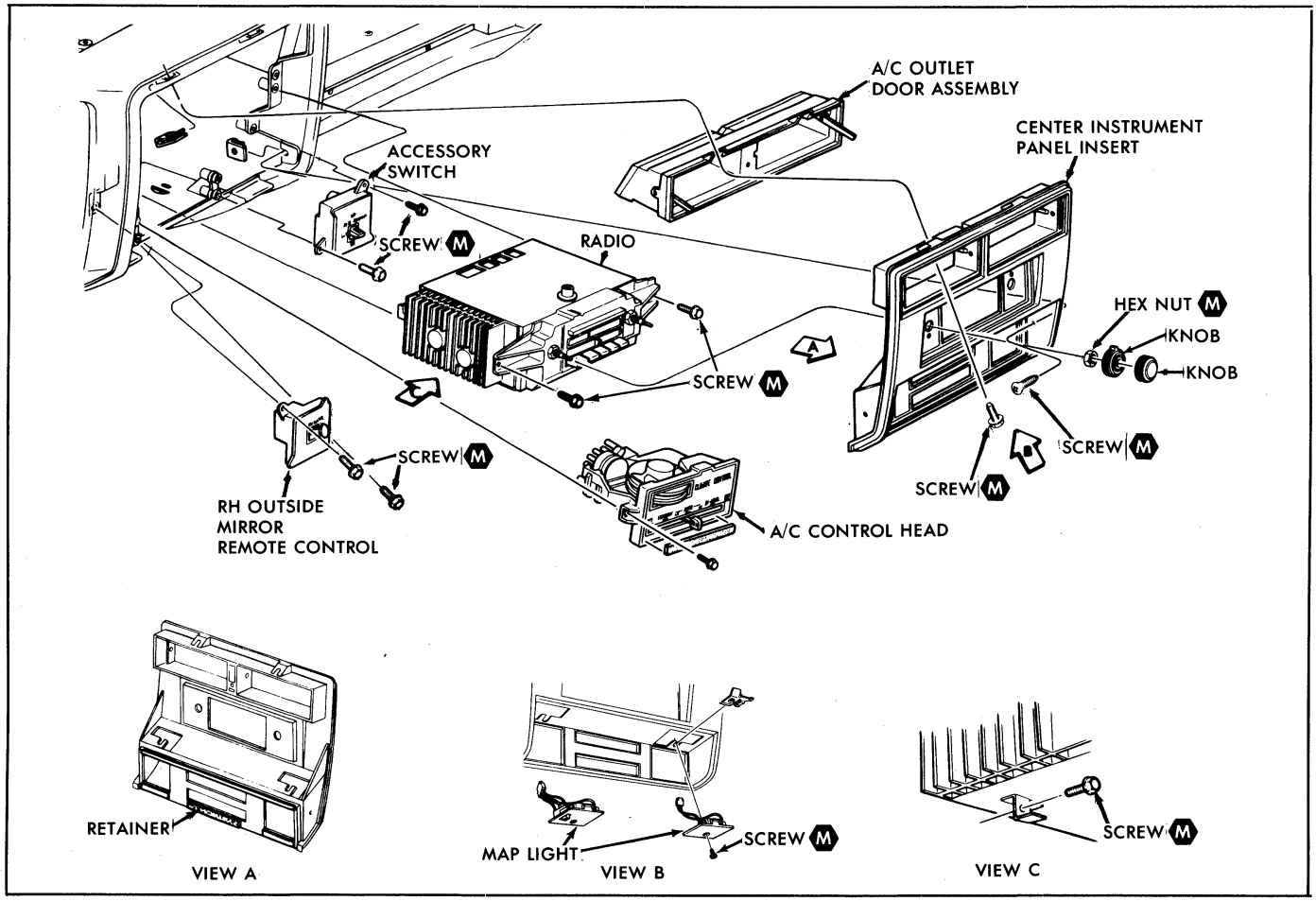


Fig. 8-8 Center Instrument Panel Insert (Except Eldorado and Seville)

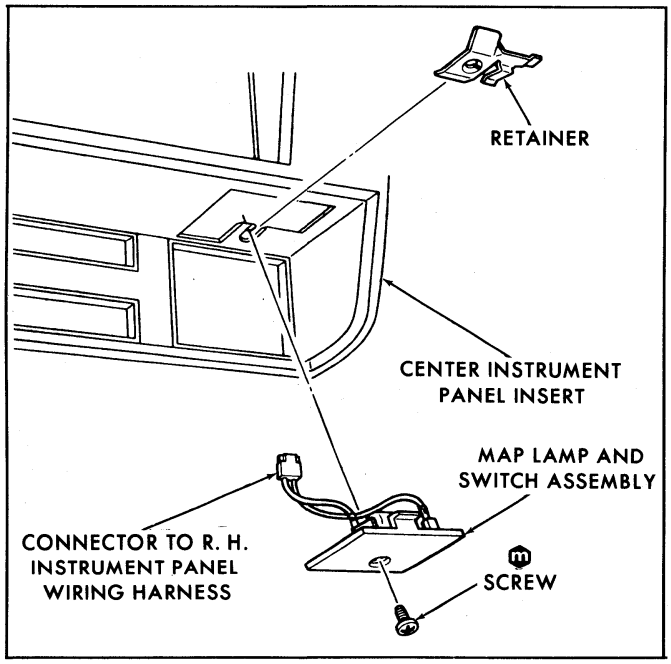


Fig. 8-9 Map Lamps - Left and Right (Except Eldorado and Seville)

b. Installation

1. Route cigar lighter harness through hole in rear of housing and connect behind dash.
2. Close ash tray assembly and install into instrument panel. Align cover surface with lower instrument panel surface carefully.
3. Tighten two screws at lower edge of instrument panel.
4. Open ash tray and install two top screws at leading edge of ash tray door.

RIGHT HAND INSTRUMENT PANEL INSERT AND APPLIQUE (Fig. 8-11)

a. Removal

1. Remove instrument panel assembly as described on Page 8-13.
2. Remove right hand outlet duct.
3. Remove air conditioner outlet door knob by loosening set screw.
4. Remove three screws securing right hand adapter and remove adapter.
5. Remove four screws securing air conditioner distributor and remove distributor.
6. Remove two upper screws securing air conditioner center outlet duct to instrument panel and roll duct away from panel.
7. Remove right hand speaker.
8. Remove glove box door as described on Page 8-12.
9. Remove seven screws securing insert to instrument panel.

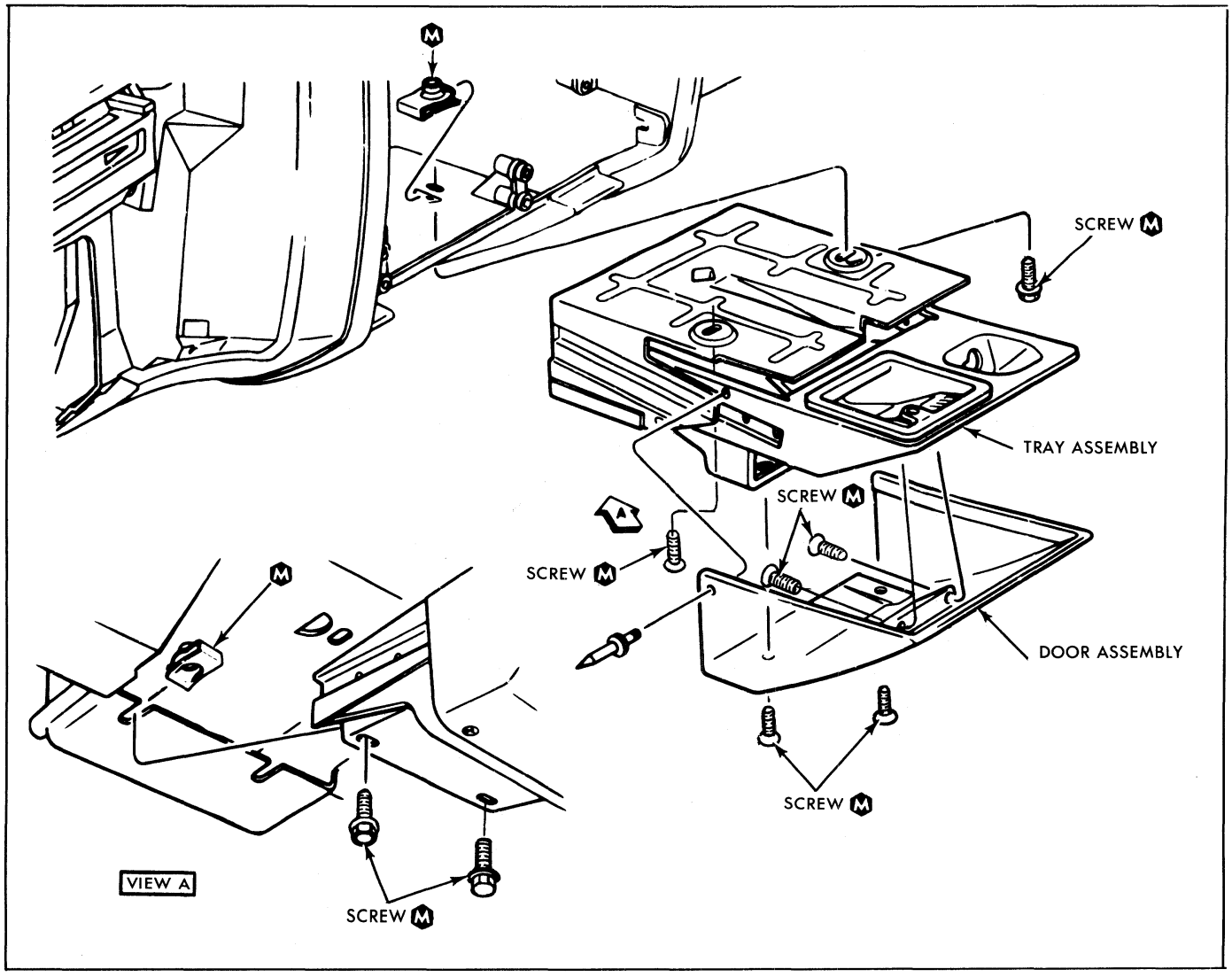


Fig. 8-10 Ash Tray (Except Eldorado and Seville)

10. Remove trunk release switch and glove box lamp switch and remove insert.

b. Installation

1. Position insert to instrument panel and secure with seven screws.

2. Install trunk release switch and glove box light switch.

3. Roll air conditioner center outlet duct into position and secure with two screws.

4. Install center air conditioner distributor and secure with four screws.

5. Install right hand air conditioner adapter and secure with three screws.

6. Install right hand outlet duct.

7. Install air conditioner outlet door knob and tighten set screw.

8. Install right hand outlet duct.

9. Install glove box door as described on Page 8-12.

10. Install instrument panel assembly as described on Page 8-13.

GLOVE BOX LINER (Fig. 8-11)

a. Removal

1. Remove four screws that secure glove box liner to instrument panel.

CAUTION: *Do not apply excessive downward pressure to the door at this point, as it may damage the glove box door hinge.*

2. Remove one screw securing glove box door cable to liner.

3. Carefully remove glove box liner through door opening.

b. Installation

1. Position glove box liner into housing through door opening.

2. Align glove box liner to housing and secure with four attaching screws.

3. Position glove box door cable to liner and secure with one screw.

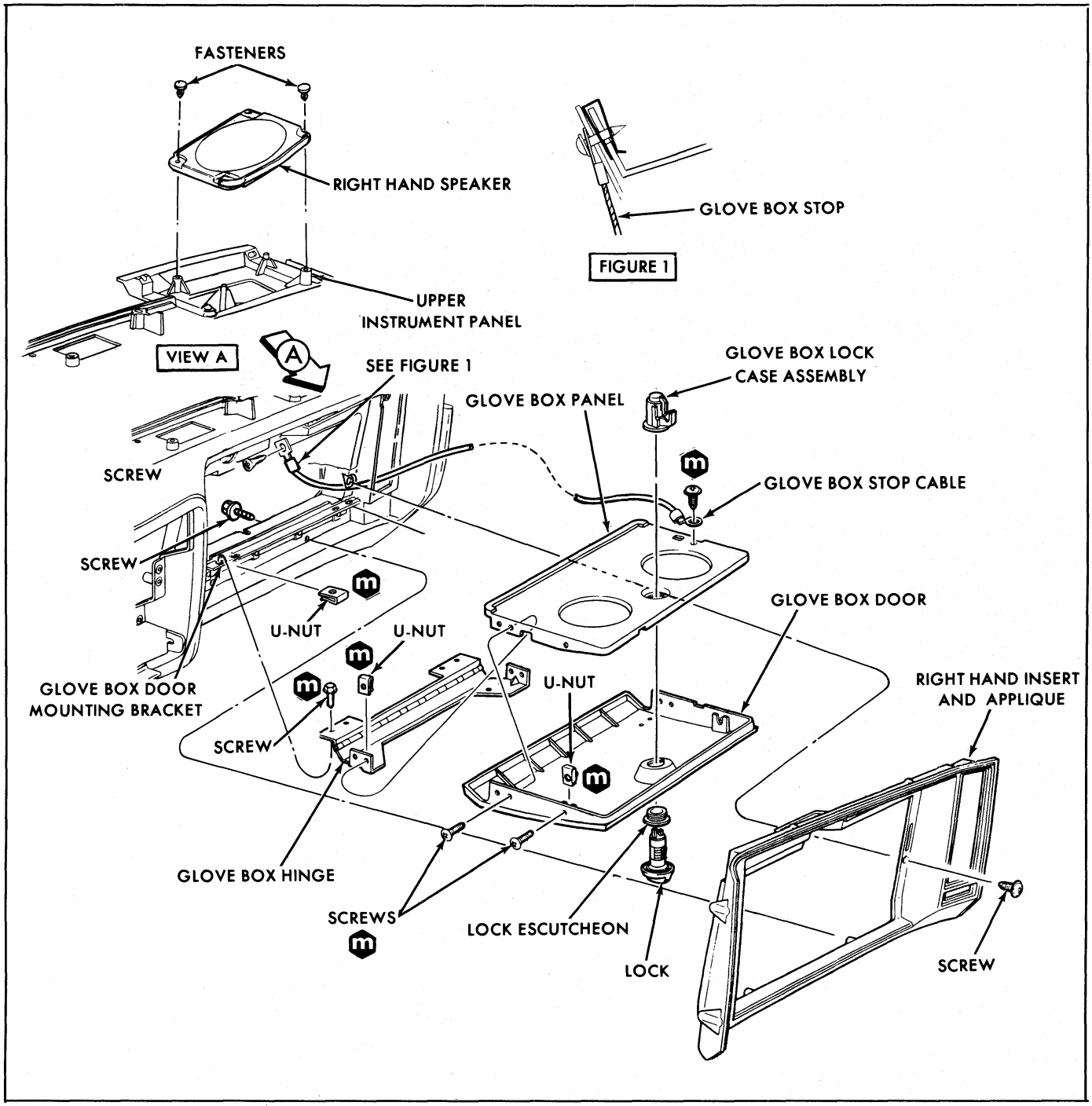


Fig. 8-11 Right Hand Instrument Panel Insert and Applique (Except Eldorado and Seville)

GLOVE BOX DOOR (Fig. 8-11)

a. Removal

1. Remove glove box liner as described above.
2. Remove four screws securing hinge to instrument panel hinge reinforcement.
3. Remove door.

b. Installation

1. Position glove box door to instrument panel and secure with four screws. Align door to applique surface before final torquing of screws.
2. Install glove box liner as described above.
3. Install glove box cable door stop.

Glove Box Lock Cylinder (Fig. 8-11)

a. Removal

1. Open glove box door.
2. Insert key and pull latch mechanism arm to latch position. Turn key to lock position and remove key.
3. Through slot in top of lock case, depress cylinder retainer and insert key into lock cylinder.
4. Release retainer and remove lock cylinder assembly.

NOTE: Lock cylinder knob is not serviced separately from cylinder.

b. Installation

1. While holding lock cylinder assembly in hand depress retainer (tumbler closest to knob) insert key and release retainer. All tumblers and retainer should be flush with lock cylinder housing.

2. Install cylinder into case with retainer at top and rotate key and lock cylinder clockwise until a "click" is heard.

3. Close glove box door, remove key and check for proper operation.

TRUNK RELEASE SWITCH

a. Removal

1. Remove glove box liner as described below.

2. Depress spring clip on rear of switch and push out through passenger side of panel.

3. Disconnect electrical connector from switch.

b. Installation

1. Depress tabs on trunk release switch and carefully insert switch into mounting cutout.

2. Connect electrical connector to switch.

Glove Box Lock Case (Fig. 8-11)

a. Removal

1. Remove lock cylinder as described above.

2. Remove escutcheon.

3. Remove washer, filler and lock cylinder case.

b. Installation

1. Position lock cylinder, filler and washer onto glove box door.

2. Install escutcheon.

3. Install lock cylinder as described above.

ELECTRONIC CONTROL UNIT

a. Removal

1. Disconnect negative battery cable.

2. Remove glove compartment liner.

3. Remove four mounting screws and remove ECU.

4. Disconnect three electrical connectors (red, black and blue) and disconnect MAP Sensor Hose.

b. Installation

1. Connect red, black and blue connectors to ECU and MAP hose to ECU fitting.

2. Position ECU to A/C module making sure that MAP sensor hose is properly routed to avoid kinks and pinches. Secure with four screws.

3. Install glove compartment liner as described on Page 8-11.

4. Connect negative battery cable.

Hood Lock Primary Release (Fig. 2C-3)

a. Removal

1. Remove clip from cable at hood lock.

2. Thread cable from radiator cradle.

3. Remove screws securing left side sill plate and remove sill plate.

4. Remove screw securing left side kick panel.

5. Partially remove kick panel to gain access to lock handle.

6. Pull handle bracket from behind tab on kick panel and remove cable assembly.

b. Installation

1. Thread cable through kick panel and fire wall.

2. Install handle assembly in kick panel so that handle is vertical and away from panel as far as possible.

3. Install handle assembly by securing under tab on kick panel.

4. Position kick panel and secure with screw.

5. Install sill plate and secure with screws.

6. Thread cable through inside of fender well and secure to hood lock latch with clip.

INSTRUMENT PANEL ASSEMBLY

a. Removal

1. Remove 4 screws securing the lower steering column cover to lower instrument panel and remove.

2. Remove air conditioner left hand outlet duct extension as described on Page 8-16.

3. Remove instrument panel top cover as described on Page 8-2.

4. Remove center instrument panel insert as described on Page 8-8.

5. Remove right hand outside rear view mirror remote control from instrument panel as described on Page 8-8 in steps 3a and 4a of right hand remote mirror service procedure.

6. Remove steering column as described on Page 3B-63.

7. Disconnect guidematic outside wiring.

8. Disconnect cruise control brake release switch.

9. Disconnect stop light switch.

10. Disconnect rear defogger relay on top of relay panel.

11. Disconnect dimmer switch.

12. Disconnect all relays at relay convenience panel. (horn, seat belt, antenna, air conditioner, key buzzer).

13. Disconnect body connector at fuse block.

14. Disconnect aspirator hose at air conditioner programmer.

15. Disconnect vacuum harness at vacuum hose interconnect.

16. Disconnect 2 electrical connectors at air conditioner programmer.

17. Disconnect right hand instrument panel ground screw.

18. Remove 2 screws securing 2 halves of main instrument connector together and separate connector.

19. Remove engine air cleaner assembly.

20. Remove screw securing two halves of center bulkhead connector and disconnect.

21. Remove 2 screws securing inner half of center bulkhead to firewall and remove connector.

22. Remove right and left instrument panel side mounting screws. (2 each side, 1 upper and 1 lower).

23. Remove 2 screws securing upper steering column guide bracket to instrument panel and remove bracket.

24. Remove 4 screws securing instrument panel to firewall at base of windshield.

25. Slide panel away from firewall and disconnect electric deck lid lock release, speedometer, rear seat speakers and antenna.

26. With the aid of a helper remove instrument panel from car.

Installation

NOTE: Before installing instrument panel be sure side mounting bracket "J" nuts are properly positioned.

1. With the aid of a helper, rest instrument panel on side mounting brackets.

2. Connect electric deck lid lock release switch, speedometer, rear seat speakers and antenna.

3. Slide panel toward firewall and secure with 4 screws located at base of windshield. Make sure down tangs on instrument panel mounting brackets slip into slots on upper surface of body mounting brackets.

4. Install right and left instrument panel side mounting screws (2 each side, one upper and one lower).

5. Position upper steering column guide bracket and secure with 2 screws.

6. Position inner half of center bulkhead connector to firewall and secure with 2 screws.

7. Connect outer half to inner half of center bulkhead connector and secure with 1 screw.

8. Install engine air cleaner assembly.

9. Connect 2 halves of main instrument panel connector together and secure with 2 screws.

10. Install right hand instrument panel ground screw.

11. Connect 2 electrical connectors at air conditioner programmer.

12. Connect vacuum harness at air conditioner control head.

13. Connect aspirator hose at air conditioner programmer.

14. Connect body connector at fuse block. Connect all relays in relay panel (horn, seat belt, antenna, air conditioner, key buzzer).

15. Connect dimmer switch.

16. Connect rear defogger relay on top of relay panel.

17. Connect stoplight switch.

18. Connect cruise control brake release switch.

19. Connect guidematic outside wiring.

20. Install steering column as described on Page 3B-63.

21. Install right hand outside rear view mirror remote control as described on Page 8-8.

22. Install center instrument panel insert as described on Page 8-8.

23. Install instrument panel top cover as described on Page 8-2.

24. Install climate control left hand outlet duct extension as described on Page 8-16.

25. Install lower steering column cover and secure with four screws.

AIR CONDITIONER LEFT HAND ADAPTER (Fig. 8-12)

a. Removal

1. Remove instrument panel assembly as described on Page 8-13.

2. Remove two screws securing adapter to instrument panel and remove.

b. Installation

1. Position adapter to panel and secure with two screws.

2. Install instrument panel assembly as described on Page 8-13.

AIR CONDITIONER RIGHT HAND ADAPTER (Fig. 8-12)

a. Removal

1. Remove instrument panel assembly as described on Page 8-13.

2. With panel lying face down on bench, remove three screws securing adapter to instrument panel and remove duct.

b. Installation

1. Position adapter onto panel and secure with three screws.

2. Install instrument panel assembly as described on Page 8-13.

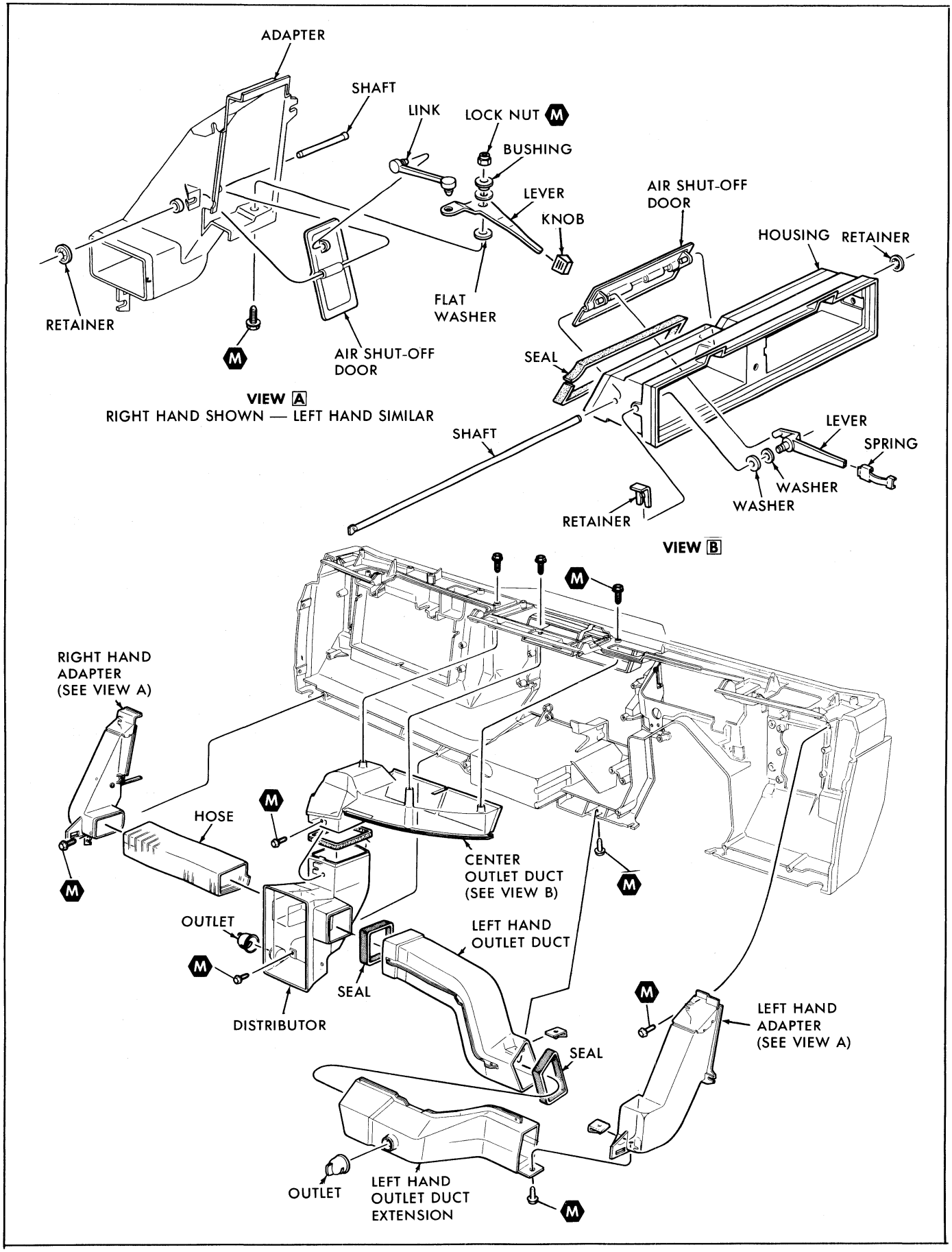


Fig. 8-12 A/C Ducts (Except Eldorado and Seville)

AIR CONDITIONER DISTRIBUTOR (Fig. 8-12)

a. Removal

1. Remove instrument panel as described on Page 8-13.

2. Remove two bottom screws securing distributor to instrument panel.

3. Remove screw on top of distributor which secures distributor to center duct.

4. Remove flexible hose between distributor and right hand adapter by compressing ends of hose towards each other.

5. Remove distributor.

b. Installation

1. Install flexible hose on right hand adapter and distributor.

2. Position distributor with preassembled top and left outlet seals to center and left outlet ducts.

3. Install two bottom distributor attaching screws and one top attaching screw at center outlet duct.

4. Install instrument panel as described on Page 8-13.

AIR CONDITIONER CENTER OUTLET DUCT (Fig. 8-12)

a. Removal

1. Remove instrument panel as described on Page 8-13.

2. Remove air conditioner distributor as described above.

3. Remove three top screws securing center outlet duct to instrument panel and remove duct.

b. Installation

1. Position duct on instrument panel and secure with three top attachment screws.

2. Install air conditioner distributor as described above.

3. Install instrument panel as described on Page 8-13.

AIR CONDITIONER LEFT HAND OUTLET DUCT EXTENSION (Fig. 8-12)

Removal and Installation

Remove screw securing duct extension to left hand adapter and remove duct extension and seal by pulling extension out of left hand outlet duct. Install by reversing steps.

AIR CONDITIONER LEFT HAND OUTLET DUCT (Fig. 8-12)

a. Removal

1. Remove outlet duct extension as described above.

2. Remove screw securing left hand outlet duct to instrument panel.

3. Remove duct and seal by pulling duct out of distributor.

b. Installation

1. Install left hand outlet duct and seal on distributor and secure to instrument panel with bottom attachment screw.

2. Install left hand outlet duct extension as described above.

AIR CONDITIONER RIGHT HAND FLEXIBLE HOSE DUCT (Fig. 8-12)

Removal and Installation

This flexible hose duct can be removed and replaced by axially compressing the ends towards each other.

SPECIFICATIONS

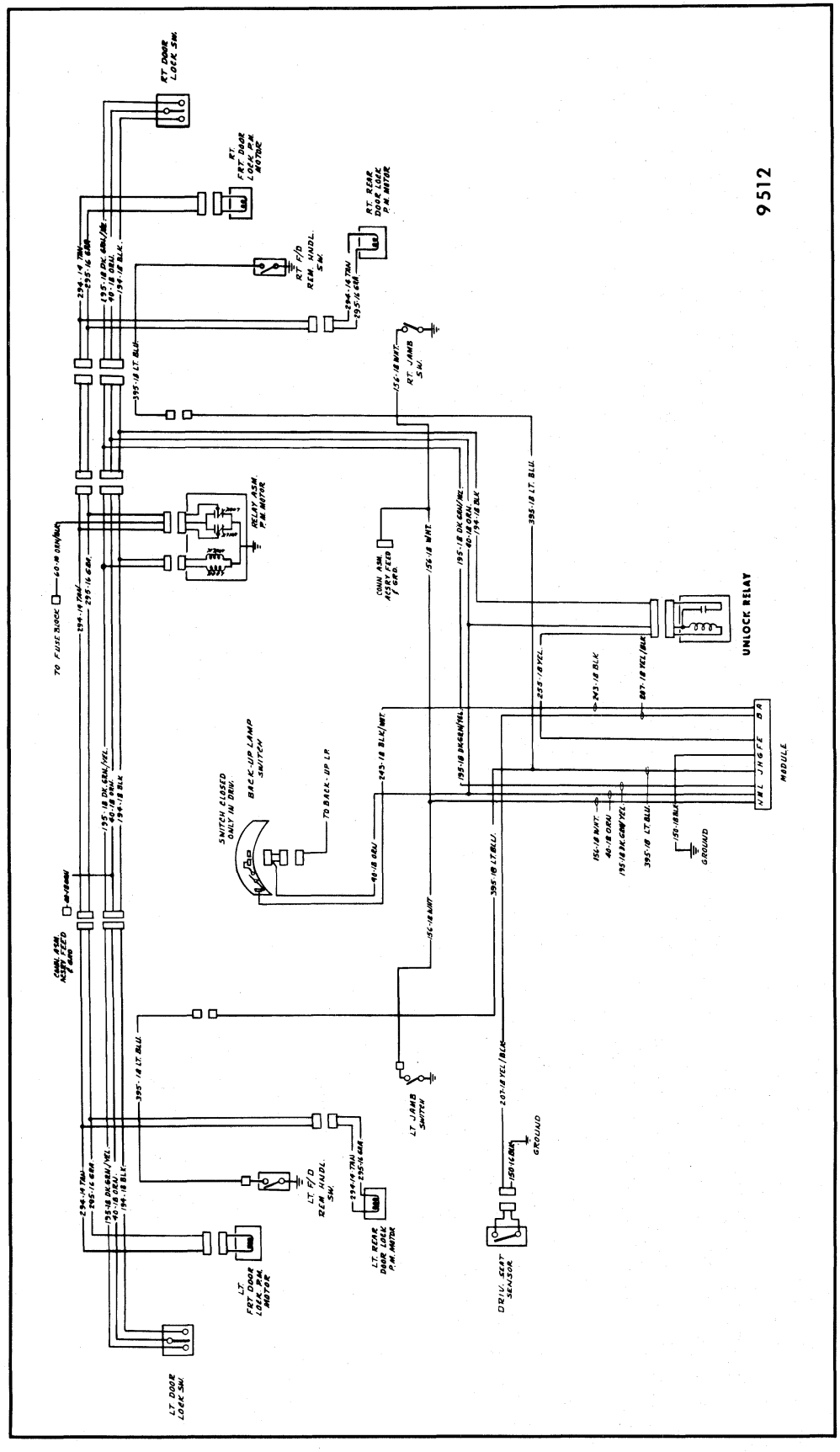


Fig. 8-13 Automatic Door Lock Circuit Diagram

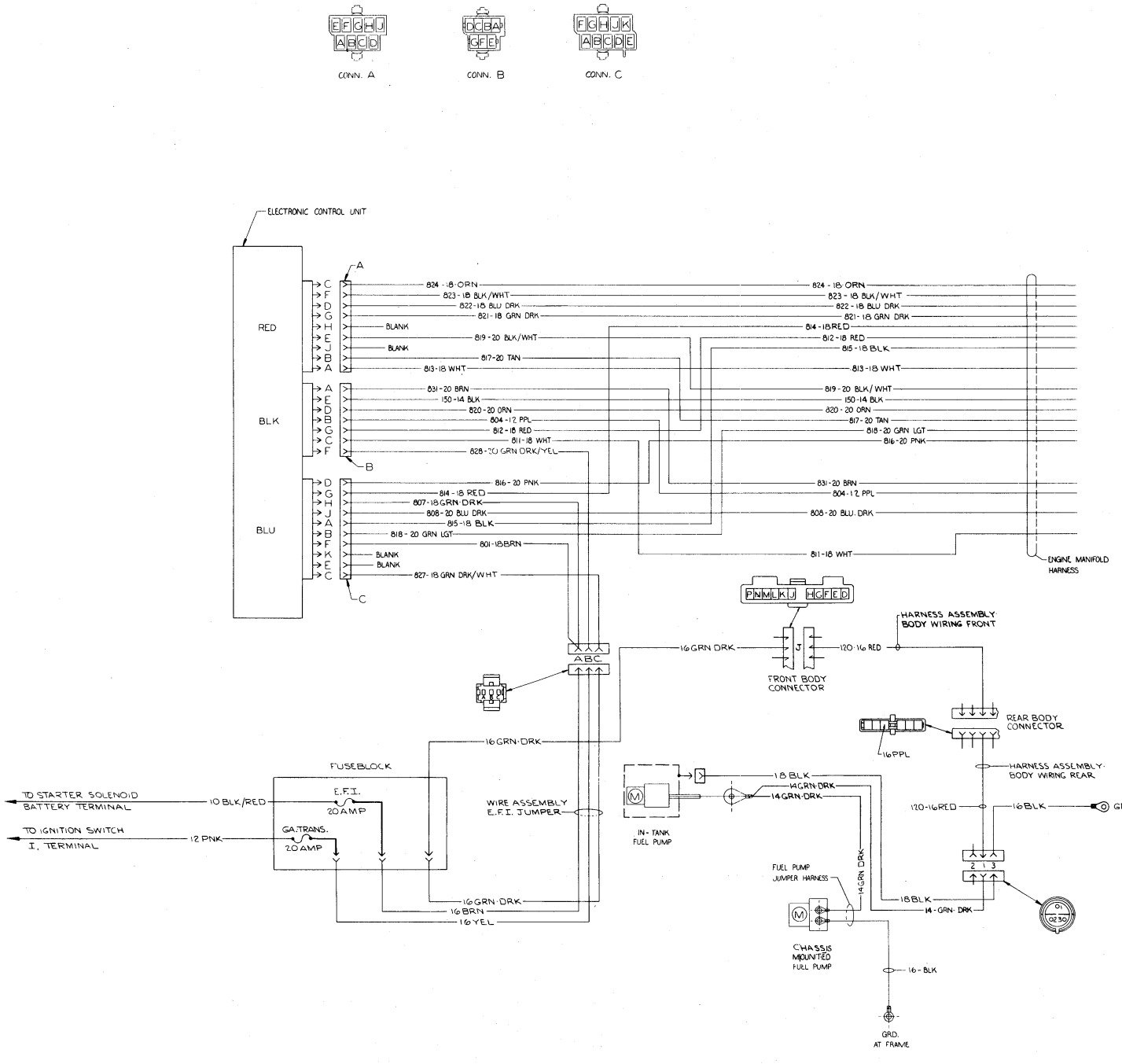


Fig. 8-14 EFI Electrical Circuit - DeVille, Brougham

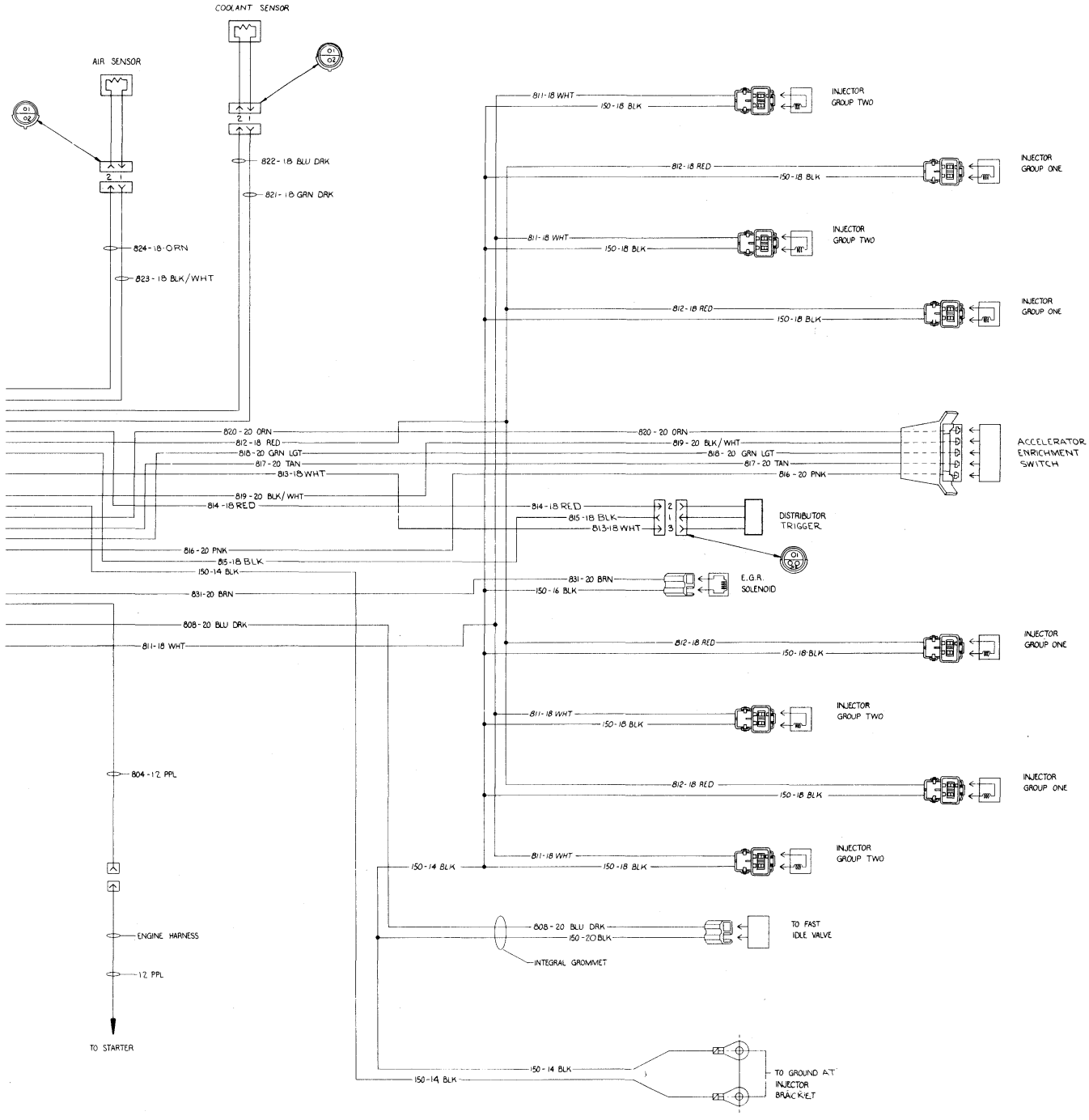


Fig. 8-14 EFI Electrical Circuit Diagram - DeVille, Brougham

LIGHTING AND CHASSIS ELECTRICAL TORQUE SPECIFICATIONS (EXCEPT ELDORADO AND SEVILLE)

Material	Application	Size	Inch Pounds	Newton Metres
6010M	Antenna Mast Tube Bracket to Fender Screws	M4.2 x 1.41 x 16	15-20	1.6-2.2
Special	Antenna Lower Support to Motor Housing Screw	1/4-20	55-75	NA
9.8	Antenna Lower Support Bracket to Fender	M8.0 x 1.25 x 20	55-75	6.0-8.4
6010M	Cornering Lamp to Fender Screws	M4.0 x 0.7 x 25	15-25	1.6-2.8
6172M	Fuel Economy Switch to Cowl Screw	M6.3 x 1.81 x 16	60	7.0
6010M	Fuse Block to Cowl Screws	M4.2 x 1.41 x 80	15-20	1.6-2.2
6010M	Headlamp Bezel; Ataching Screws	M4.2 x 1.41 x 25	15-20	1.6-2.2
6010M	Headlamp Housing Attaching Screws	M4.2 x 1.41 x 20	15-20	1.6-2.2
6010M	Horns and Horn Mounting Brkt. Screws	M7.9 x 2.12 x 20	20-25*	27-34
1050M	Lamp Monitor to Fender Nuts	M5.0 x 15	20-30	2.2-3.4
510M	Rearside Marker and Taillamp Attach Nut	M6.3 x 1.00	80-100	8.8-11.0
9.8	Theft Deterrent Controller to Inst. Panel	M.5.8 x 0.8 x 16	30-40	3.4-4.6
4435M	Washer Fluid Bottle Brkt. to Wheelhouse Nut	M11.0 x 6.3	45-65	5.0-25
6010M	Washer Nozzle Attach Screw	M4.2 x 1.41 x 16	10-20	1.1-2.2

*Foot Pounds

INSTRUMENT PANEL TORQUE SPECIFICATIONS (EXCEPT ELDORADO AND SEVILLE)

Material	Application	Size mm (Dia. x Pitch x Length)	Inch Pounds	Newton Metres
1022	Telltale Cluster to Inst. Panel Screw	M4.2 x 1.41 x 20	10-15	1.1-1.6
1022	Clock to Telltale Cluster Screw	M4.2 x 1.41 x 20	17-22	2.0-2.4
1022	Photocell Brkt. to Inst. Panel Screw	M4.2 x 1.41 x 20	10-15	1.1-1.6
5	Clock to Printed Circuit Nut	M4.0 x 0.70	6-12	0.6-1.4
1022	RH Upper Insert and Applique to Inst. Panel Screw	M4.2 x 1.41 x 20	10-15	1.1-1.6
1022	Headlamp Switch to Inst. Panel Screw	M4.2 x 1.41 x 20	10-15	1.1-1.6
1022	Cruise Control Switch to Inst. Panel Screw	M4.2 x 1.41 x 20	10-15	1.1-1.6
1022	Accessory Switch to Inst. Panel Screw	M4.2 x 1.41 x 20	10-15	1.1-1.6
1022	Air Cond. Control Head to Inst. Panel Screw	M4.2 x 1.41 x 20	10-15	1.1-1.6
6010M	Speedo. Cluster to Inst. Panel Screw	M4.2 x 1.41 x 20	10-20	1.1-2.2
1050M	Glove Box Door to Inner Panel Screw	M4.2 x 1.41 x 25	10-20	1.1-2.2
1050M	Glove Box Door to Filler Screw	M4.2 x 1.41 x 25	10-20	1.1-2.2
9.8	Glove Box Door Hinge to U-Nut Screw	M4.0 x 0.7 x 16	20-30	2.2-3.4
6010M	Glove Box Liner to Inst. Panel	8-18ST	10-20	N.A.
9.8	Striker Attach Screw	M5.0 x 0.8 x 25	30-40	2.2-3.4
1022	RH Insert and Applique Attach Screw-Outside	8-18TS	10-15	N.A.
1022	RH Insert and Applique Attach Screw-Inside	M4.2 x 1.41 x 20	10-15	1.1-1.6
1050M	Center Insert and Applique Attach Screw	M4.2 x 1.41 x 25	10-20	1.1-2.2
1022	Air Cond. Ducts Attach Screw	M4.2 x 1.41 x 20	10-20	1.1-2.2
1022	RH Outside Mirror Control Switch Attach Screw	M4.2 x 1.41 x 20	10-15	1.1-1.6
1050M	LH Insert and Applique Attach Screw	M4.2 x 1.41 x 25	10-15	1.1-1.6
1022	Wiper Switch to Inst. Panel Screw	M4.2 x 1.41 x 20	10-15	1.1-1.6
6010M	Inst. Panel RH and LH End Brkt. Side Attach Screw	M4.2 x 1.41 x 20	10-20	1.1-2.2
1022	Inst. Panel RH and LH End Brkt. Rear Attach Screw	M4.2 x 1.41 x 20	10-15	1.1-1.6
6010M	Inst. Panel RH and LH Attach. Brkt. to Body Screw	M8.0 x 1.25 x 25	18-25*	2.0-2.8
9.8	Inst. Panel RH and LH End Brkt. to Attach Brkt. Screw	M6.3 x 1.0 x 25	80-100	9.2-11.0
6010M	Inst. Panel to Body Top Attach Screw	M4.2 x 1.41 x 20	10-20	1.1-2.2
6010M	Inst. Panel Top Cover to Def. Grille Screw	M42. x 1.41 x 20	15-20	1.6-2.2
1050	Inst. Panel Top Cover to Def. Grille Nut	M4.0 x 0.70	5-8	0.6-1.0
6010M	Inst. Panel Top Cover to Inst. Panel Side Attach Screw	M4.2 x 1.41 x 20	10-15	1.1-1.6
6010M	Inst. Panel Top Cover to Inst. Panel Bottom Attach Screw	M4.2 x 1.41 x 45	15-20	1.6-2.2
1050	Speaker Grille Attach Nut	M4.0 x 0.70	5-8	0.6-1.0
1022	Radio to Inst. Panel Atach. Screw	M4.2 x 1.41 x 20	10-15	1.1-1.6

ST — Self Tapping Screw
NA — Not Applicable
* — Foot Pounds

INSTRUMENT PANEL (Eldorado)

GENERAL DESCRIPTION

The five major parts of the panel are the top cover, instrument panel pad, horizontal support, lower instrument panel cover and lower steering column cover. This section includes procedures for the removal and installation of all components that are a part of or attached to the above major parts. Included are the following:

Top Cover - Radio speakers, speakers and defroster grilles, twilight sentinel photocell, climate control sensor, fuel gage, digital clock, tell tale housing assembly and extensions.

Instrument Panel Pad - Windshield wiper switch, climate control outlets, doors and ducts.

Horizontal Support - Cluster assembly and bezel, left and right inserts and appliques, headlamp or guidematic or twilight sentinel switch, air conditioning control, cruise control switch, accessory switches (Sunroof, power antenna, rear window defogger) radio receiver, theft deterrent controller, rear window defogger relay, control for right hand mirror and map light.

Lower Instrument Panel Cover - Ashtray and lighter, glove box assembly and power trunk release switch.

Lower Steering Column Cover (Reinforcement) - Twilight sentinel amplifier and turn signal flasher.

The procedures for disassembly, assembly, or adjustment of the various components are covered in the specific sections of this manual where they apply. A full color Chassis Wiring Circuit diagram is located on the rear cover gatefold.

The instrument panel utilizes printed circuits in both the cluster and tell tale assemblies. They are connected to the wiring harness through multiple terminal connectors which are plugged into the back of the cluster and underside of the telltale assembly. The printed circuit permits removal of all bulbs and sockets without removing of any wire or terminal.

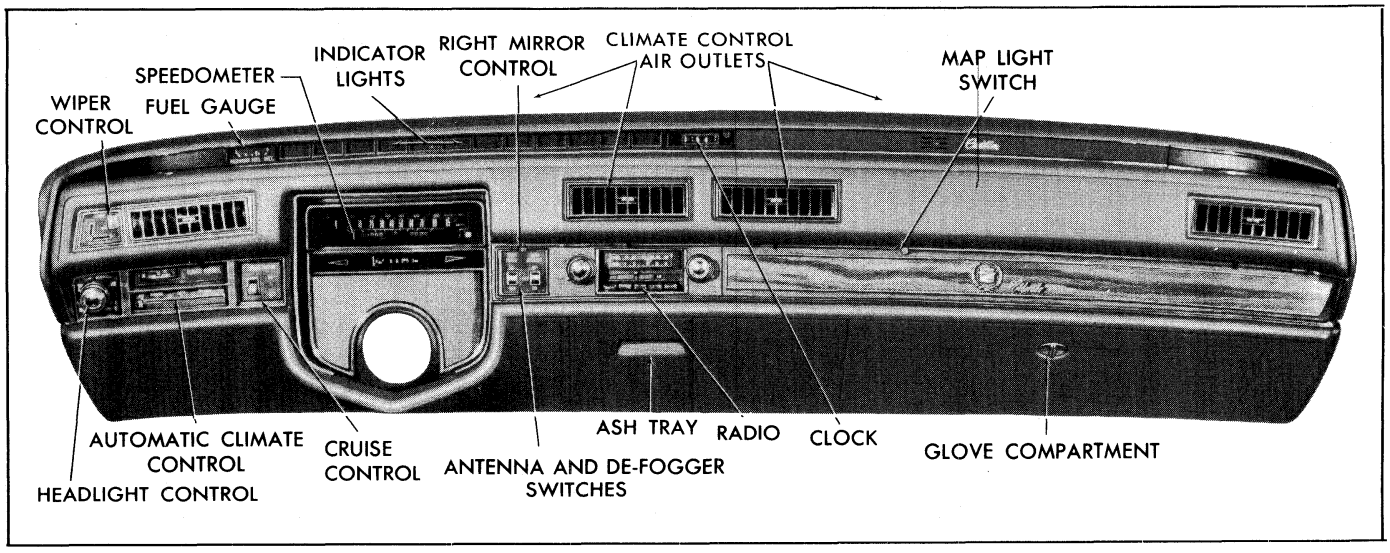


Fig. 8-15 Instrument Panel Assembly (Eldorado)

ON-CAR SERVICE

Climate Control Air Outlet Grilles (Fig. 8-16)

a. Removal

1. Using Remover and Installer Tool, J-24612, compress release tabs.
2. Rotate grille upward and remove grille.

b. Installation

Using Remover and Installer Tool J-24612 compress release tabs and position grille.

2. Remove tool and position grille so that tabs snap into retaining holes.

Lower Steering Column Cover (Fig. 8-17)

a. Removal

1. Remove four screws securing lower cover to lower steering column cover reinforcement.
2. Remove four screws securing lower cover to instrument panel horizontal support.

b. Installation

1. Place lower cover in position and install four screws securing cover to instrument panel horizontal support.
2. Install four screws securing lower cover to lower steering column cover reinforcement.

Instrument Panel Pad (Fig. 8-18)

a. Removal

1. Disconnect negative battery cable.
2. Remove three climate control outlet grilles - right, left and right center - as described above.



Fig. 8-16 Removing Air Conditioning Air Outlet Grille (Eldorado)

3. Working through outlet openings, remove 3 fasteners securing pad to instrument panel support.

4. Remove 4 screws securing pad to instrument panel horizontal support.

5. Pull pad outward and disconnect electrical connector from windshield wiper switch.

6. Remove pad.

NOTE: To facilitate removal or installation, place shift lever in lo range and on cars equipped with tilt wheel, place wheel in lowest position.

b. Installation

1. Position pad to instrument panel and connect electrical connector for wiper switch.

2. Install 4 screws securing pad to instrument panel horizontal support.

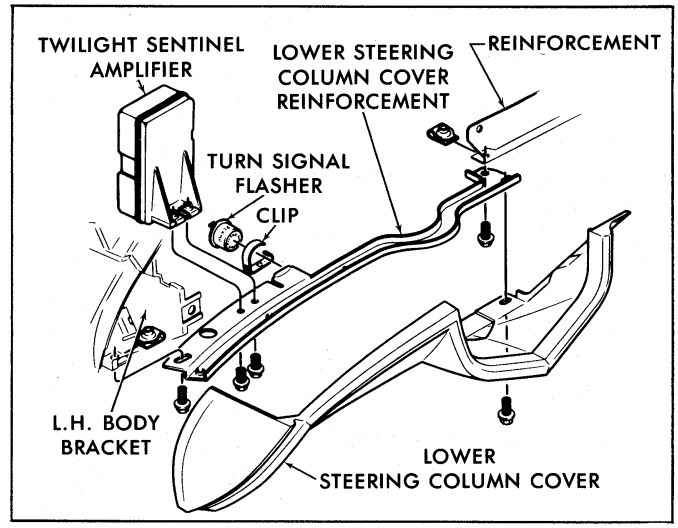


Fig. 8-17 Lower Steering Column Cover (Eldorado)

3. Working through climate control outlet openings, install 3 fasteners securing pad to instrument panel support.

4. Install air outlet grilles as described above.

5. Connect negative battery cable. Tighten to 70 inch-pounds.

Instrument Panel Top Cover (Fig. 8-19)

a. Removal

1. Remove instrument panel pad as described above.

2. Remove screw securing top cover to left and right side of instrument panel.

3. Remove 2 top cover to horizontal support studs.

4. Loosen, but do not remove, nut securing top cover to instrument panel brace on cowl.

NOTE: Nut is located forward and to the left of the clock.

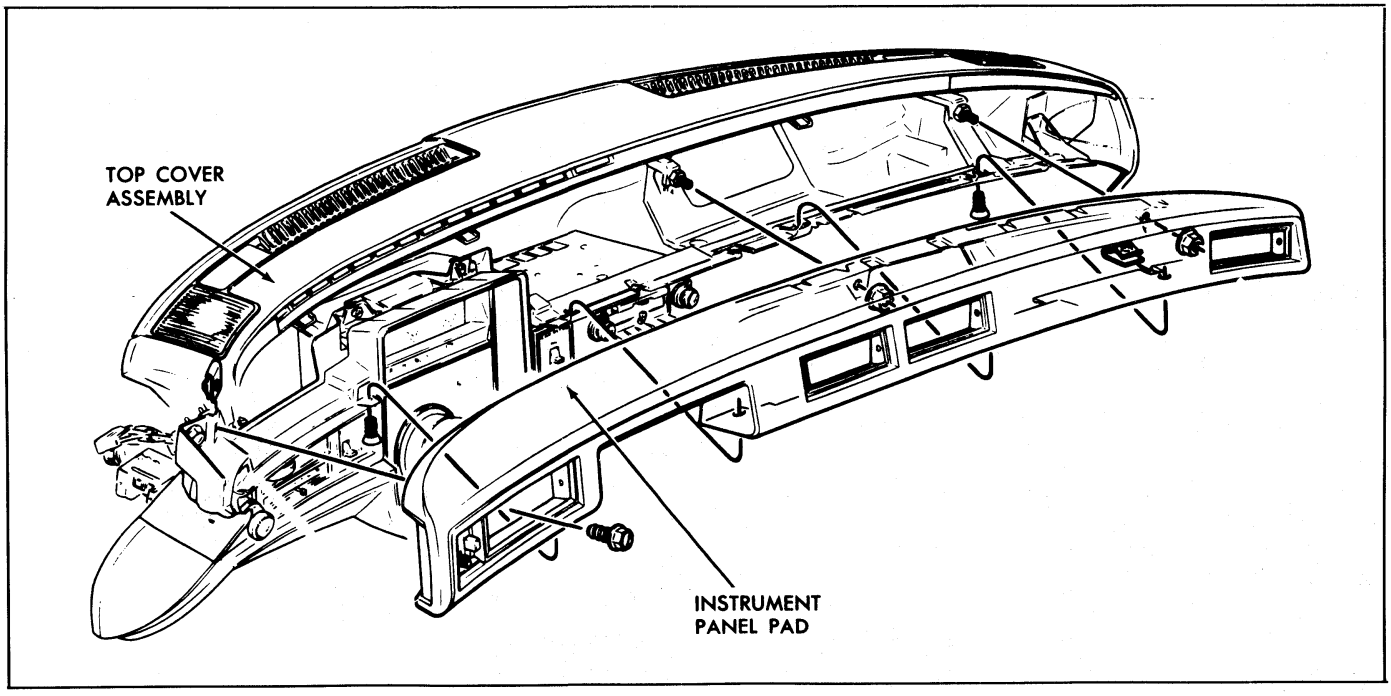


Fig. 8-18 Removing Instrument Panel Pad (Eldorado)

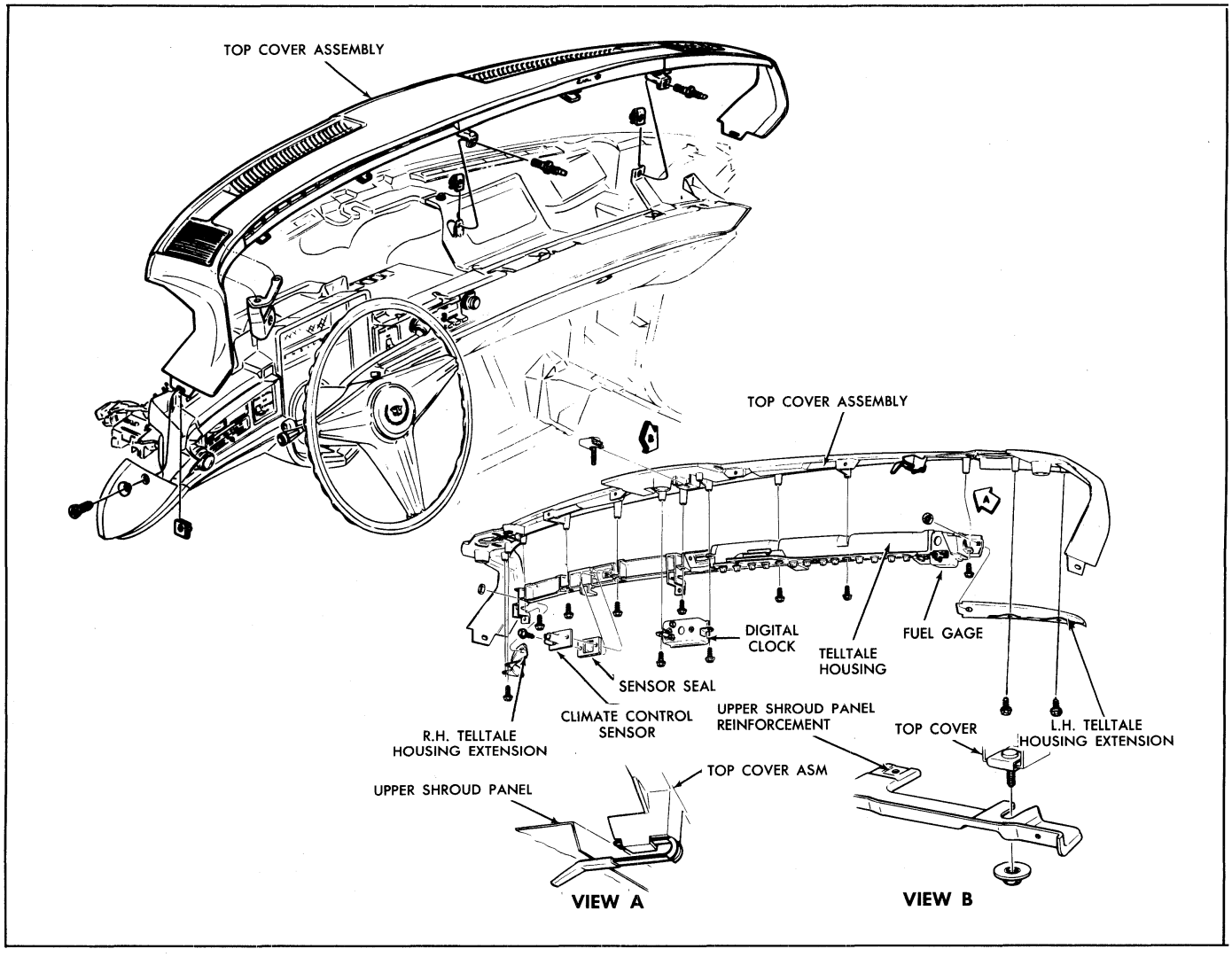


Fig. 8-19 Instrument Panel Top Cover Assembly (Eldorado)

5. Working from under panel, disconnect radio front speaker connector at radio.

6. Pull top cover straight out and lift slightly to gain access and disconnect the following connections as required; printed circuit connector, fuel gage connector and bulb, clock connector and bulb, climate control in-car sensor hose and twilight sentinel photocell.

7. Remove top cover.

b. Installation

1. Position top cover and connect the following connectors as required: printed circuit connector, fuel gage connector and bulb, clock connector and bulb, climate control in-car sensor, and twilight sentinel photocell.

2. Slide top cover into position and tighten nut securing cover to instrument panel brace on cowl.

3. Install screw securing top cover to right side of instrument panel and 2 top cover-to-horizontal support studs.

4. Connect radio front speaker connector at radio.

5. Install instrument panel pad as described above.

Speedometer Cluster Bezel Assembly (Fig. 8-20)

a. Removal

1. Remove 6 screws securing bezel t cluster and remove bezel.

NOTE: Bezel comes out in two pieces. Steering column seal is attached to bezel and split on lower surface for removal.

b. Installation

1. Position upper bezel against cluster snd secure with 4 screws.

2. Position lower bezel and steering column seal to steering column.

3. Secure with 2 screws.

Speedometer Cluster (Fig. 8-20)

a. Removal

1. Disconnect negative battery cable.

2. Remove cluster bezel as described above.

3. With shift lever in "P" (Park) remove 1 screw securing shift indicator cable to steering column.

4. Remove 2 upper screws securing cluster assembly to instrument panel horizontal support.

5. Remove 2 lower inboard screws securing cluster to horizontal support.

NOTE: The 2 outboard screws remain in place for rear speedometer cable mounting.

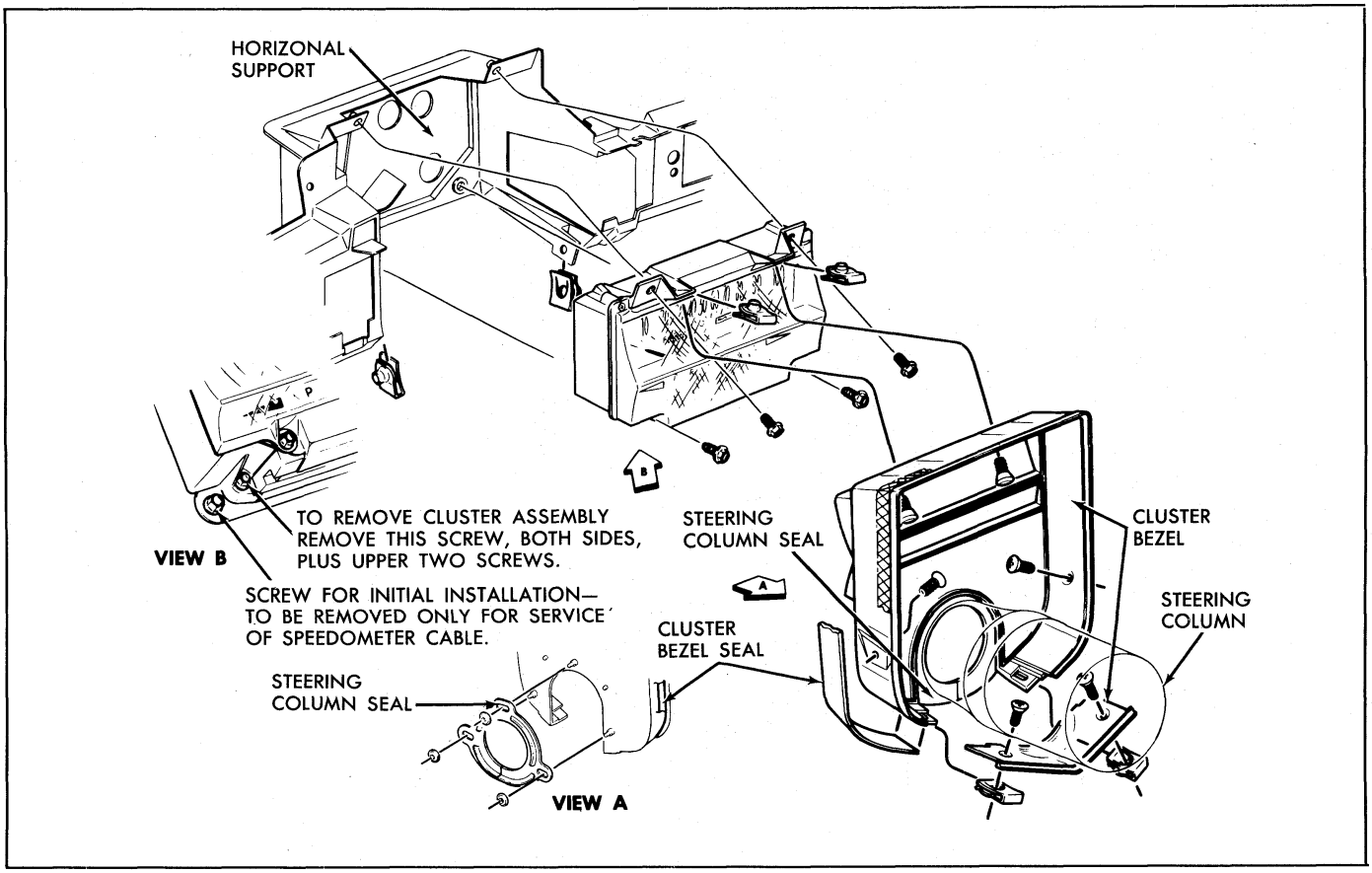


Fig. 8-20 Speedometer Cluster and Bezel (Eldorado)

6. Pull cluster outward to disengage from speedometer cable, rotate top downward and disconnect printed circuit connector.

CAUTION: *On vehicles so equipped, disconnect speed control sensor electrical connector from cluster with a small screwdriver (Fig. 9-39) prior to completely removing cluster assembly. This will prevent connector from damaging cluster as cluster assembly is being removed from car.*

7. Remove cluster.

NOTE: Removal or installation can be facilitated by placing shift lever in low range and on cars equipped with tilt wheel, placing the wheel in lowest position.

b. Installation

1. Connect printed circuit connector to cluster and speed control electrical connector if so equipped.
2. Place cluster into position in the instrument panel and engage speedometer cable.
3. Install 4 screws securing cluster to instrument panel.
4. With column in "P" (Park) loosely install screw securing shift indicator cable to steering column and align pointer with column in Neutral. Tighten screw.
5. Install cluster bezel as described above.
6. Connect negative battery cable.

Cluster Printed Circuit (Fig. 8-77)

a. Removal

1. Remove cluster as described above.
2. Remove all sockets and bulbs from cluster case.
3. Remove printed circuit.

NOTE: No attempt should be made to repair this circuit. If inoperative, it should be replaced.

b. Installation

1. Position printed circuit on back of cluster case.
2. Install all sockets and bulbs into cluster case. See Fig. 8-77.

NOTE: Black socket should contain a No. 161 bulb specific to shift indicator illumination. All other sockets are gray with No. 194 bulbs.

Speedometer Head (Fig. 8-21)

a. Removal

1. Remove speedometer cluster as described above.
2. Remove 4 screws securing speedometer cluster lens to cluster housing.
3. Remove lens and face plate.
4. Remove selector quadrant assembly from cluster housing by pulling straight out.
5. Remove 2 rubber mounted screws securing speedometer head assembly and remove from cluster housing.
6. Remove 2 screws securing dial to speedometer head and remove dial. Use care not to damage pointer.

b. Installation

1. Install 2 screws securing dial to speedometer head. Use care not to damage pointer.
2. Install 2 screws through rubber bushings in

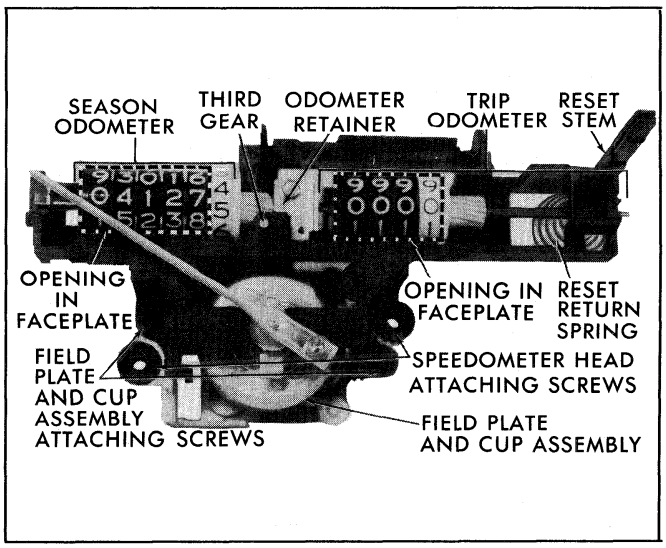


Fig. 8-21 Speedometer Head

speedometer head assembly and secure to cluster housing.

3. Install selector quadrant assembly to cluster housing.

4. Install face plate and lens. Secure with 4 screws.

5. Install speedometer cluster and speedometer cluster bezel as described above.

SPEEDOMETER HEAD COMPONENT SERVICE (Fig. 8-21)

a. Disassembly

1. Remove screw and odometer retainer plate.

2. Remove trip odometer assembly (trip odometer assembly is serviced only as a complete unit).

3. Remove season odometer assembly (season odometer assembly is serviced only as a complete unit).

4. Remove jack gear.

5. Remove trip reset spring retainer by pinching upper and lower clips together.

6. Remove reset rack and spring assembly.

NOTE: Further disassembly requires removal of field plate and speed cup assembly and subsequent recalibration of speedometer. If speedometer tester is not available for recalibration, repairs requiring disassembly beyond this point should be referred to your designated speedometer service station.

7. Carefully remove orange painted pointer assembly (press fit). Turn against zero stop and lightly lift pointer assembly at hub.

8. Remove 2 screws securing speed cup assembly to frame and remove.

NOTE: On cars equipped with Cruise Control be sure to keep magnet shaft and speed cup free of contaminants to avoid improper speed signals to speed sensor.

9. Remove third gear.

10. Inspect second gear for signs of damage. Do not remove unless necessary. Remove from frame assembly if necessary.

NOTE: Further disassembly, such as removal of the magnet shaft from frame and speed cup assembly is not recommended.

b. Assembly

1. If removed, position second gear in frame assembly with gear end contacting worm gear magnet shaft.

NOTE: On cars equipped with Cruise Control be sure to keep field plate and cup assembly free of contaminants to avoid improper speed signals to speed sensor.

2. If removed, position third gear with bevel gear end engaging worm gear end on second gear.

3. If removed, position speed cup assembly to frame and secure with 2 screws.

NOTE: Make sure speed cup stop tab is on correct side of field plate so as to permit needle rotation. Hairspring coil on speed cup must be evenly spaced when in wound position. It may be necessary to use tweezers to adjust coils. Move regulator arm to horizontal position, if necessary, so that maximum adjustment may be made in either direction during calibration.

4. Install reset rack and spring assembly and spring retainer.

5. Install jack gear.

6. Rotate trip odometer wheels until all zeros are opposite slotted ears (zeros facing forward).

7. Wipe odometers clean of fingerprints with a lint free cloth or soft chamois.

8. Install odometers, making sure slotted ears of pinion carriers fit in locating slots.

9. Install retainer plate and secure with screw.

10. Mount pointer on tapered spindle so that it points at approximately 30 mph. Twist pointer back to, and in line with, "0" graduation while pressing down lightly.

11. Check for secure pointer to spindle contact by inserting a short piece of speedometer cable with proper tip in drive end of speedometer. An initial fast spin of test cable should swing pointer to approximately 30 mph and then briskly return to "0". Perform this test several times. If pointer becomes loose on spindle, repeat Step 10.

12. If during the performance of Step 11 pointer returns to "0" intermittently or not at all, this indicates a speed cup and magnet assembly malfunction.

13. If field plate and speed cup assembly were removed, calibrate speedometer assembly, following the instructions furnished by the manufacturer for the speedometer tester being used.

SPEEDOMETER CABLE AND CABLE HOUSING

a. Removal

1. Remove Speedometer Cluster and Bezel as described on Page 8-23.

2. Disconnect cable housing from locking spring on mounting plate and pull through firewall from underhood.

3. Raise car on hoist.

4. Disconnect cable at transmission.

5. Remove cable assembly.

b. Installation

1. Raise car on hoist.

2. Install cable to transmission.

3. Route cable up through engine compartment using retaining clips.

4. Lower car.

5. Route cable through dash and install grommet into hole. Cable end must be protected with tapered end cap to force through grommet.

6. Install Speedometer Cluster and Bezel as described on Page 8-23.

SPEEDOMETER DRIVEN GEAR (Fig. 8-22)

Refer to Figure 8-22 for the removal and installation of speedometer driven gears.

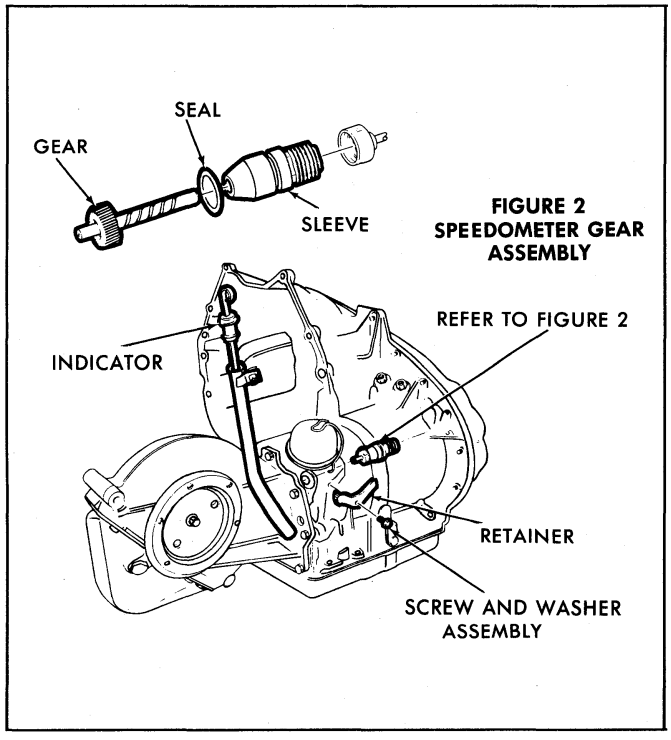


Fig. 8-22 Speedometer Driven Gear (Eldorado)

Twilight Sentinel Photocell (Fig. 8-23)

NOTE: Should it be necessary to replace the photocell, both photocell and amplifier must be replaced as a matched set.

a. Removal

1. Disconnect negative battery cable.
2. Remove three climate control air outlet grilles right, left, and right center as described on Page 8-21.
3. Working through outlet openings, remove 3 fasteners securing pad to instrument panel support.
4. Remove screws securing pad to horizontal support and move pad rearward to gain access to photocell.
5. Rotate plastic photocell holder counterclockwise to remove from underside of top cover.
6. Remove photocell from plastic holder.

b. Installation

1. Insert photocell into plastic holder.
2. Insert plastic holder into underside of top cover and rotate clockwise.
3. Position pad and secure with screws to horizontal support.
4. Working through climate control outlet openings, install 3 fasteners securing pad to instrument panel support.
5. Install air outlet grilles as described on Page 8-21.
6. Connect negative battery cable. Tighten to 70 inch-pounds.

Twilight Sentinel Amplifier (Fig. 8-23)

NOTE: Should it be necessary to replace the photocell, both photocell and amplifier must be replaced as a matched set.

a. Removal

1. Remove 2 screws and washers securing amplifier to lower steering column cover reinforcement.
2. Disconnect electrical connector at amplifier and remove amplifier.

b. Installation

1. Connect electrical connector at amplifier.
2. Position amplifier on lower steering column cover reinforcement and secure with 2 screws and washers.

Tell-Tale Printed Circuit (Fig. 8-19 and 8-75)

a. Removal

1. Remove instrument panel top cover as described on Page 8-22.
2. With cover lying top down on bench, remove all tell tale bulbs and sockets.

NOTE: Bulbs must be reinstalled in correct locations for proper functioning of tell tale circuits.

3. Remove screws securing printed circuit to tell tale housing and remove printed circuit.

b. Installation

1. Position printed circuit on tell tale housing and secure with one screw.

NOTE: Circuit is positioned to connector opening with double sided tape. Printed circuit tabs must be centrally positioned to insure proper connections.

2. Install all tell tale bulbs and sockets.
3. Install top cover as described on Page 8-22.
4. Install instrument panel pad as described on Page 8-21.

SPEEDOMETER GEAR APPLICATION CHART

Series	Axle Ratio	Tire Size	Transmission Type And Model	Speedo-Meter Drive Gear No. of Teeth	Color of Driven Gear	Driven Gear No. of Teeth
DeVille	2.28	GR78-15	THM400	36	White	21
DeVille	2.73	GR78-15	THM400	37	Red	18
DeVille	3.08	GR78-15	THM400	42	Green	18
Brougham	2.28	HR78-15	THM400	36	White	21
Brougham	2.73	HR78-15	THM400	37	Red	18
Brougham	3.08	HR78-15	THM400	42	Green	18
Limousine	3.08	HR78-15	THM400	41	Yellow	18
Commercial	3.08	HR78-15	THM400	41	Yellow	18
Eldorado	2.73	LR78-15	THM425	27	Black	14
Eldorado	3.07	LR78-15	THM425	31	White	14
Seville	2.56	GR78-15	THM400	35	Pink	18
Seville	3.08	GR78-15	THM400	42	Green	18

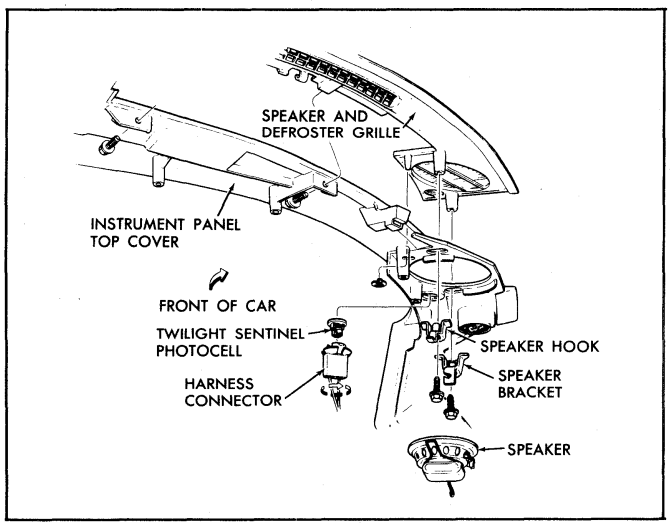


Fig. 8-23 Twilight Sentinel Photocell (Eldorado)

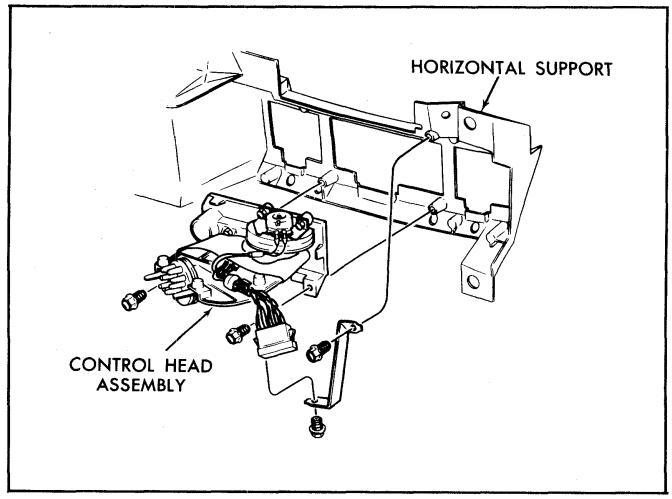


Fig. 8-24 Air Conditioner Control Head (Eldorado)

Tell-Tale Housing (Components and Lenses) (Fig. 8-19)

a. Removal

1. Remove tell-tale printed circuit as described above.
2. Remove 2 screws securing fuel gage and remove gage.
3. Remove remaining tell tale housing and extensions to top cover screws and remove housing assembly.
4. Remove tell tale housing cover screws, cover and tell tale lenses.

b. Installation

1. Position tell tale lenses into housing install cover and secure with screws.
2. Position tell tale housing onto top cover and install attaching screws.
3. Install fuel gage to tell tale housing with 2 screws.
4. Attach printed circuit board to tell tale housing cover.
5. Install printed circuit connector and bulbs.
6. Install instrument panel top cover as described on Page 8-22, and instrument panel pad as described on Page 8-21.

Air Conditioning Control Head (Fig. 8-24)

a. Removal

1. Disconnect negative battery cable.
2. Remove lower steering column cover as described on Page 8-21.
3. Remove 2 control to support mounting screws.
4. Remove control to bracket mounting screw from left rear corner of control.
5. Remove control from support and disconnect vacuum connector, electrical connector and bulb.

b. Installation

1. Connect vacuum connector, electrical connector and bulb to control.
2. Install control to support and bracket and attach with 3 mounting screws.
3. Install lower steering column cover as described on Page 8-21.
4. Connect negative battery cable. Tighten to 70 inch-pounds.

Climate Control In-Car Sensor (Fig. 8-19)

a. Removal

1. Remove instrument panel top cover as described on Page 8-22.
2. Disconnect aspirator hose from sensor. Remove 2 screws securing sensor to tell tale assembly and remove sensor.

b. Installation

1. Position sensor on tell tale assembly and secure with 2 screws. Connect aspirator hose to sensor.
2. Install instrument panel top cover as described on Page 8-22 and instrument panel pad as described on Page 8-21.

Climate Control Outlet Doors and Bezels (Fig. 8-25)

a. Removal

1. Remove instrument panel pad as described on Page 8-21.
2. With pad lying face down on bench, remove 2 screws and plastic guides securing door to pad and remove door.
3. Push bezel out of pad from the rear side of the pad.

b. Installation

1. Push bezel into instrument panel pad from the front side of the pad.
2. Position door on pad and secure with 2 plastic guides and screws.
3. Install instrument panel pad as described on Page 8-21.

Climate Control Duct - Left Side (Fig. 8-25)

a. Removal

1. Remove instrument panel pad as described on Page 8-21.
2. Remove 4 screws securing duct to cover and remove duct.

b. Installation

1. Position duct on cover and secure with 4 screws.
2. Install instrument panel pad as described on Page 8-21.

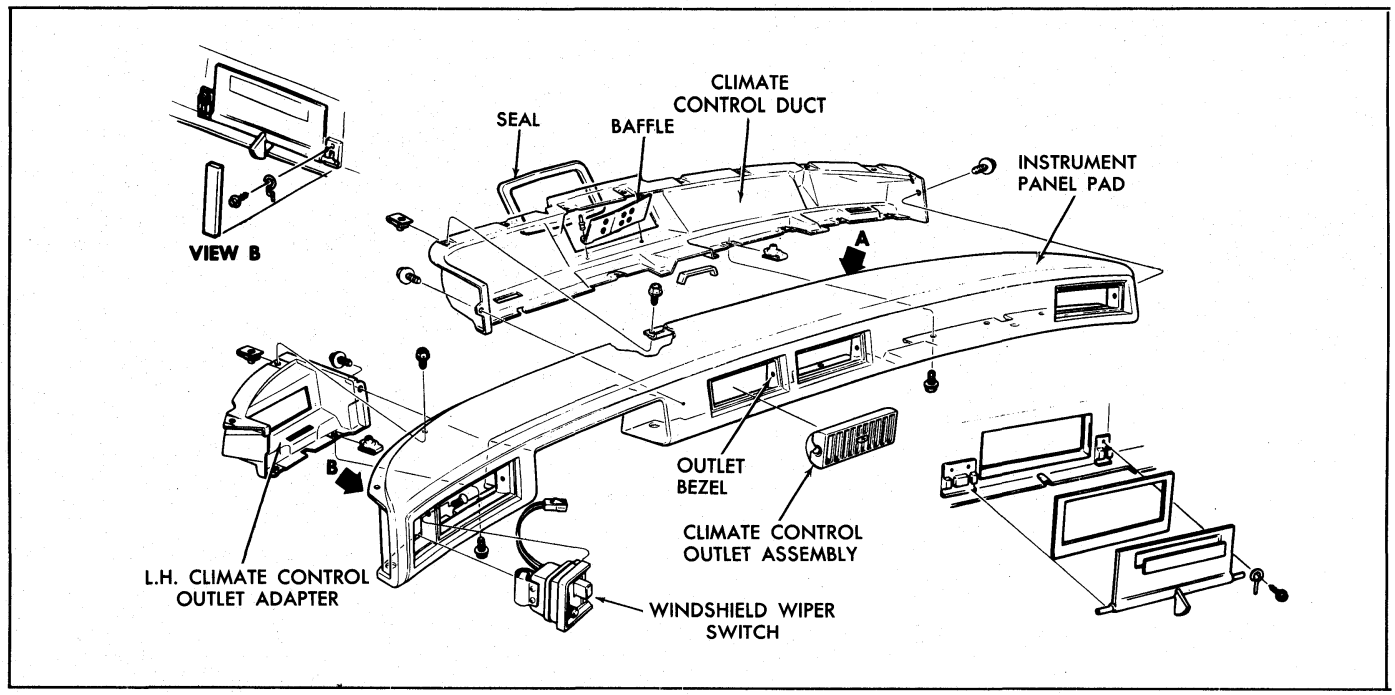


Fig. 8-25 Instrument Panel Pad - Disassembled (Eldorado)

Climate Control Duct - Right Side (Fig. 8-25)

a. Removal

1. Remove instrument panel pad as described on Page 8-21.

2. With panel lying face down on bench, remove 15 screws securing right hand duct to panel and remove duct.

b. Installation

1. Position duct onto panel and secure with 15 screws.

2. Install instrument panel pad as described on Page 8-21.

Windshield Wiper Switch (Fig. 8-25)

a. Removal

1. Disconnect negative battery cable.

2. Remove left hand climate control outlet grille as described on page 8-21.

3. Working through outlet opening, remove screw securing switch to instrument panel.

4. Pull wiper switch and electrical connector out of panel and disconnect from harness.

b. Installation

1. Install electrical connector to harness and position switch into instrument panel pad opening.

2. Working through air outlet grille, install screw securing switch to instrument panel.

3. Install left hand climate control outlet grille as described on Page 8-21.

4. Connect negative battery cable. Tighten to 70 inch-pounds.

Ash Tray (Fig. 8-26)

a. Removal

1. Remove lower steering column cover as described on Page 8-21.

2. Remove ash tray lower bracket to reinforcement screw.

3. Remove 2 attaching screws on left ash tray mounting bracket.

4. Remove right hand ash tray attaching screw (use 5/16" nutrunner or socket with 3" extension and work from lower edge of instrument panel.)

5. Remove ash tray from instrument panel and disconnect electrical connector and bulb.

b. Installation

1. Install electrical connector and bulb.

2. Position ash tray and loosely install screws.

3. Align right side with intrument panel lower cover and tighten screws.

4. Install lower steering column cover as described on Page 8-21.

Ash Tray Door and Cigar Lighter Base Assembly (Fig. 8-26)

Removal

1. Open ash tray and depress flat stop spring.

2. Pull ash tray out just enough to gain access to 4 screws.

3. Remove 4 screws securing ash tray door to ash tray housing.

4. Disconnect cigar lighter electrical connector.

5. Disconnect ash tray housing bulb and shield.

6. Remove lighter base from sleeve by holding sleeve and rotating lighter base.

7. Remove lighter base from ash tray housing.

b. Installation

1. Position lighter base in ash tray housing.

2. Hold lighter sleeve in position and screw base into

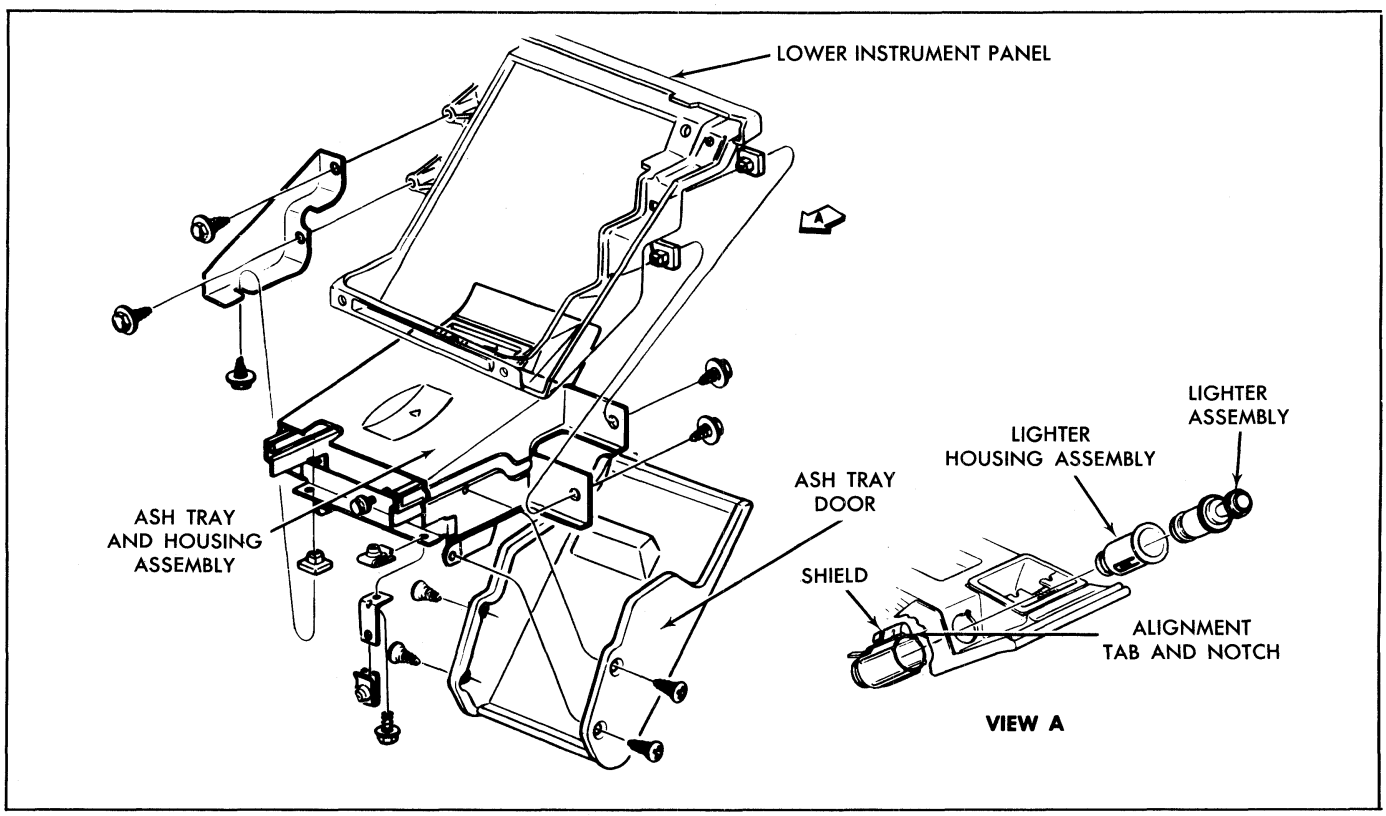


Fig. 8-26 Ash Tray - Disassembled (Eldorado)

sleeve. Bulb shield must face up when tight to allow light to enter ash tray receptacle.

3. Connect ash tray housing bulb shield and feed wires to cigar lighter base.

4. Secure ash tray door to ash tray housing with 4 screws.

5. Depress flat stop spring and push ash tray assembly forward.

Left Hand Instrument Panel Insert (Fig. 8-27)

a. Removal

1. Remove lower steering column cover as described on Page 8-21.

2. Remove 4 screws securing insert to horizontal support.

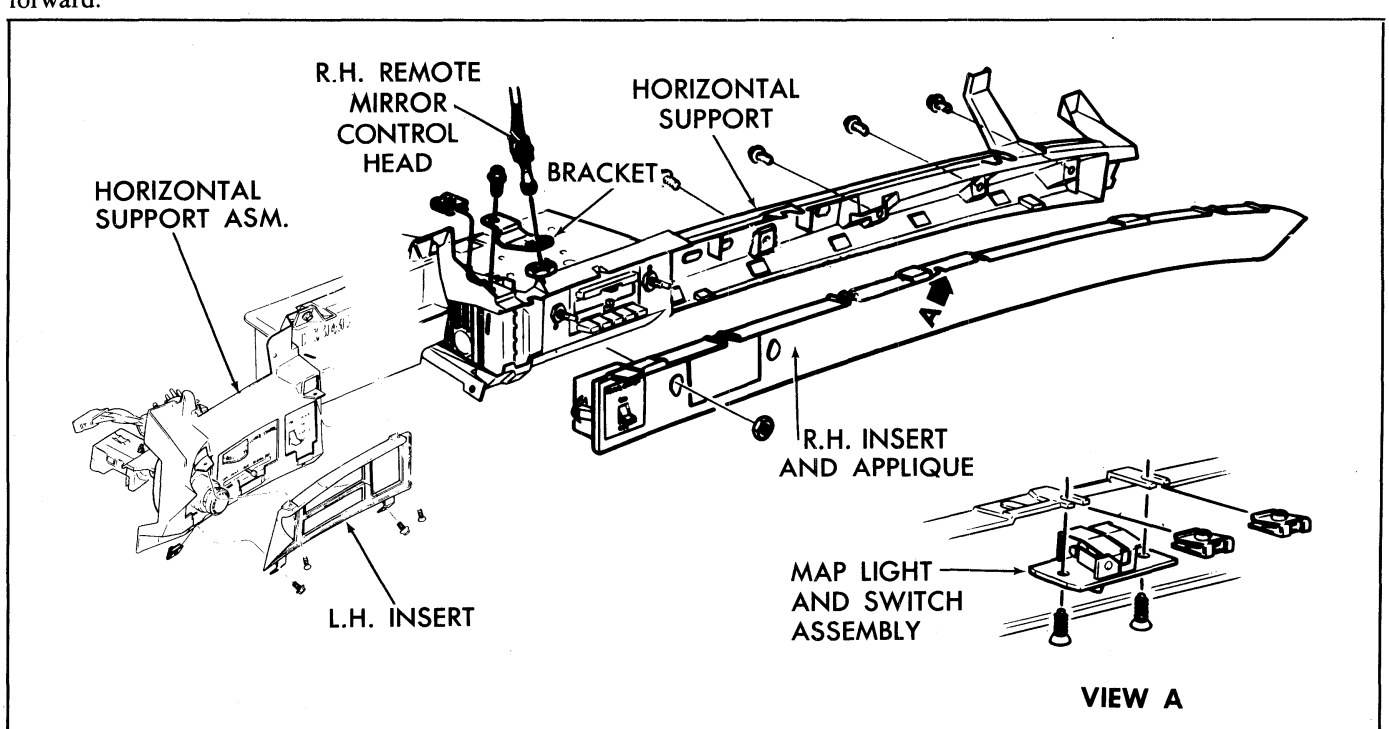


Fig. 8-27 Inserts, Map Light and R.H. Mirror Control (Eldorado)

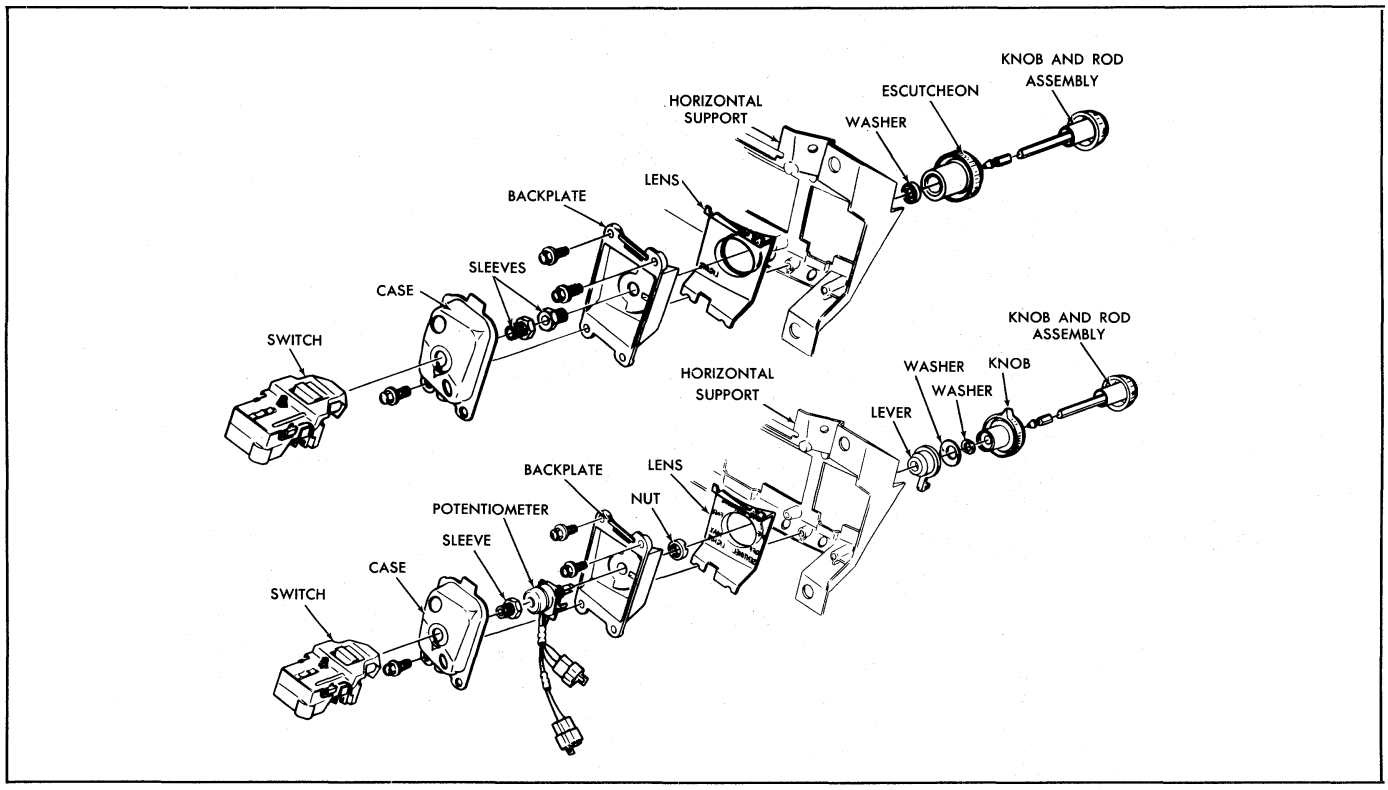


Fig. 8-28 Headlamp Switches - Disassembled (Eldorado)

b. Installation

1. Position insert on instrument panel and secure with 4 screws.
2. Install lower steering column cover as described on Page 8-21.

Right Hand Instrument Panel Insert and Applique (Fig. 8-27)

a. Removal

1. Remove radio knobs, anti rattle springs, control rings and left hex nut.
2. Remove attaching screws from rear of insert through opening in top of glove box.
3. Push accessory switch(es) until it "snaps" out of insert and applique and disconnect bulbs **carefully noting which lamps go to each switch.**

NOTE: Incorrect installation will affect accessory switch lighting. See Fig. 8-29).

4. Disconnect map light connector.

b. Installation

1. Connect map light connector.
2. Connect accessory switch(es) and bulbs to insert and applique in the exact position from which they were removed. See Fig. 8-29.
3. Position insert and applique onto support and install screws.
4. Install left hex nut, control rings, anti rattle springs and radio knobs.

Headlamp Switch (Guide Matic or Twilight Sentinel Switch) (Fig. 8-28)

a. Removal

1. Disconnect negative battery cable.
2. Remove lower steering column cover as described on Page 8-21.
3. Disconnect headlamp electrical connector and lower bulb.
4. Pull knob to "headlamps on" position, depress spring loaded button on top side of switch and while holding the button remove the knob, escutcheon and washer.
5. Remove 3 headlamp switch case to instrument panel support screws.
6. Lower switch assembly, disconnect upper bulb and remove switch.

b. Installation

1. Position switch assembly (connector down), install upper bulb and position into instrument panel horizontal support.
2. Secure with 3 attaching screws.
3. Install knob, escutcheon and washer by depressing spring loaded button on top side of switch and while holding the button insert the knob, escutcheon and washer into the switch.
4. Connect headlamp electrical connector and lower bulb.
5. Install lower steering column cover as described on Page 8-21.
6. Connect negative battery cable. Tighten to 70 inch-pounds.

Cruise Control Switch (Fig. 8-15)

a. Removal

1. Disconnect negative battery cable.
2. Remove lower steering column cover as described on Page 8-21.

3. Disconnect cruise control electrical connectors and bulbs.

4. Remove 2 switch to instrument panel horizontal support screws.

NOTE: Use of a three inch extension will aid in the removal of upper screw.

5. Remove switch assembly.

b. Installation

1. Position switch assembly into instrument panel and install 2 attaching screws.

2. Connect cruise control electrical connectors and bulbs.

3. Install lower steering column cover as described on Page 8-21.

4. Connect negative battery cable. Tighten to 70 inch-pounds.

Power Antenna Relay

a. Removal

1. Pull carpet away from front passenger side toe pan.

2. Disconnect 2 electrical connectors.

3. Remove 2 screws and washers securing delay and bracket to toe pan.

b. Installation

1. Position relay and bracket on toe pan and secure with 2 screws.

2. Connect electrical connectors.

3. Reposition carpet.

Trunk Release Switch

a. Removal

1. Open glove box door.

2. Reaching through glove box liner access hole, disconnect electrical connector from trunk release switch.

3. Depress tabs on trunk release switch and remove from passenger side of panel.

b. Installation

1. Depress tabs on trunk release switch and carefully insert switch into mounting cutout.

2. Reach through top of glove box liner to make certain tabs are fully extended.

3. Connect electrical connector to switch.

4. Depress switch button to check trunk release for proper operation.

Theft Deterrent Controller

See Page 9-74 for removal and installation of theft deterrent controller.

Accessory Switches and Housing (Figs. 8-27 and 8-29)

a. Removal

1. Remove instrument panel pad as described on Page 8-21.

2. Remove right hand insert and applique as described on page 8-30.

3. Push switch from insert and applique side of instrument panel until it "snaps" out of the accessory switch housing.

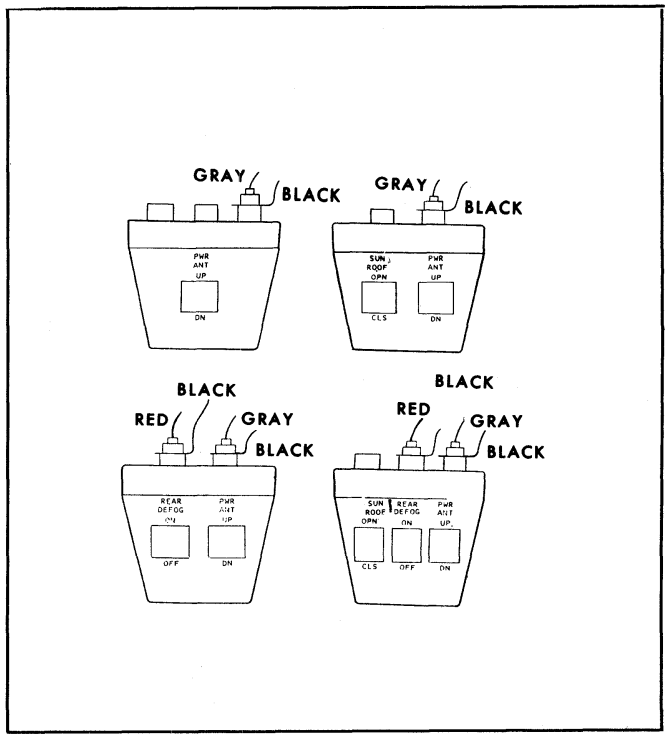


Fig. 8-29 Accessory Switch Wiring (Eldorado)

NOTE: Accessory switch housing need not be removed in accessory switch replacement.

4. Remove accessory switch wiring terminals from accessory switch electrical connector.

5. Remove 2 screws and accessory switch housing.

b. Installation

1. Position accessory switch housing and install 2 housing to instrument panel support screws.

2. Install accessory switch wiring terminals into accessory switch electrical connector.

NOTE: See chassis wiring circuit diagram on rear cover gatefold for wiring color codes.

3. Push accessory switch into the switch housing until it "snaps" into position.

4. Install right hand insert and applique as described on Page 8-30.

5. Install instrument panel pad as described on Page 8-21.

Accessory Switch Bulb

a. Removal

1. Remove radio knobs, anti rattle springs, control rings and left hand hex nut.

2. Remove left hand insert and applique to horizontal support screw.

3. Gently pull left edge of applique until bulb sockets are exposed.

4. Remove bulb.

NOTE: Proper bulb location and type are important to ensure correct accessory switch lighting.

b. Installation.

1. Install new bulb.

2. Position insert and applique against horizontal support.

3. Install left hand retaining screw.

4. Install left hand radio hex nut, control rings, anti rattle springs and knobs.

Fuel Gage (Fig. 8-19)

a. Removal

1. Remove instrument panel top cover as described on Page 8-22

2. Remove 3 nuts securing wiring to fuel gage, Fig. 8-19.

3. Remove 2 screws securing fuel gage to telltale housing.

b. Installation

1. Position fuel gage on talltale housing and secure with 2 screws.

2. Install electrical connectors.

3. Install instrument panel top cover as described on Page 8-23 and instrument panel pad as described on Page 8-21.

Digital Clock (Fig. 8-19)

a. Removal

1. Remove instrument panel top cover as described on Page 8-22.

2. Disconnect electrical connector and bulbs.

3. Remove 2 screws securing clock to top cover.

CAUTION: *Pull clock straight back to avoid damaging the reset stem.*

4. Remove clock.

b. Installation

1. Install bulb and electrical connector.

2. Position clock on top cover using care to align reset stem with hole in lens and secure with 2 screws.

3. Install instrument panel top cover as described on Page 8-22 and instrument panel pad as described on Page 8-21.

Rear Window Defogger Timer Relay and Circuit Breaker

a. Removal

1. Disconnect negative battery cable.

2. Remove lower steering column cover as described on Page 8-21.

3. Remove 2 screws which attach relay to lower steering column cover reinforcement.

4. Disconnect electrical connectors and remove relay.

b. Installation

1. Connect electrical connectors.

2. Secure relay to lower steering column cover reinforcement with 2 screws.

3. Install lower steering column cover as described on Page 8-21.

4. Connect negative battery cable.

Hood Lock Primary Release

a. Removal

1. Remove clip from cable at hood lock.

2. Thread cable from radiator cradle.

3. Remove screws securing left side sill plate and remove sill plate.

4. Remove screw securing left side kick panel.

5. Partially remove kick panel to gain access to lock handle.

6. Pull handle bracket from behind tab on kick panel and remove cable assembly.

b. Installation

1. Thread cable through kick panel and firewall.

2. Install handle assembly in kick panel so that handle is vertical and away from panel as far as possible.

3. Install handle assembly by securing under tab on kick panel.

4. Position kick panel and secure with screw.

5. Install sill plate and secure with screws.

6. Thread cable through inside of fender well and secure to hood lock latch with clip.

Glove Box Liner

a. Removal

1. Remove 5 screws that secure glove box liner to glove box housing.

CAUTION: *Do not apply excessive downward pressure to the door at this point, as it may break the glove box door hinge.*

2. Carefully remove glove box liner through door opening.

b. Installation

1. Position glove box liner into housing through door opening.

2. Align glove box liner to housing and secure with 4 attaching screws, leaving the upper right screw out.

3. Position right hand door stop cable to liner at upper right hand position and secure with remaining screw.

Glove Box Door

a. Removal

1. From underside of instrument panel, remove three hinge to support screws.

2. Open glove box door and remove door stop cable screw.

3. Remove door.

b. Installation

1. Position glove box door and attach door stop cable screw.

2. Loosely install three hinge to support screws.

3. Close glove box door, align with lower instrument panel and tighten screws.

Glove Box Lock Cylinder

a. Removal

1. Open glove box door.

2. Insert key and pull latch mechanism arm to latch position. Turn key to lock position and remove key.

3. Through slot in top of lock case, depress cylinder retainer and insert key into lock cylinder.

4. Release retainer and remove lock cylinder assembly.

NOTE: Lock cylinder knob is not serviced separately from cylinder.

b. Installation

1. While holding lock cylinder assembly in hand depress retainer (tumbler closest to knob) insert key and release retainer. All tumblers and retainer should be flush with lock cylinder housing.
2. Install cylinder into case with retainer at top and rotate key and lock cylinder clockwise until a "click" is heard.
3. Close glove box door, remove key and check for proper operation.

Glove Box lock Case

a. Removal

1. Remove lock cylinder as described above.
2. Remove escutcheon.
3. Remove washer, filler and lock cylinder case.

b. Installation

1. Position lock cylinder, filler and washer onto glove box door.
2. Install escutcheon.
3. Install lock cylinder as described above.

Right Hand Rear View Mirror

a. Removal

1. Remove right hand door upper and lower trim panels as described in the body service manual.
2. Remove instrument panel pad as described on Page 8-21.
3. Remove control head by loosening nut on support bracket.
4. Remove remote control cable from clips at glove box and front door outer panel reinforcement.
5. Remove cable from front door conduit.
6. Remove 2 nuts securing mirror to door and pull mirror and cable out of door outer panel.

b. Installation

1. Insert mirror in door outer panel, feeding remote control cable through large center hole.
2. Secure mirror to door outer panel with two nuts.
3. Feed cable through front door conduit and over glove box to support bracket.
4. Secure cable to glove box and front door inner panel reinforcement clips.
5. Install control head in support bracket and install nut.
6. Install instrument panel pad as described on Page 8-21.
7. Install upper and lower front door trim panels as described in the body service manual.

Electronic Control Unit (ECU) (Fig. 8-30)

a. Removal

1. Disconnect negative battery cable.
2. Remove three climate control outlet grilles - right, left and right center, Fig. 8-16.
3. Working through outlet openings, remove 3 fasteners securing pad to instrument panel support, Fig. 8-18.
4. Remove screws securing pad to instrument panel horizontal support, Fig. 8-18.
5. Pull pad outward and disconnect electrical connector from windshield wiper switch.
6. Remove pad.

NOTE: To facilitate removal or installation, place shift lever in lo range and on cars equipped with tilt wheel, place wheel in lowest position.

7. Remove MAP sensor hose, Fig. 8-30.
8. Remove three mounting screws holding ECU in position (one in front, two at side bracket, Fig. 8-30), and remove ECU.
9. Disconnect electrical connectors (3) from side of ECU.

b. Installation

1. Connect electrical harness to ECU - 3 connectors. Connectors will only fit one way, black towards front of car, blue in center and red towards rear.
2. Position ECU with electrical connectors on right side of car and install three mounting screws, Fig. 8-30.
3. Install MAP sensor hose, Fig. 8-30.
4. Position pad to instrument panel and connect electrical connector for wiper switch.
5. Install screws securing pad to instrument panel horizontal support.
6. Working through climate control outlet openings, install 3 fasteners securing pad to instrument panel support.
7. Install air outlet grilles as described on Page 8-21.
8. Connect negative battery cable.

Seat Belt Timer and Buzzer Assembly

a. Removal

1. Remove lower steering column cover as described on Page 8-21.
2. Remove timer and buzzer assembly from L.H. body bracket.
3. Disconnect electrical connector.

b. Installation

1. Connect electrical connector to timer and buzzer assembly.
2. Install timer and buzzer assembly to L.H. body bracket.
3. Install lower steering column cover as described on Page 8-21.

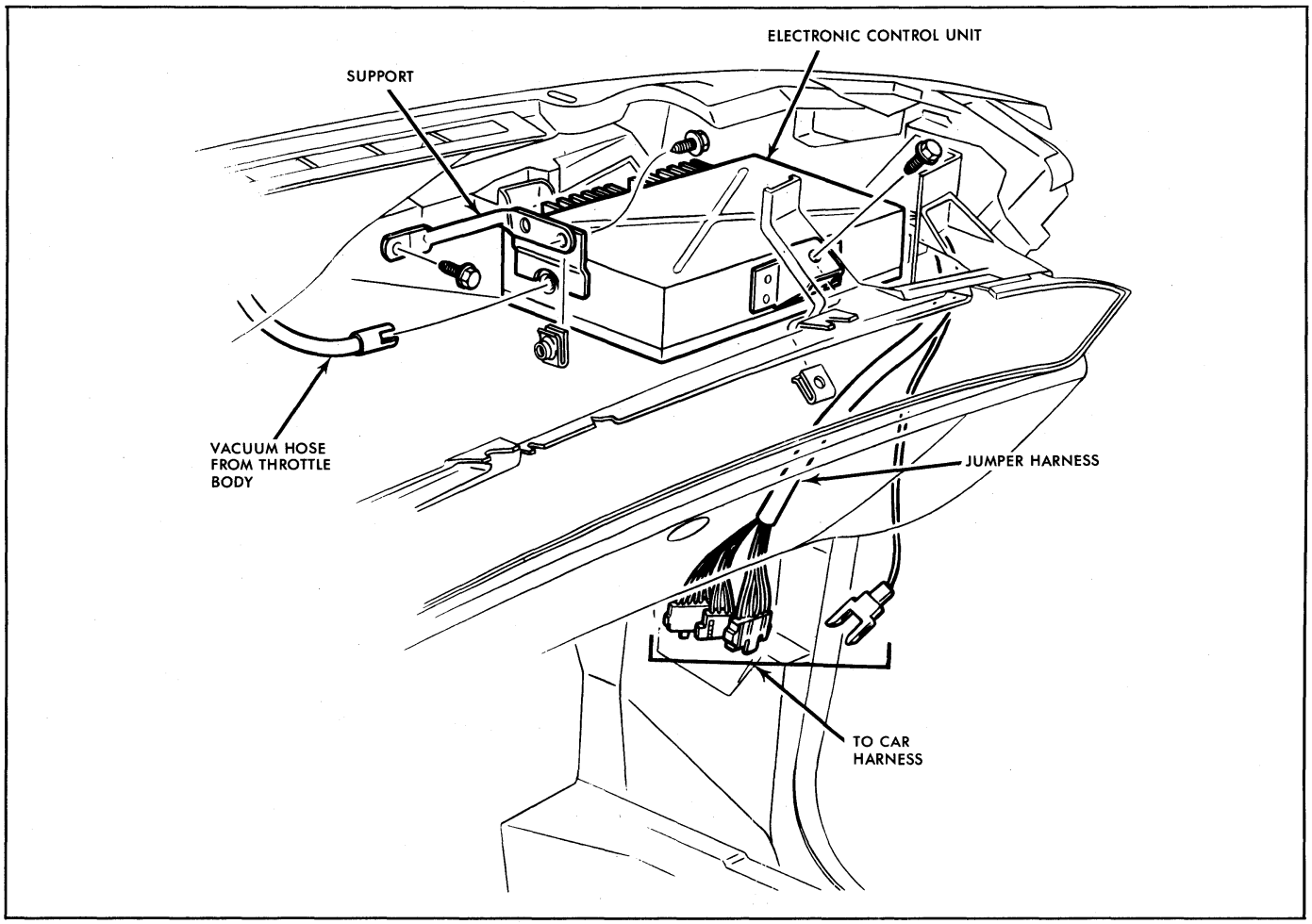


Fig. 8-30 Fuel Injection ECU Mounting (Eldorado)

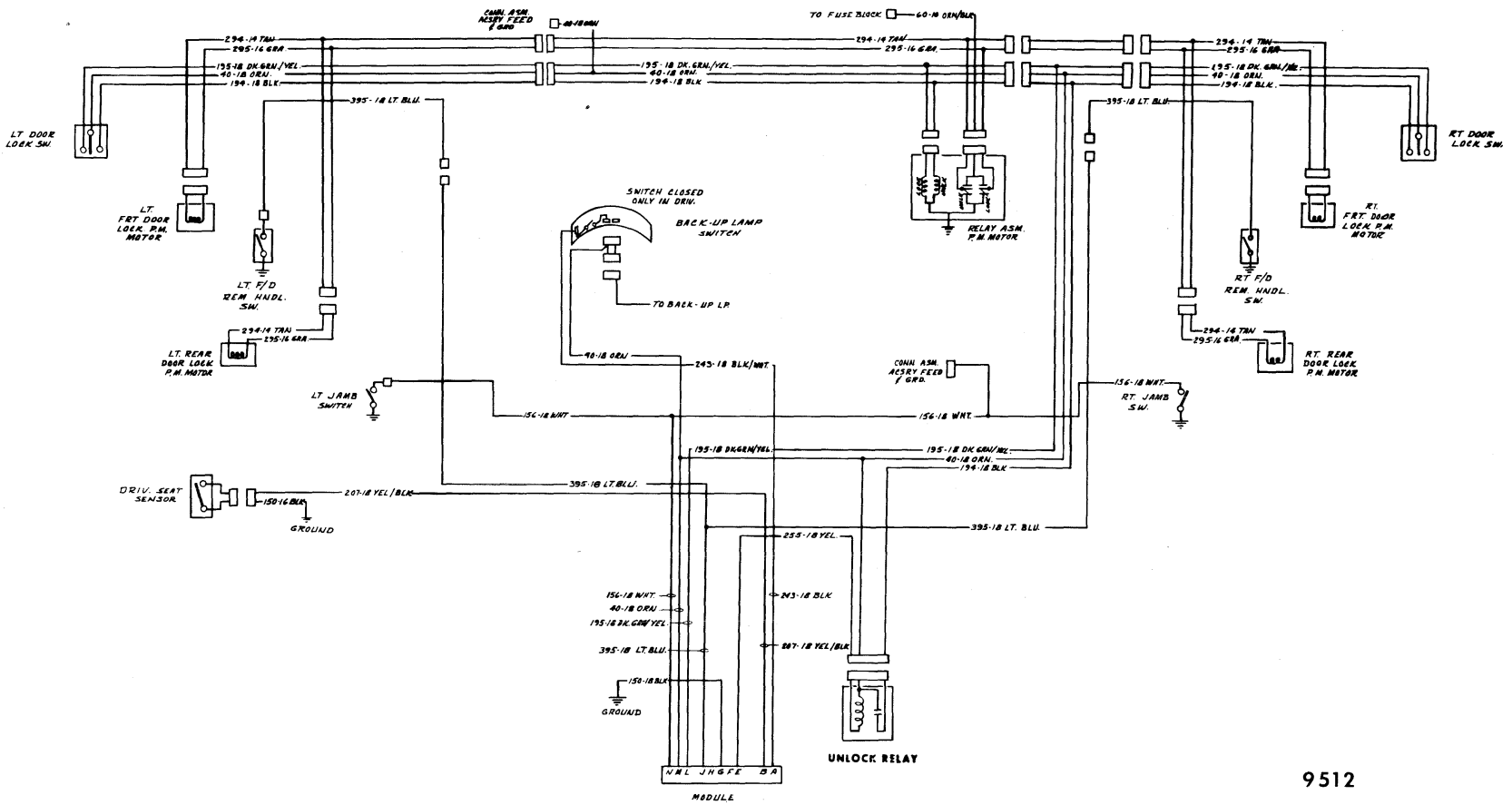


Fig. 8-31 Automatic Door Lock Circuit Diagram

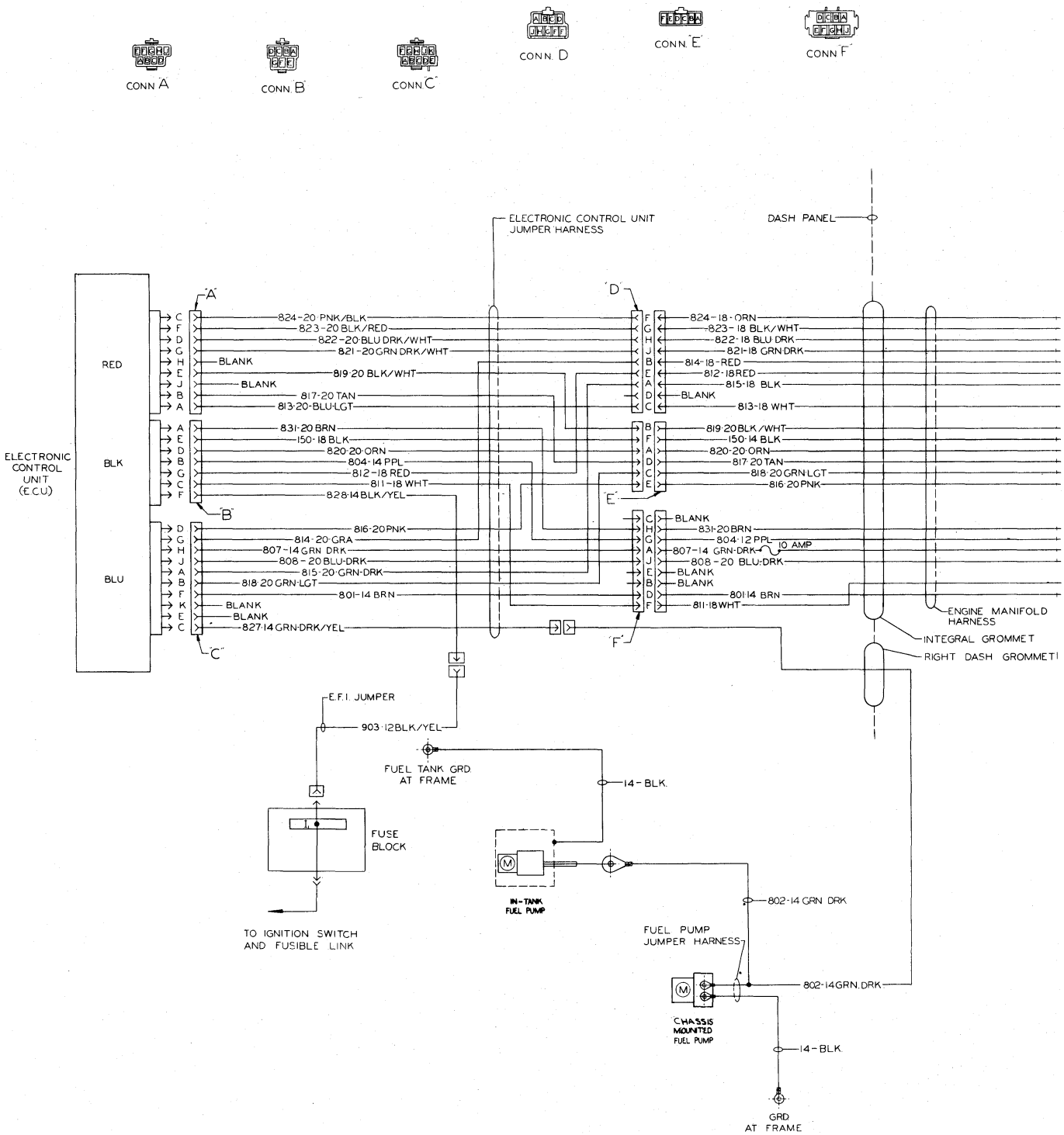


Fig. 8-32 EFI Electrical Circuit - Eldorado

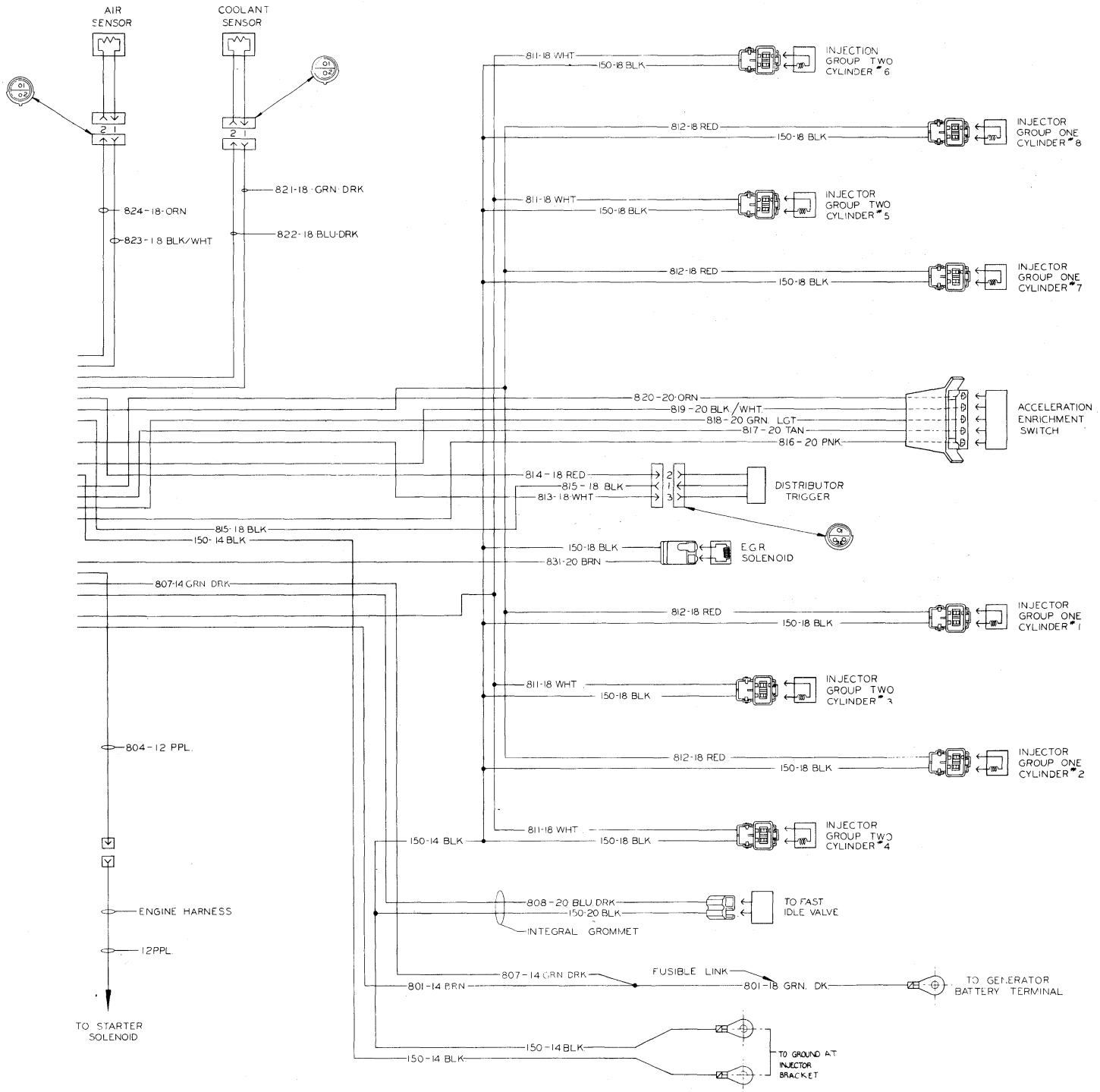


Fig. 8-32 EFI Electrical Circuit - Eldorado (Cont.-Page 2)

LIGHTING AND CHASSIS ELECTRICAL TORQUE SPECIFICATIONS (ELDORADO)

Material	Application	Size	Inch Pounds
6010M	Antenna Mast Tube Bracket to Fender Screws	10–16 TS	30
Special	Antenna Lower Support to Motor Housing Screw	1/4–20	65
275M	Antenna Lower Support Bracket to Wheelhouse	5/16–18	18*
6010M	Antenna Relay to Toe Pan Screws	8–18 TS	25
1010	Back Up Lamp to Body Screws	1/4–20	60
Stainless	Cornering Lamp to Fender Screws	1/4–20	60
6010M	Fuel Economy Switch to Cowl Screw	1/4–14 TS	60
6010M	Fuse Block to Cowl Screws	10–16 TS	25
1010	Grille Extension Molding to Headlamp Housing	10–24	20
6010M	Guide-Matic Relay to Cowl	1/4–14 TS	25
Stainless	Headlamp Bezel Attaching Screws	8–18 TS	15
275M	Headlamp Housing Attaching Screws	1/4–20	75
6010M	Horns and Horn Mounting Bracket Screws	5/16–12	22*
1050	Lamp Monitor Housing to Fender Nuts	3/16	12
1050	Lamp Monitor Lens to Housing Nut	5/32	
1010	License Lamp to Mounting Bracket	10–24	25
260M	Park Lamp Housing to Bumper Bracket	3/8–16	18*
1010	Rear Defogger Relay and Circuit Breaker	8–32	15
Stainless	Rear Side Marker Lamp Attaching Screw	8–32	18
Stainless	Reflex attaching Screw	8–32	18
6010M	Tail Lamp Bezel to Body Screw	8–18 TS	15
Stainless	Tail Lamp Escutcheon to Tail Lamp Screw	8–18 TS	15
1010	Tail Lamp and Mounting Bracket Screws	1/4–20	60
1010	Theft Deterrent Controller to Support	10–24	25
6010M	Washer Fluid Bottle Bracket to Cowl	1/4–14 TS	45
6010M	Washer Nozzle Attaching Screw	10–16 TS	18

TS – Self Tapping Screw

* – Foot Pounds

INSTRUMENT PANEL TORQUE SPECIFICATIONS (ELDORADO)

Material	Application	Size	Inch Pounds
1022	A/C Outlet Door to I.P. Pad Screws	10–16 HL	20
1022	Accessory Switch Housing to R.H. Insert and Applique	10–16 HL	20
6010M	Ash Tray L.H. and Lower Attaching Screws	10–16 TS	18
1022	Ash Tray R.H. Bracket to R.H. Lower I.P.	10–16 HL	20
6010M	Ash Tray Door Attaching Screws	10–16 TS	18
1010	Ash Tray "L" Bracket to I.P. or Ash Tray	10–24	25
6010M	Climate Control, Cruise Control and Headlamp Switch Housing to Horizontal Support	10–24 TS	35
6010M	Climate Control Bracket to Control Head Screw	10–24 TS	25
275M	Center Supports Attaching Screws	5/16–18	18*
275M	Fuel Injection ECU Attaching Screws	1/4–20	75
6010M	Fuel Injection ECU Mounting Bracket to Cowl	1/4–14 TS	60
6010M	Glove Box Liner Attaching Screws	8–18 TS	15
1010	Glove Box Hinge to Hinge Support	10–24	25
6010M	Glove Box Hinge to Glove Box Door	10–24 TS	15
Special	Glove Box Lock Case Escutcheon		45
1010	Glove Box Striker Attaching Screws	10–24	25
6010M	Glove Box Door Support Cable Screws	8–18 TS	15
6010M	Glove Box Door Inner to Outer Halves	10–18 TS	15
Special	Headlamp Switch Sleeve to Switch or Backplate	7/16–28	45
275M	Horizontal Support to Body Brackets	5/16–18	18*
284M	I.P. Pad Attaching – Right and Center Nuts	10–24	30
1010	– Left Screw	10–24	25
6010M	– Lower Screws	10–16 TS	25
6010M	I.P. Pad, A/C Duct to Pad – Upper and Lower	8–18 TS	18
1022	– Right Screw	10–16 HL	20
1022	– Left Screw	10–16 HL	20
286M	I.P. Top Cover Attaching – Center Foreward Nut	1/4–20	50
6010M	– Side Trim Screws	8–18 TS	14
286M	– Underside Studs	10–24	35
6010M	L.H. Insert Attaching Screws – Upper	10–16 TS	18
1010	– Lower	10–24	25
1010	Lower Steering Column Cover to Support – Upper	10–24	18
6010M	– Lower	10–24 TS	35
275M	Lower Steering Column Cover Reinforcement	1/4–20	75
1050	Mirror, R.H. Control Nut	3/4–20	60
1010	Mirror, R.H. Control Bracket Attaching Screw	10–24	35
1022	R.H. Insert and Applique Attaching Screws	10–16 HL	20
275M	R.H. Lower I.P. to Lower Support Screws	5/16–18	18*
1010	R.H. Lower I.P. to Horizontal Support	10–24	25
1010	Radio Control Thin Hex Nuts	7/16–28	60
284M	Radio Rear Support Rod to Radio Nut	10–24	25
1010	Radio Rear Support Rod to I.P. Reinforcement	10–24	25
6010M	Speedometer Cluster to Horizontal Support	10–24 TS	35
1010	Speedometer Cluster Bezel Attaching Screws	10–24	25
1022	Telltale Housing, Clock, Climate Control Outlet Ducts and In-Car Sensor to I.P. Top Cover Screws	10–16 HL	20
1010	Windshield Wiper Switch Mounting Screw	10–24	20

TS – Self Tapping Screw
HL – HiLo Thread Diameter
*Foot Pounds
For HiLo applications a #11 – 16 (oversize) screw is available for repair purposes (1600491 or equivalent)

INSTRUMENT PANEL (Seville)

GENERAL DESCRIPTION

The Seville instrument panel major supports are welded to the body and add stability and strength to the cowl and forward body area.

The instrument panel may be classified into four basic sections as follows:

1. TOP COVER - The top cover is a one piece unit which houses the front radio speakers, telltale housing, climate control outlets, doors and ducts, digital clock, climate control in-car sensor, twilight sentinel photocell, windshield wiper switch and fuel gage.

2. SPEEDOMETER SECTION - The speedometer section includes the lower steering column cover, speedometer cluster, and speedometer cluster bezel. The speedometer cluster houses the shift selector quadrant, turn signal indicators, speedometer, odometer, trip odometer and high beam indicator.

3. LEFT HAND LOWER INSTRUMENT PANEL - The left hand lower instrument panel consists of an insert and a base assembly. The headlamp controls, cruise control switch and climate control head are mounted directly to the insert.

4. RIGHT HAND LOWER INSTRUMENT PANEL - The right hand lower instrument panel assembly combines the glove box assembly, lower instrument panel and right hand insert and applique into a single assembly. The right hand insert and applique provides the location for the accessory switches and housing (rear defogger and/or electric antenna), right hand mirror control, radio, ash tray and lighter. The electric trunk release switch is attached to the lower instrument panel and concealed from view when the glove box door is closed. The seat belt warning chime is located on the forward side of the glove box liner.

Both the windshield wiper and top cover electrical connectors are rigidly fastened to the instrument panel support. Printed circuit boards are utilized in both the telltale indicator and speedometer clusters. The fuel gage is included in the telltale circuit board. The printed circuit boards are connected to the wiring harness through multiple terminal connectors which are plugged into the back side of the speedometer cluster and the underside of the telltale cluster. The printed circuit permits removal of all bulbs and sockets without any wire removal.

The torque specification chart at the back of this section lists both the tightness and the type fasteners to be used. Use of the hi-lo thread diameter screws where specified is important in order to maintain the instrument panel as a tight, rattle and vibration-free unit.

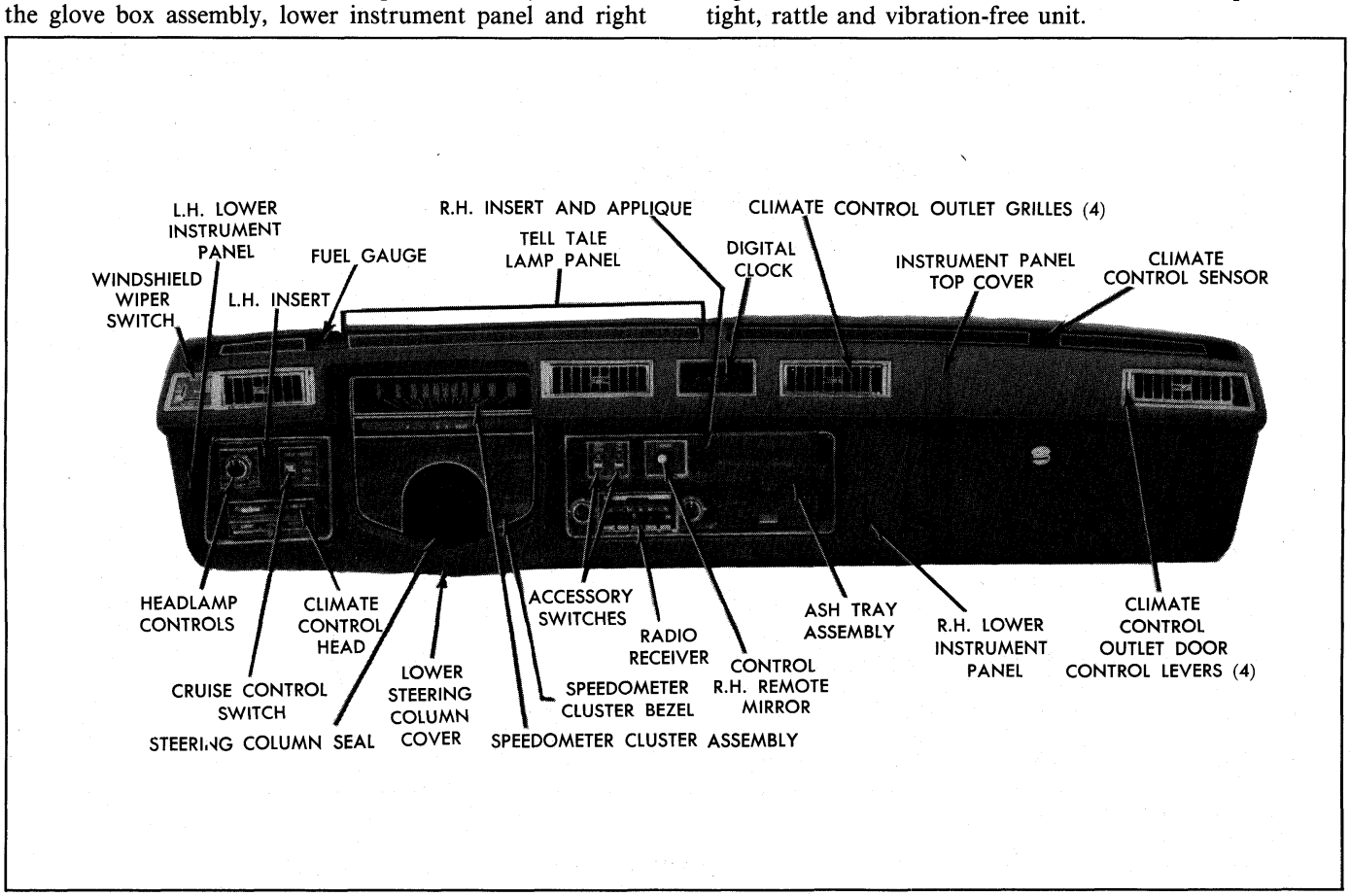


Fig. 8-33 Instrument Panel (Seville)

ON-CAR SERVICE

Climate Control Air Outlet Grilles (Fig. 8-34)

a. Removal

1. Rotate grille upward.
2. Using Tool J-21612 or a thin-bladed screwdriver on each side, compress tabs inward and remove grille.

b. Installation

1. Rotate grille upward and depress each tab inward with Tool J-21612 or a thin-bladed screwdriver.
2. Position grille into outlet, remove tool or screwdrivers, and allow grille tabs to snap into retaining holes.

Climate Control Outlet Assemblies (Fig. 8-34)

a. Removal

1. Remove instrument panel top cover as described on Page 8-44.
2. Remove radio speaker wire from clip on climate control outlet.
3. Left and left center outlets only - remove telltale housing assembly as on page 8-46.
4. Remove 2 screws securing outlet duct to top cover.
5. Remove push on retainer securing lever to outlet duct.
6. Remove wave washer, flat washer and lever from outlet duct.
7. Remove retainer from air door shaft and remove shaft and door.

b. Installation

NOTE: Use care to assemble outlet assemblies with lever on correct side for the specific location being serviced. Speaker wire clip on duct must be positioned toward top of instrument panel.

1. Position door into duct, insert shaft and secure with push on retainer.
2. Position lever onto duct, making certain tab on lever is into door.
3. Place flat washer and wave washer onto lever and secure with push on retainer.

NOTE: The flat washer is placed onto the lever first to eliminate the possibility of the wave washer cutting into the plastic duct.

4. Position duct assembly onto top cover and secure with 2 screws.
5. Place radio speaker wire under clip.
6. Left and left center outlets only - install telltale housing assembly as described on page 8-46.
7. Install instrument panel top cover assembly as described on Page 8-44.

Lower Steering Column Cover and Reinforcement (Fig. 8-35)

a. Removal

1. Remove 2 screws from lower edge of instrument panel.
2. Remove 2 screws from upper sides of steering column cover.
3. Lower cover and disconnect rear defogger circuit breaker from connector.
4. Remove lower steering column cover and reinforcement.

b. Installation

1. Connect rear defogger circuit breaker electrical connector.
2. Position lower steering column cover and reinforcement and secure with 2 upper and 2 lower screws.

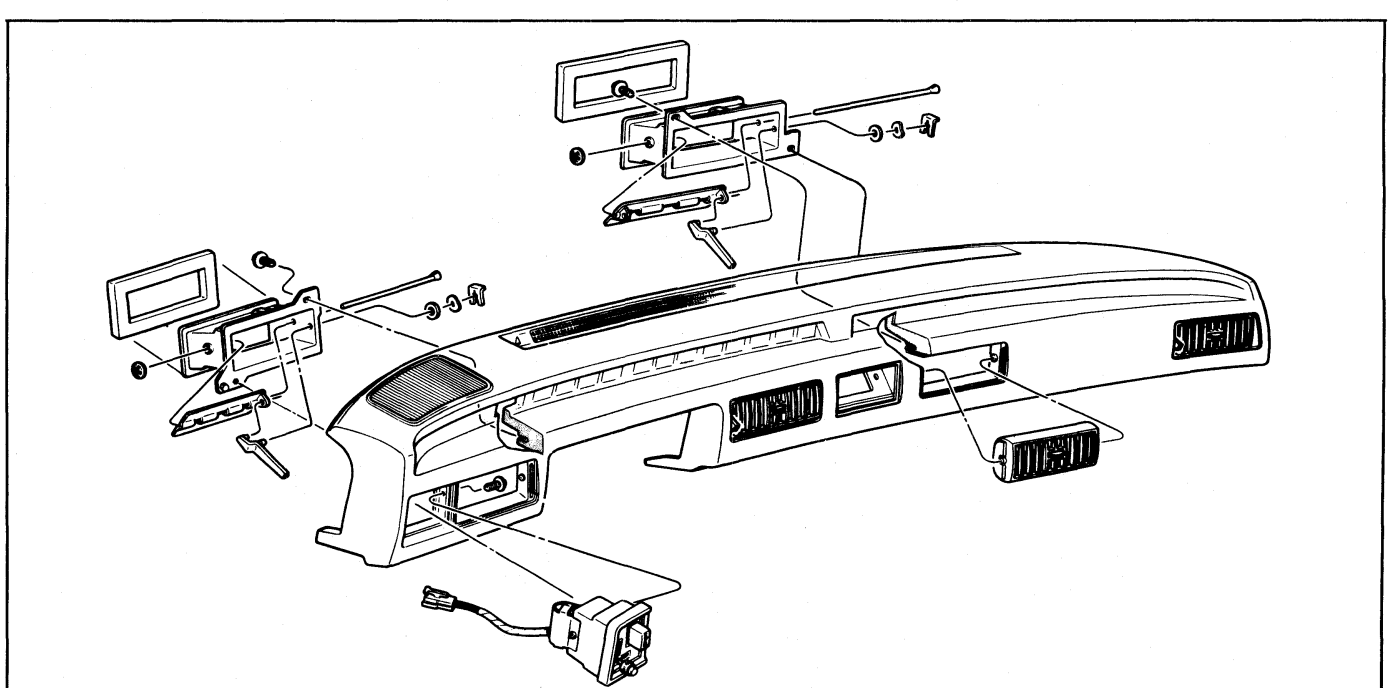


Fig. 8-34 Climate Conrol Outlets and Wiper Switch (Seville)

Windshield Wiper Switch (Fig. 8-34)

a. Removal

1. Disconnect negative battery cable.
2. Remove left hand climate control outlet grille as described on page 8-41.
3. Working through outlet opening, remove screw securing switch to instrument panel.
4. Pull wiper switch and electrical connector out of panel and disconnect from harness.

b. Installation

1. Install electrical connector to harness and position switch into instrument panel pad opening.
2. Working through air outlet grille, install screw securing switch to instrument panel.
3. Install left hand climate control outlet grille as described on page 8-41.
4. Connect negative battery cable. Tighten to 70 inch-pounds.

Rear Window Defogger Circuit Breaker

a. Removal

1. Disconnect negative battery cable.
2. Remove lower steering column cover as described on page 8-41.
3. Remove 2 screws which attach circuit breaker to lower steering column cover reinforcement.
4. Disconnect electrical connectors and remove.

b. Installation

1. Connect electrical connectors.
2. Secure circuit breaker to lower steering column cover reinforcement with 2 screws.
3. Install lower steering column cover as described on page 8-41.
4. Connect negative battery cable.

Speedometer Cluster Bezel Assembly (Fig. 8-35)

a. Removal

1. Remove lower steering column, cover assembly as described on Page 8-41.
2. Remove 4 screws securing speedometer cluster bezel to lower instrument panel and cluster assembly.
3. Press bezel downward slightly, rotate top outward and carefully remove bezel.

NOTE: Steering column seal may be replaced by removing 3 push on clips. Split in seal faces downward.

a. Installation

1. Position cluster bezel and slip steering column seal over column.
2. Secure with 4 screws. (2 hi-lo into lower instrument panel, 2 No. 10-24 into top).
3. Install lower steering column cover as described on Page 8-41.

Speedometer Cluster (Fig. 8-35)

a. Removal

1. Disconnect negative battery cable.
2. Remove lower steering column cover as described on Page 8-41.
3. Remove speedometer cluster bezel as described above.
4. With shift lever in "Park" position remove screw and washer securing shift indicator cable to steering column.
5. Remove upper 2 screws securing cluster assembly to instrument panel support.
6. Remove 2 lower inboard screws securing cluster to speedometer cable retainer adapter.

NOTE: Speedometer cable retainer adapter should not be removed when servicing cluster and related components.

7. Pull cluster outward to disengage from speedometer cable and rotate top downward to disconnect printed circuit connector.
8. Remove cluster.

CAUTION: *On vehicles so equipped, disconnect speed control sensor electrical connector from cluster with a small screwdriver (Fig. 9-39) prior to completely removing cluster assembly. This will prevent connector from damaging cluster as cluster assembly is being removed from car.*

NOTE: Removal or installation of cluster can be facilitated by placing shift lever in "Lo" range and positioning tilt steering wheel in lowest position.

b. Installation

1. Connect printed circuit connector to cluster and speed control electrical connector, if so equipped.
2. Position cluster into instrument panel and engage speedometer cable.
3. Install 4 screws securing cluster to support and speedometer cable retainer adapter.
4. With shift selector in "Park" position, loosely install screw and washer securing shift indicator cable to steering column. Place shift indicator in "Neutral" and align pointer with "N". Tighten screw and recheck pointer alignment in shift selector positions.
5. Install cluster bezel as described above.
6. Install lower steering column cover as described on Page 8-41.
7. Connect negative battery cable. Tighten to 70 inch-pounds torque.

Speedometer Cluster Printed Circuit (Fig. 8-80)

a. Removal

1. Remove cluster as described above.
2. Remove all sockets and bulbs from cluster case.
3. Remove printed circuit.

NOTE: No attempt should be made to repair this circuit. If inoperative it should be replaced.

b. Installation

1. Position printed circuit on back of cluster case.
2. Install sockets and bulbs into case.

NOTE: The shift quadrant illumination bulb and socket assembly is specific and should be installed in the same location from which it was removed.

3. Install cluster as described above.

Speedometer Head (Fig. 8-36)

a. Removal

1. Remove speedometer cluster as described above.
2. Remove four screws securing speedometer cluster lens to cluster housing.
3. Remove lens and face plate.
4. Remove selector quadrant assembly from cluster housing by pulling straight out.
5. Remove two rubber mounted screws securing speedometer head assembly and remove from cluster housing.
6. Remove two screws securing dial to speedometer head and remove dial. Use care not to damage pointer.

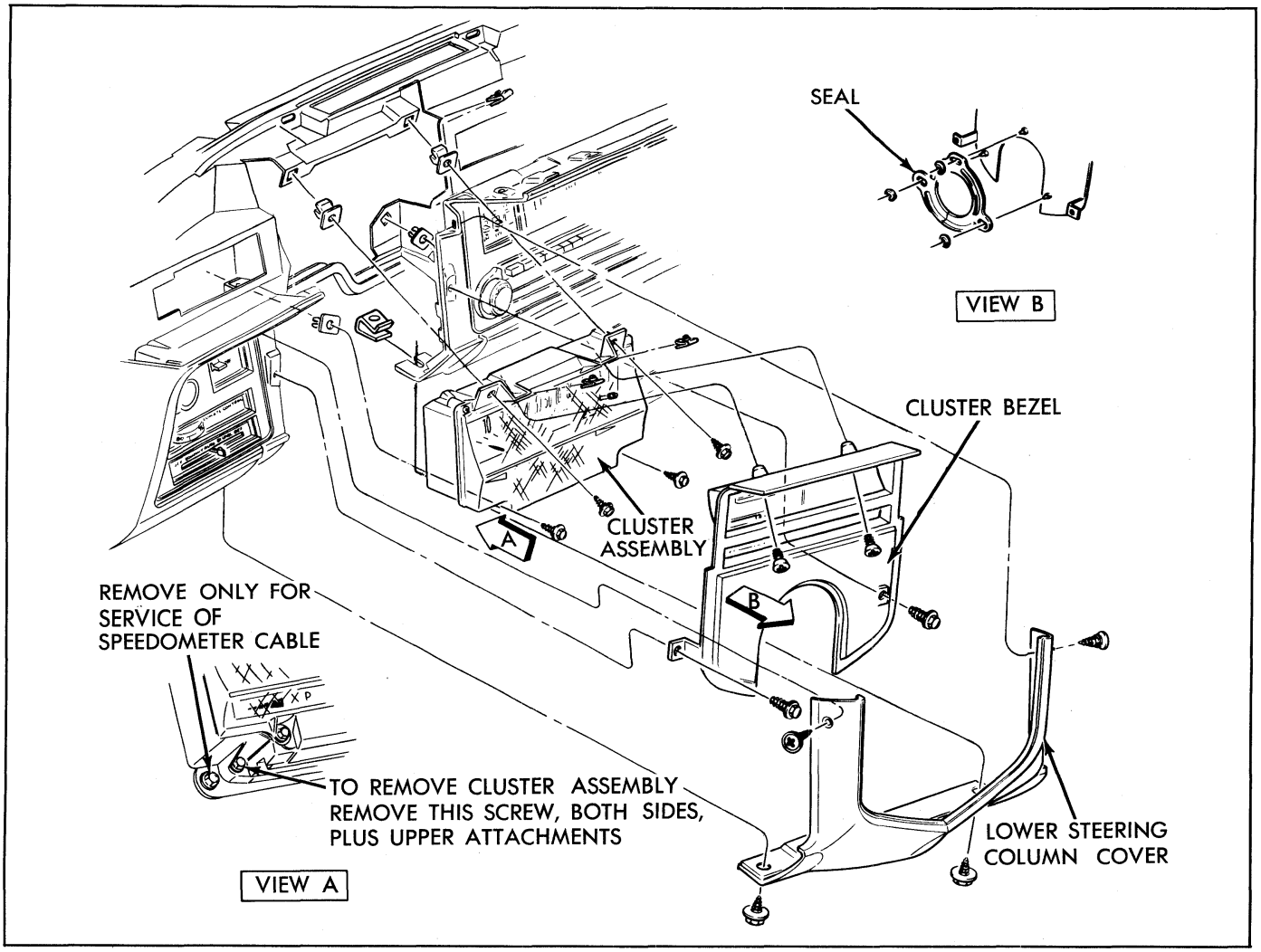


Fig. 8-35 Speedometer Cluster, Bezel and Lower Cover (Seville)

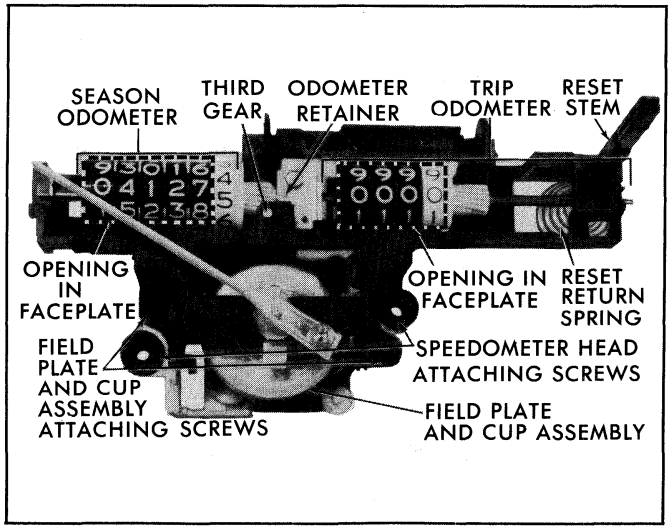


Fig. 8-36 Speedometer Head

b. Installation

1. Install two screws securing dial to speedometer head. Use care not to damage pointer.
2. Install two screws through rubber bushings in speedometer head assembly and secure to cluster housing.
3. Install selector quadrant assembly to cluster housing.
4. Install face plate and lens. Secure with four screws.
5. Install speedometer and speedometer cluster bezel as described above.
6. Install lower steering column cover as described on Page 8-41.

SPEEDOMETER HEAD COMPONENT SERVICE (Fig. 8-36)

A. Disassembly

1. Remove screw and odometer retainer plate.
2. Remove trip odometer assembly (trip odometer assembly is serviced only as a complete unit).
3. Remove season odometer assembly (season odometer assembly is serviced only as a complete unit).
4. Remove jack gear.
5. Remove trip reset spring retainer by pinching upper and lower clips together.
6. Remove reset rack and spring assembly.

NOTE: Further disassembly requires removal of field

plate and speed cup assembly and subsequent recalibration of speedometer. If speedometer tester is not available for recalibration, repairs requiring disassembly beyond this point should be referred to your designated speedometer service station.

7. Carefully remove orange painted pointer assembly (press fit). Turn against zero stop and lightly lift pointer assembly at hub.

8. Remove 2 screws securing speed cup assembly to frame and remove.

NOTE: On cars equipped with Cruise Control be sure to keep magnet shaft and speed cup free of contaminants to avoid improper speed signals to speed sensor.

9. Remove third gear.

10. Inspect second gear for signs of damage. Do not remove unless necessary. Remove from frame assembly if necessary.

NOTE: Further disassembly, such as removal of the magnet shaft from frame and speed cup assembly is not recommended.

b. Assembly

1. If removed, position second gear in frame assembly with gear end contacting worm gear magnet shaft.

NOTE: On cars equipped with Cruise Control be sure to keep field plate and cup assembly free of contaminants to avoid improper speed signals to speed sensor.

2. If removed, position third gear with bevel gear end engaging worm gear end on second gear.

3. If removed, position speed cup assembly to frame and secure with 2 screws.

NOTE: Make sure speed cup stop tab is on correct side of field plate so as to permit needle rotation. Hairspring coil on speed cup must be evenly spaced when in wound position. It may be necessary to use tweezers to adjust coils. Move regulator arm to horizontal position, if necessary, so that maximum adjustment may be made in either direction during calibration.

4. Install reset rack and spring assembly and spring retainer.

5. Install jack gear.

6. Rotate trip odometer wheels until all zeros are opposite slotted ears (zeros facing forward).

7. Wipe odometers clean of fingerprints with a lint free cloth or soft chamois.

8. Install odometers, making sure slotted ears of pinion carriers fit in locating slots.

9. Install retainer plate and secure with screw.

10. Mount pointer on tapered spindle so that it points at approximately 30 mph. Twist pointer back to, and in line with, "0" graduation while pressing down lightly.

11. Check for secure pointer to spindle contact by inserting a short piece of speedometer cable with proper tip in drive end of speedometer. An initial fast spin of test cable should swing pointer to approximately 30 mph and then briskly return to "0". Perform this test several times. If pointer becomes loose on spindle, repeat Step 10.

12. If during the performance of Step 11, pointer returns to "0" intermittently or not at all, this indicates a speed cup and magnet assembly malfunction.

13. If field plate and speed cup assembly were removed, calibrate speedometer assembly, following the instructions furnished by the manufacturer for the speedometer tester being used.

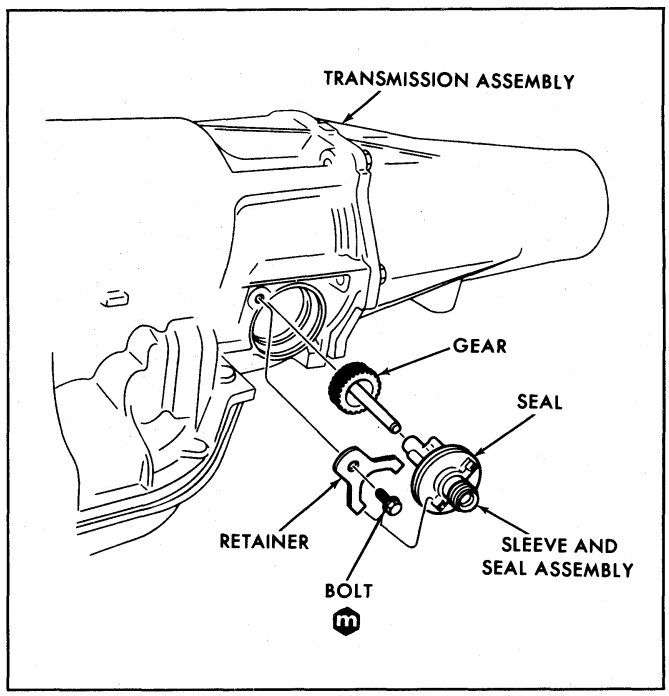


Fig. 8-37 Speedometer Driven Gear (Except Eldorado)

SPEEDOMETER CABLE AND CABLE HOUSING

a. Removal

1. Remove Speedometer Cluster and Bezel as described on Page 8-42.

2. Disconnect cable housing from locking spring on mounting plate and pull through firewall from underhood.

3. Raise car on hoist.

4. Disconnect cable at transmission.

5. Remove cable assembly.

b. Installation

1. Raise car on hoist.

2. Install cable to transmission.

3. Route cable up through engine compartment using retaining clips.

4. Lower car.

5. Route cable through dash and install grommet into hole. Cable end must be protected with tapered end cap to force through grommet.

6. Install Speedometer Cluster and Bezel as described on Page 8-42.

SPEEDOMETER DRIVEN GEAR (Fig. 8-37)

Refer to Figure 8-37 for the removal and installation of speedometer driven gears for all cars except Eldorado.

Instrument Panel Top Cover (Fig. 8-38)

a. Removal

1. Remove negative battery cable.

2. Remove 4 screws on sides of defroster outlets.

3. Remove 5 screws from lower edge of top cover.

4. Pull top cover out to gain access to and disconnect the following connections as required:

Windshield wiper switch connector.

Telltale printed circuit connector.

Twilight sentinel photocell.

Clock, radio speaker and climate control in-car sensor connector, climate control aspirator hose, security system telltale socket and bulb.

SPEEDOMETER GEAR APPLICATION CHART

Series	Axle Ratio	Tire Size	Transmission Type And Model	Speedo-Meter Drive Gear No. of Teeth	Color of Driven Gear	Driven Gear No. of Teeth
DeVille	2.28	GR78-15	THM400	36	White	21
DeVille	2.73	GR78-15	THM400	37	Red	18
DeVille	3.08	GR78-15	THM400	42	Green	18
Brougham	2.28	HR78-15	THM400	36	White	21
Brougham	2.73	HR78-15	THM400	37	Red	18
Brougham	3.08	HR78-15	THM400	42	Green	18
Limousine	3.08	HR78-15	THM400	41	Yellow	18
Commercial	3.08	HR78-15	THM400	41	Yellow	18
Eldorado	2.73	LR78-15	THM425	27	Black	14
Eldorado	3.07	LR78-15	THM425	31	White	14
Seville	2.56	GR78-15	THM400	35	Pink	18
Seville	3.08	GR78-15	THM400	42	Green	18

5. Remove top cover.

NOTE: To facilitate removal and installation place shift lever in "Lo" and tilt steering wheel to lowest position).

b. Installation

1. Position top cover and as required connect the following:

Windshield wiper switch connector.

Telltale printed circuit connector.

Twilight sentinel photocell.

Clock, radio speaker and climate control in-car sensor connector, climate control aspirator hose, security system telltale socket and bulb.

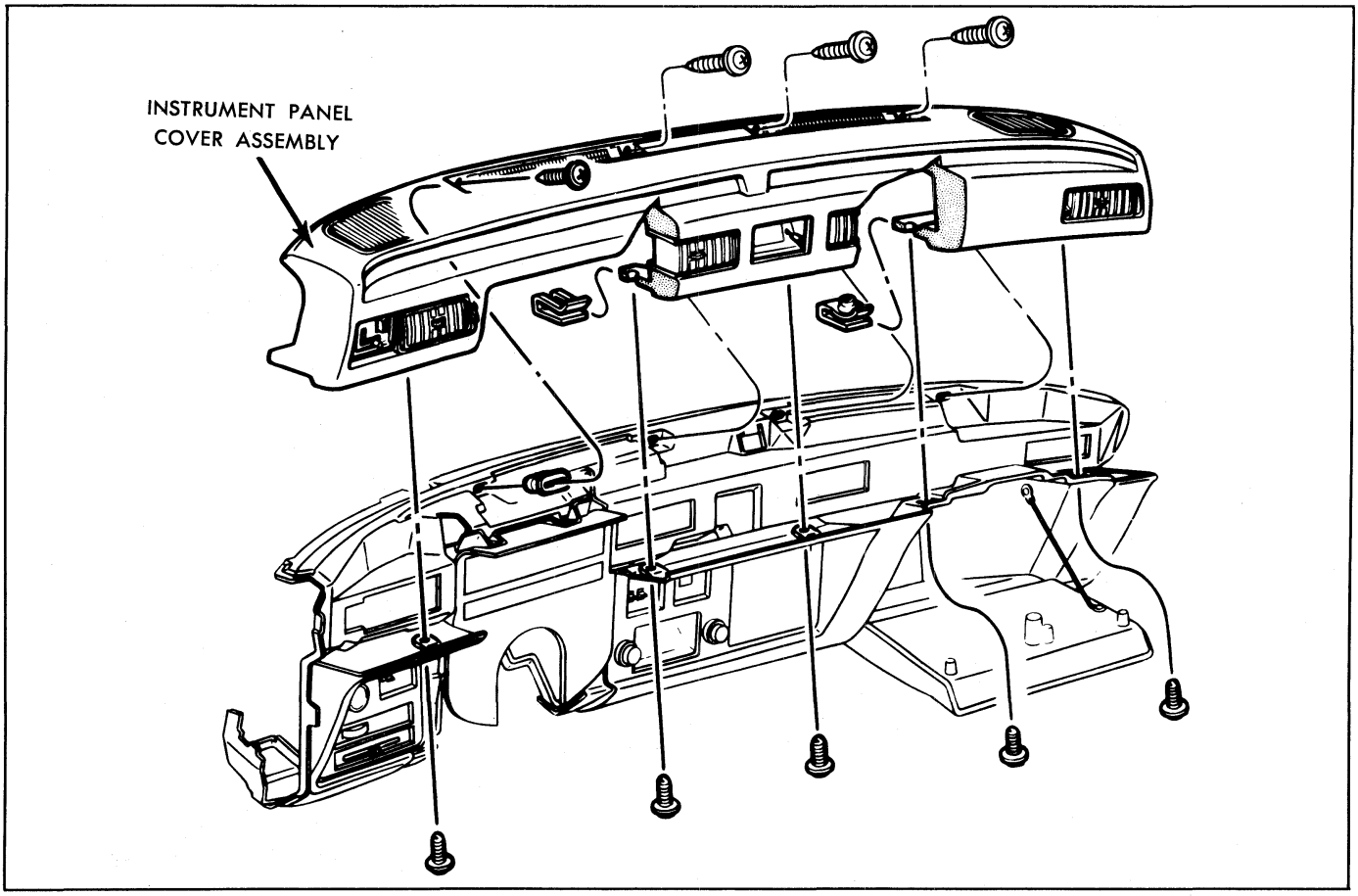


Fig. 8-38 Instrument Panel Top Cover (Seville)

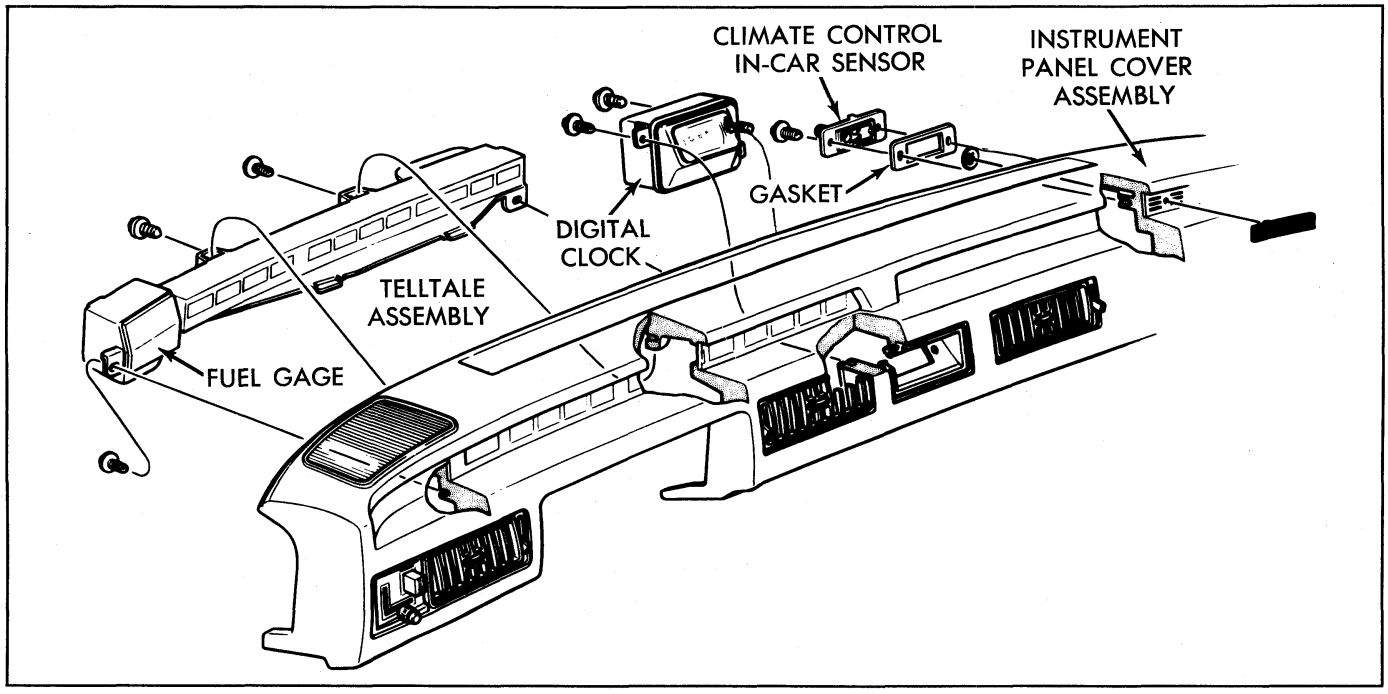


Fig. 8-39 Telltale Housing, Clock and In-Car Sensor (Seville)

2. Push top cover forward and secure with 5 screws from underside.

3. Install 4 screws next to defroster outlets.

4. Connect negative battery cable. Tighten to 70 inch-pounds torque.

Defroster Grilles (Fig. 8-38)

a. Removal

1. Remove 4 screws on sides of defroster outlets.

2. Remove 5 screws from lower edge of top cover.

3. Pull top cover out to gain access to defroster grilles.

4. Remove grilles by lifting upward.

b. Installation

1. Snap defroster grilles into instrument panel reinforcement.

2. Position top cover and secure with 5 screws under lower edge of top cover.

3. Install 4 screws next to defroster outlets.

Telltale and Fuel Gage Assembly (Fig. 8-39)

a. Removal

1. Remove top cover as described on Page 8-44.

2. Lay top panel upside down on clean workbench. Cover workbench if required to protect appearance surfaces.

3. Remove 4 screws securing telltale housing to top cover.

b. Installation

1. Position telltale housing to top cover and secure with 4 screws.

2. Install top cover as described on Page 8-44.

Telltale and Fuel Gage Printed Circuit (Fig. 8-79)

a. Removal

1. Remove top cover and telltale housing as described above.

2. Remove telltale sockets and bulbs.

3. Remove fuel gage illumination bulb and socket and 3 nuts.

4. Remove telltale printed circuit.

b. Installation

1. Position telltale printed circuit onto telltale housing.

2. Install bulb and sockets into telltale housing.

NOTE: Bulb and socket assemblies are specific and should be installed in the same locations from which they were removed.

3. Install fuel gage illumination bulb and socket and 3 nuts.

4. Install telltale housing and top cover as described above.

Fuel Gage (Fig. 8-39)

a. Removal

1. Remove top cover and telltale housing as described above.

2. Remove illumination bulb and socket and 3 nuts from back of fuel gage.

3. Remove 2 screws securing fuel gage to telltale housing.

b. Installation

1. Secure fuel gage to telltale housing with 2 screws.

2. Install fuel gage illumination bulb and socket and 3 nuts.

3. Install telltale housing to top cover as described above.

4. Install top cover as described above.

Instrument Panel Top Cover Inserts

a. Removal - Right Hand Insert

1. Remove instrument panel top cover as described on Page 8-44.
2. Remove retainer securing nameplate to top cover.
3. Remove 4 fasteners securing insert to top cover.

b. Removal - Left Hand Lens Insert

1. Remove instrument panel top cover as described on Page 8-44.
2. Remove telltale housing as described above.
3. Remove 3 fasteners securing lens insert to top cover.

NOTE: Use care to avoid scratching lens surface. Replace if scratched.

c. Installation - Right Hand Insert

1. Position insert onto top cover and secure with 4 fasteners.
2. Position nameplate and secure with retainer.
3. Install top cover onto instrument panel as described on Page 8-44.

d. Installation - Left Hand Lens Insert

1. Position lens insert into top cover and secure with 3 fasteners.
2. Install telltale housing onto top cover as described above.
3. Install top cover onto instrument panel as described on Page 8-44.

Climate Control In-Car Sensor (Fig. 8-39)

a. Removal

1. Remove instrument panel top cover as described on Page 8-44.
2. Remove 2 screws securing in-car sensor to top cover.

b. Installation

1. Secure in-car sensor to instrument panel top cover with 2 screws.
2. Install top cover onto instrument panel as described on Page 8-44.

Right Hand Insert and Applique (Fig. 8-40)

a. Removal

1. Remove radio control knobs, anti-rattle spring, control rings and both hex nuts.

NOTE: Both control knobs on radios with integral 8-track tape players are retained with 5/64 inch allen head set screws.

2. Open ash tray door and remove ash tray receptacle.
3. Working through ash tray opening, remove screw from behind right side of insert and applique.
4. Close ash tray door and remove 3 screws which secure insert and applique to right hand instrument panel assembly.
5. Pull insert and applique out enough to disconnect electrical connectors from cigar lighter and accessory switches. Disconnect cigar lighter bulb and shield from housing by gently squeezing shield.
6. Remove clip which secures right hand remote mirror control to back of control housing assembly.

b. Installation

1. Insert right hand remote control mirror cable through control housing and secure with clip.
2. Attach cigar lighter lamp to lighter housing assembly.
3. Connect electrical connectors to accessory switches and cigar lighter.
4. Position insert and applique onto right hand instrument panel and secure with 3 top screws.
5. Working through ash tray opening, install right side screw from back of insert and applique.
6. Install ash tray receptacle.
7. Install radio hex nuts, control rings, anti-rattle springs and control knobs.

Accessory and/or Antenna Switch(es) and Housing (Fig. 8-40)

a. Removal

1. Remove radio control knobs, anti-rattle springs, control rings and both hex nuts.
2. Open ash tray door and remove ash tray receptacle.
3. Working through ash tray opening, remove screw from behind right side of insert and applique.
4. Close ash tray door and remove 3 screws which secure insert and applique to right hand instrument panel assembly.
5. Pull insert and applique out far enough to disconnect accessory switch electrical connector.
6. Bend retaining tang on switch housing lower edge enough to snap switch(es) from housing.
7. To remove housing, remove illumination and indicator bulbs and sockets. Remove 2 screws which secure housing to insert and applique.

b. Installation

1. Secure accessory switch housing to insert and applique with 2 screws.
2. Push switch(es) into housing until they snap into place.
3. Connect electrical connectors and illumination and indicator bulbs and sockets.
4. Position insert and applique to instrument panel and secure with upper 3 screws.
5. Working through ash tray opening, install screw into right side of insert and applique from rear.
6. Install ash tray receptacle.
7. Install radio hex nuts, control rings, anti-rattle springs and control knobs.
8. Check operation of accessory switches.

Right Hand Remote Control Mirror

a. Removal

1. Remove right hand insert and applique as described above.
2. Loosen 5/64 inch allen head set screw located in back of mirror control housing and remove control head from housing.
3. Remove right front door trim panel as described in the Body Service Manual.
4. Carefully pull mirror control cable into right front door assembly.
5. Remove 2 nuts which secure mirror to right front door.
6. Remove mirror and cable assembly from door.

b. Installation

1. Feed mirror control cable through right front door and position mirror onto door.
2. Secure mirror with 2 nuts.
3. Feed control cable through door-to-body tube and position under instrument panel.
4. Insert control cable head into mirror control housing and tighten 5/64 inch allen head set screw.

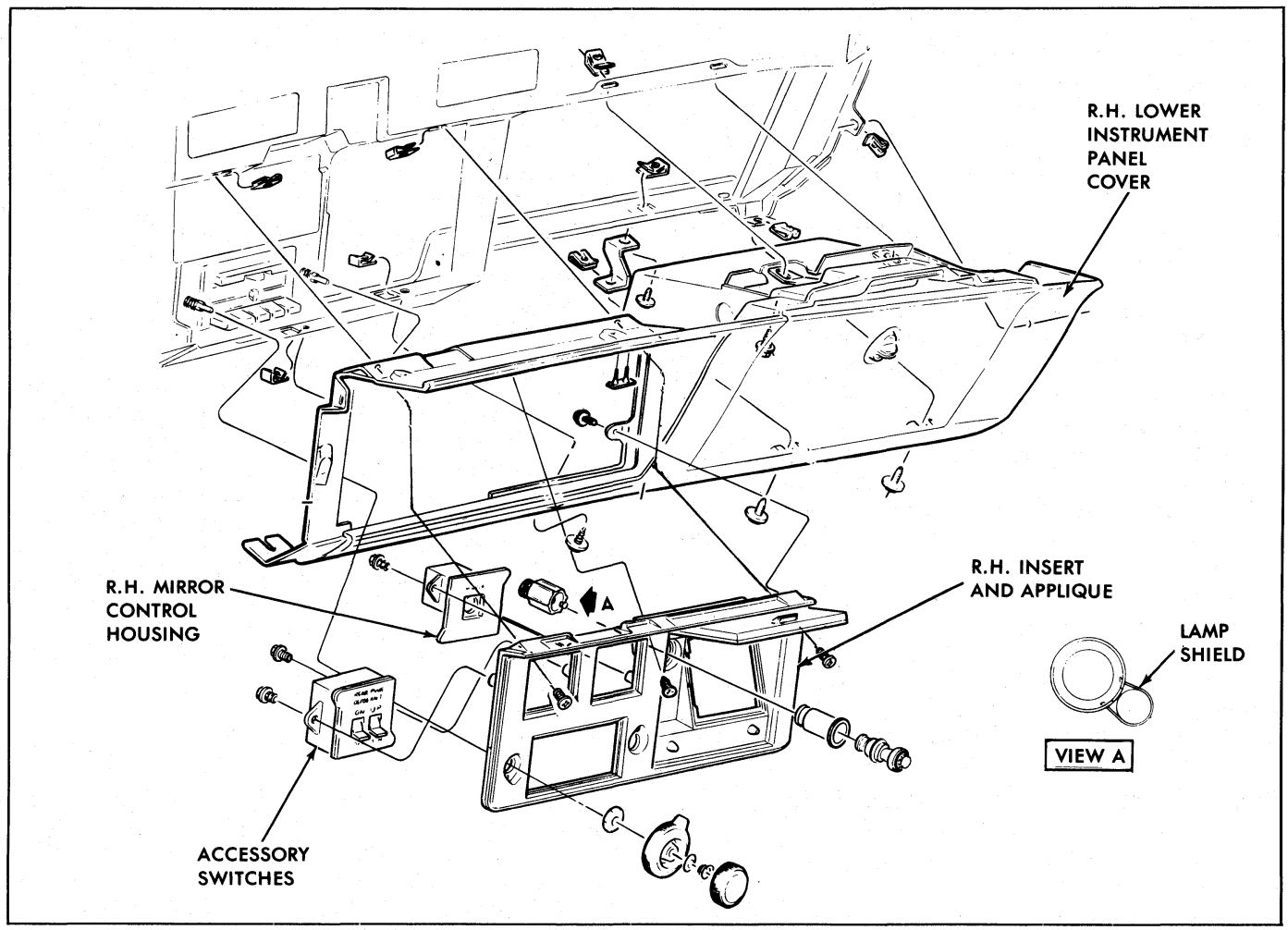


Fig. 8-40 Right Hand Lower Instrument Panel (Seville)

5. Position right hand insert and applique onto instrument panel and check mirror operation.

6. Install right hand insert and applique as described above.

7. Install right front door trim cover as described in the Body Service Manual.

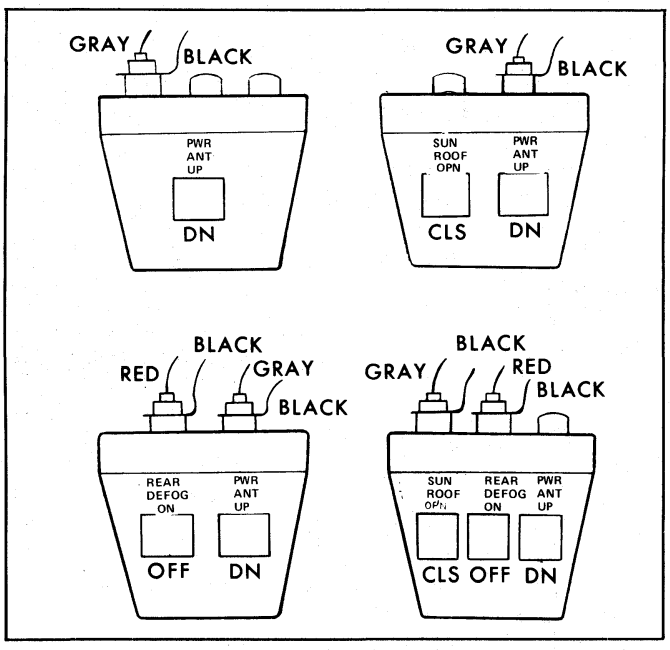


Fig. 8-41 Accessory Switch Wire Locations (Seville)

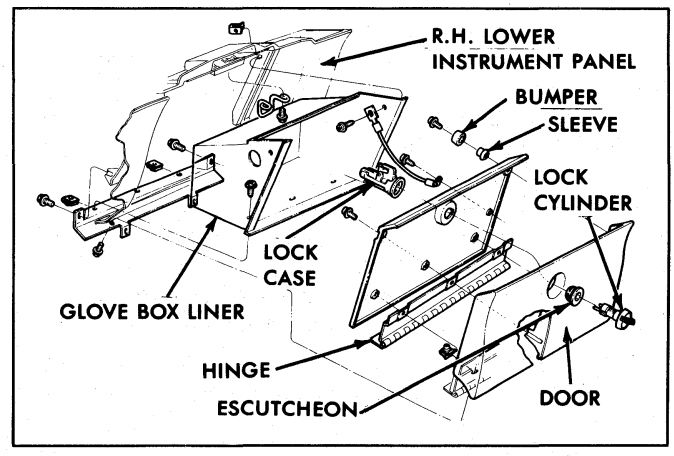


Fig. 8-42 Glove Box Assembly (Seville)

Trunk Release Switch

a. Removal

1. Open glove box door.
2. Reaching through glove box liner access hole, disconnect electrical connector from trunk release switch.
3. Depress tabs on trunk release switch and remove from passenger side of panel.

b. Installation

1. Depress tabs on trunk release switch and carefully insert switch into mounting cutout.
2. Reach through top of glove box liner to make certain tabs are fully extended.
3. Connect electrical connector to switch.
4. Depress switch button to check trunk release for proper operation.

Glove Box Door (Fig. 8-42)

a. Removal

1. Remove screw which secures cable to glove box door.
2. Remove 3 screws which secure glove box door to right hand lower instrument panel.

b. Installation

1. Install glove box door and secure with 3 screws.
2. Attach cable to door. Secure with 1 screw.

NOTE: Cable should face approximately the 10 o'clock position from the eyelet.

Glove Box Lock Cylinder (Fig. 8-42)

a. Removal

1. Open glove box door.
2. Insert key and pull latch mechanism arm to latch position. Turn key to lock position and remove key.
3. Through slot in top of lock case, depress cylinder retainer and insert key into lock cylinder.
4. Release retainer and remove lock cylinder assembly.

NOTE: Lock cylinder knob is not serviced separately from cylinder.

b. Installation

1. While holding lock cylinder assembly in hand depress retainer (tumbler closest to knob) insert key and release retainer. All tumblers and retainer should be flush with lock cylinder housing.
2. Install cylinder into case with retainer at top and rotate key and lock cylinder clockwise until a "click" is heard.
3. Close glove box door and remove key.

Glove Box Lock Case (Fig. 8-42)

a. Removal

1. Remove lock cylinder as described above.
2. Remove escutcheon.
3. Remove washer, filler and lock cylinder case.

b. Installation

1. Position lock cylinder, filler and washer onto glove box door.
2. Install escutcheon.
3. Install lock cylinder as described above.

Glove Box Liner (Fig. 8-42)

a. Removal

1. Open glove box door and remove 5 screws which secure glove box liner to instrument panel.
2. Pull glove box liner out enough to disconnect seat belt chime electrical connector. Disconnect 3 connections at transceiver and 2 screws securing unit to mounting brackets on CB radio equipped vehicles.
3. Remove glove box liner through glove box door opening.

b. Installation

1. Position glove box liner onto glove box door.
2. Connect seat belt chime electrical connector. Connect 3 connections at transceiver and 2 screws securing unit to mounting brackets on CB radio equipped vehicles.
3. Install glove box liner into instrument panel and secure with 5 screws.

Seat Belt Warning Chime

a. Removal

1. Reach under instrument panel and disconnect seat belt warning chime electrical connector.
2. Open glove box and remove 2 screws which secure seat belt warning chime to front of glove box liner. Reach under instrument panel and support chime so that it does not fall.
3. Remove chime from under instrument panel.

b. Installation

1. Position seat belt warning chime under instrument panel to the front side of the glove box liner.
2. Secure chime with 2 screws.
3. Reaching under instrument panel, connect chime electrical connector.

Theft Deterrent Fuses

a. Removal

1. Remove glove box liner as described above.
2. Open wiring shroud above glove box to gain access to either the 20 amp "lights" or the 25 amp "horn" in-line fuses.
3. Remove fuse by holding the far end of the fuse holder stationary, depressing the near end slightly and turning it counter-clockwise.

b. Installation

1. Install fuse in holder, place holder end cover over fuse, depress end slightly and turn clockwise.
2. Position fuse into shroud and close shroud.
3. Install glove box liner as described above.

Theft Deterrent Controller

a. Removal

1. Disconnect negative battery cable.
2. Remove glove box liner as described above.
3. Disconnect electrical connectors from theft deterrent controller.
4. Remove 2 screws which secure theft deterrent controller to right hand body bracket.

b. Installation

1. Position theft deterrent controller to right hand body bracket and secure with 2 screws.
2. Connect electrical connectors to theft deterrent controller.
3. Install glove box liner as described above.

4. Connect negative battery cable and tighten to 70 inch-pounds torque.

5. Check operation of theft deterrent system as described in Section 9.

Climate Control Cross Car Duct

a. Removal

1. Remove instrument panel top cover as described on Page 8-44.

2. Remove right hand insert and applique assembly as described on Page 8-47.

3. Remove glove box liner as described above.

4. Remove upper and lower screws which secure center car vertical support rod. Remove rod, Fig. 9-20.

5. Remove 2 screws which secure plenum to cross car duct. Lower plenum, remove left hand flexible hose and remove plenum.

6. Remove 4 screws which secure cross car duct to instrument panel support.

7. Lower cross car duct and remove through glove box opening.

b. Installation

1. Insert cross car duct through glove box liner and position on instrument panel support. Secure with 4 screws.

2. Position lower edge of climate control plenum into heater assembly, attach flexible duct to left hand side and secure plenum to cross car duct with 2 screws.

3. Install center car vertical support rod and secure with 2 screws, Fig. 9-20.

4. Install glove box liner as described above.

5. Install right hand insert and applique as described on Page 8-47.

6. Install instrument panel top cover as described on Page 8-44.

Right Hand Lower Instrument Panel (Fig. 8-40)

a. Removal

1. Remove lower steering column cover as described on Page 8-41 and cluster bezel as described on Page 8-42.

2. Remove right hand insert and applique as described on Page 8-47.

3. Remove 6 screws which secure right hand lower instrument panel to instrument panel top cover and reinforcement.

NOTE: Open glove box door to gain access to screws on right hand side.

4. Open right hand door and remove trim screw from right side.

5. Loosen 4 screws which secure right hand lower instrument panel to lower side of instrument panel support.

6. Disconnect glove box light and trunk release switch connectors and remove instrument panel.

b. Installation

1. Position lower instrument panel to instrument panel support. Connect glove box light and trunk release switch connectors.

2. Tighten 4 screws which secure right hand lower instrument panel cover to lower instrument panel support to 15 inch-pounds torque.

3. Install right hand trim screw.

4. Install 6 screws which secure upper edge of lower instrument panel.

5. Install right hand insert and applique as described on Page 8-47.

6. Install cluster bezel as described on Page 8-42 and lower steering column cover as described on Page 8-41.

Left Hand Lower Instrument Panel (Fig. 8-43)

a. Removal

1. Disconnect negative battery cable.

2. Remove lower steering column cover as described on Page 8-41 and cluster bezel as described on Page 8-42.

3. Remove trim screw from left side of lower panel.

4. Remove 2 screws securing left hand lower instrument panel to top cover.

5. Loosen screw securing lower panel to reinforcement.

6. Pull left hand lower instrument panel out to gain access to connectors. Disconnect climate control electrical and vacuum connectors, cruise control connectors, headlamp connectors, illumination bulbs and sockets and ground wire(s).

2. Insert panel assembly into reinforcement and tighten lower left screw.

3. Install 2 screws which secure panel to top cover.

4. Install left hand trim screw.

5. Install cluster bezel as described on Page 8-42 and lower steering column cover as described on Page 8-41.

6. Connect negative battery cable. Tighten to 70 inch-pounds torque.

Headlamp Switch (Guide-Matic and/or Twilight Sentinel Controls (Fig. 8-44)

a. Removal

1. Remove left hand lower instrument panel assembly as described above.

2. Pull knob to "headlights On" position and depress spring loaded button on bottom of switch. While depressing button, remove headlamp knob and rod assembly.

3. Remove 4 headlamp case-to-instrument panel insert screws and separate headlamp swich assembly from left hand lower instrument panel assembly.

4. Remove sleeve which secures headlamp switch to case.

5. Without Guide-Matic and/or Twilight Sentinel - remove sleeve which secures escutcheon, washer and lens to backplate.

With Guide-Matic and/or Twilight Sentinel - remove Guide-Matic knob, wave washer and twilight sentinel lever by carefully pulling straight out. Lens may be removed without further disassembly. Remove spanner nut to remove potentiometer(s) from backplate.

b. Installation

1. Without Guide-Matic and/or Twilight Sentinel - position lens, washer and escutcheon onto backplate and secure with sleeve. Tighten to 45 inch-pounds torque.

With Guide-Matic and/or Twilight Sentinel position potentiometer into backplate and secure with spanner nut. Tighten to 45 inch-pounds torque.

NOTE: Position potentiometer wires downward to insure that they may be routed between backplate and case properly without pinching or binding.

1. Assemble lens onto backplate and secure by pushing on twilight sentinel lever, wave washer and guide-matic assembly.

2. Install headlamp switch onto case and secure with sleeve. Tighten to 40 inch pounds torque.

NOTE: Switch must be positioned with electrical connector toward speedometer.

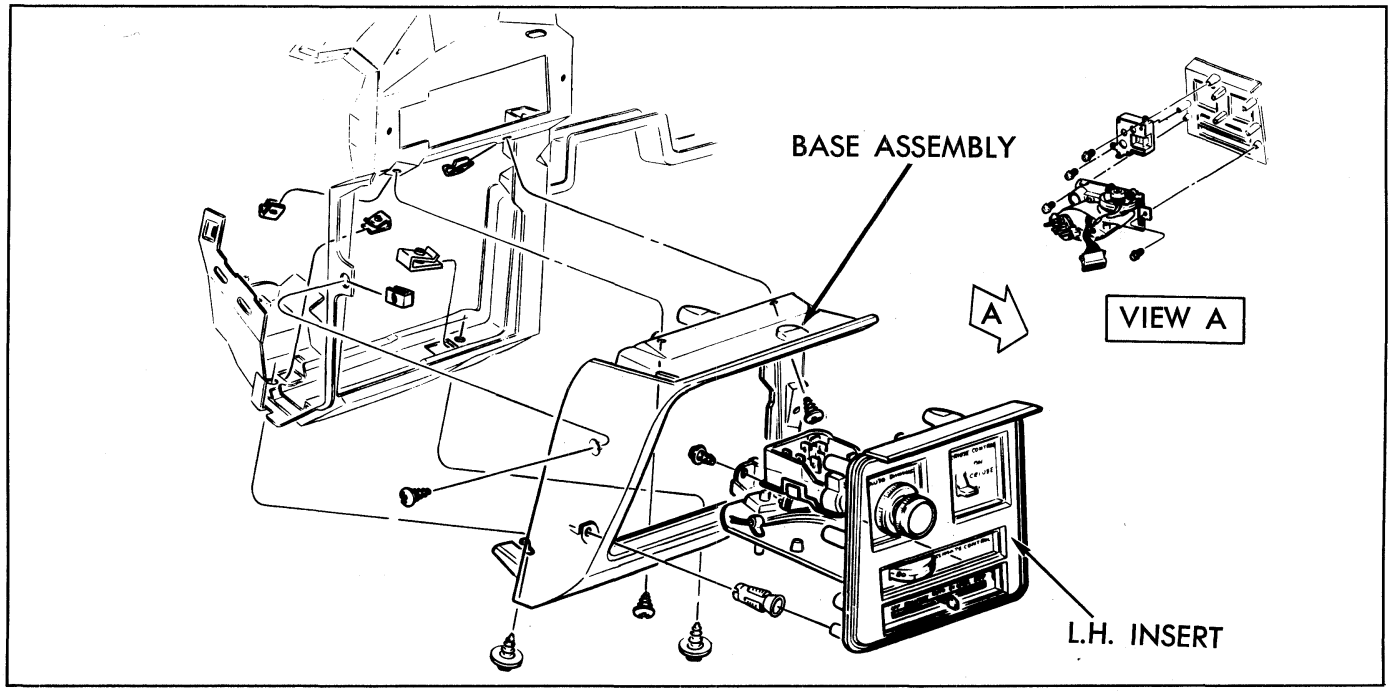


Fig. 8-43 Left Hand Lower Instrument Panel (Seville)

3. Clip case assembly to backplate assembly and secure to instrument panel insert with 4 screws. Tighten to 35 inch-pounds torque.

4. Depress button on bottom of headlamp switch and insert headlamp knob and rod assembly.

5. Install left hand lower instrument panel as described above.

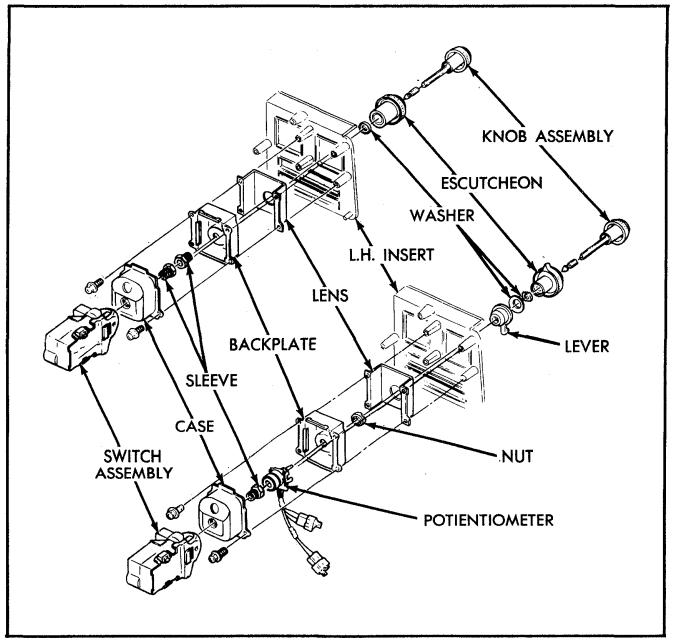


Fig. 8-44 Headlamp Control Component Parts (Seville)

Cruise Control Switch (Fig. 8-43)

a. Removal

1. Remove left hand lower instrument panel as described above.

2. Remove 2 screws and ground wire which secures cruise control switch to instrument panel insert.

3. Release tab on lower edge of housing and push switch from housing.

NOTE: Housing need not be removed for service on the switch only.

b. Installation

1. Push switch into housing until it snaps into place.

2. Position switch and housing onto instrument panel insert and secure with 2 screws.

NOTE: Be certain ground wire is retained by the upper screw.

Tighten screws to 20 inch-pounds torque.

3. Install left hand lower instrument panel as described above.

Climate Control Head (Fig. 8-43)

a. Removal

1. Remove left hand lower instrument panel assembly as described above.

2. Remove 2 screws which secure climate control head to left hand insert assembly.

b. Installation

1. Position climate control head onto left hand insert assembly.

2. Install left hand lower instrument panel assembly as described above.

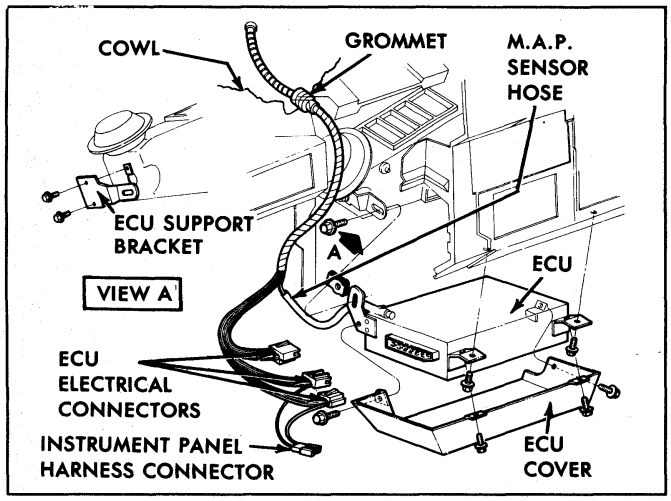


Fig. 8-45 Electronic Control Unit Attachment (Seville)

Fuel Injection Electronic Control Unit (ECU) (Fig. 8-45)

a. Removal

1. Disconnect negative battery cable.
2. Loosen right hand forward screw which secures ECU cover to ECU.
3. Remove remaining 3 screws which secure ECU cover to ECU.
4. Remove 3 screws which secure ECU to instrument panel supports.
5. Carefully lower ECU enough to disconnect 3 electrical connectors from left hand side and MAP hose from front of ECU.
6. Lower ECU and remove.

b. Installation

1. Position ECU under center of instrument panel and connect 3 electrical connectors and MAP hose.
2. Install ECU to instrument panel supports with 3 screws. Tighten to 25 inch pounds torque.
3. Position ECU cover under right hand forward screw and tighten screw to 25 inch-pounds torque.
4. Install remaining 3 ECU cover to ECU attaching screws and tighten to 25 inch pounds torque.
5. Connect negative battery cable. Tighten to 70 inch-pounds torque.

Twilight Sentinel Amplifier

a. Removal

1. Remove 2 screws which secure twilight sentinel amplifier to brake pedal support.
2. Lower amplifier and disconnect electrical connector.

NOTE: Should it be necessary to replace the amplifier, both the amplifier and the photocell must be replaced as a matched set.

b. Installation

1. Position amplifier next to brake pedal support and connect electrical connector.
2. Secure amplifier to brake pedal support with 2 screws.

Twilight Sentinel Photocell (Fig. 9-21)

a. Removal

1. Remove instrument panel top cover screws as described on Page 8-44.
2. Lift top cover enough to gain access to twilight sentinel photocell. Photocell is attached to the right side of the left front speaker grille.
3. Twist photocell holder counterclockwise, lower from top cover and remove photocell from holders.

NOTE: Should it be necessary to replace the photocell, both the photocell and the amplifier must be replaced as a matched set.

b. Installation

1. Insert photocell into holder and position onto instrument panel top cover to right of left front speaker.
2. Twist photocell clockwise to secure onto left front speaker grille.
3. Install instrument panel top cover as described on Page 8-44.

SPECIFICATIONS

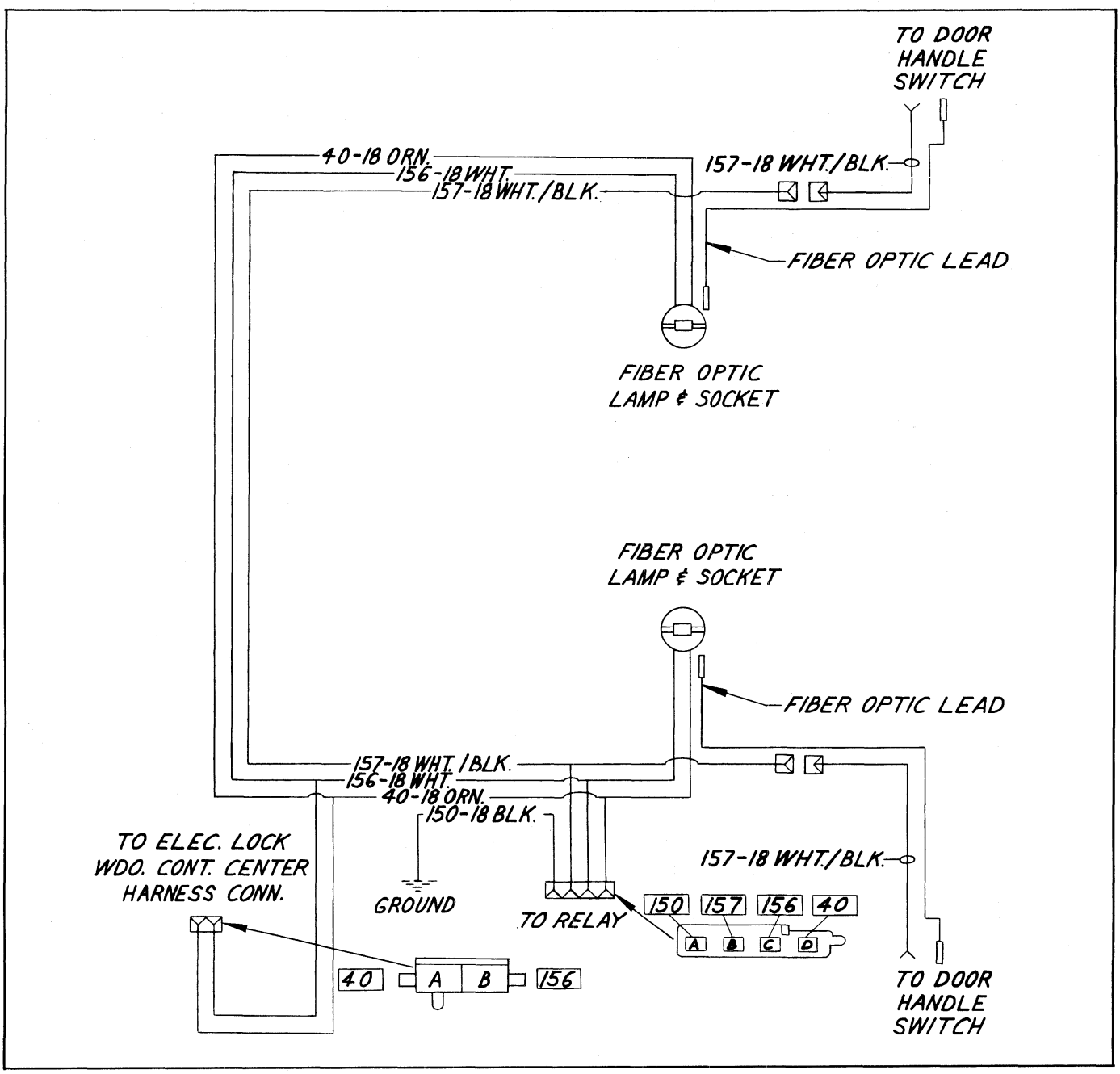


Fig. 8-46 Illuminated Door Lock Wiring Circuit Diagram (Seville)

LIGHTING AND CHASSIS ELECTRICAL TORQUE SPECIFICATIONS (SEVILLE)

Material	Application	Size	Inch Pounds
300M	Antenna Lower Support to Motor Housing Screw	1/4-20	50-75
275M	Antenna Lower Support Brkt. to Wheelhouse	5/16-18	15-20*
6010M	Antenna Relay to Inst. Panel Low Reinf.	10-16TS	10-20
51410	Cornering Lamp to Fender Screws	8-18TS	10-20
6010M	Fuel Economy Switch to Cowl Screw	1/4-14TS	50-70
6010M	Fuse Block to Cowl Screws	10-16TS	20-30
6010M	Guide-Matic Relay to Cowl	1/4-14TS	25
Stainless	Headlamp Bezel Attach. Screws	8-18TS	10-20
1050	Headlamp Housing Attach. Screws	M6.3 x 1.0 x 30	65-85 (7.5-9.7) N·m
6010M	Horns and Horn Mtg. Screw	5/16-12	20-25*
1050	Lamp Monitor Housing to Fender Nuts	3/16	20-30
6010	Rear Defogger Relay and Circuit Breaker	10-16	10-20
1010	Theft Deterrent Controller to Supt.	10-24	20-30
275M	Washer Fluid Bottle Brkt. t Whl. Hse. Screw	1/4-20	65-85
6010M	Washer Nozzle Attach. Screw	10-16TS	15-20

* — Foot Pounds
TS — Self Tapping Screw

INSTRUMENT PANEL TORQUE SPECIFICATIONS (SEVILLE)

Material	Application	Size	Foot Pounds
275M	Instrument Panel Vertical Support Rod Screws	1/4-20	75*
6010M	Lower Steering Column Cover to Support	#8-18 TS	15*
1010	Speedometer Cluster Bezel to Speedometer Cluster	#10-24	25*
1022	Speedometer Cluster Bezel to Lower Instrument Panel	#10-16 HL	20*
6010M	Speedometer Cluster to Instrument Panel Support	#10-16 TS	20*
284M	Radio Rear Support Rod Nuts	#10-24	25*
1010	Radio Control Knob Thin Hex Nuts	7/16-28	60*
275M	Antenna Lower Support to Wheelhouse Screw	5/16-18	20
280M	Antenna Lower Support to Motor Housing Screw	1/4-20	65*
Special	Antenna Housing to Fender Nut	—	80*
275M	Washer Fluid Bottle Attaching Screws	1/4-20	75*
6010M	Horn and Bracket Mounting Screws	5/16-12 TS	10
6010M	Horn Relay to Mounting Bracket Screws	#10-24 TS	25*
6010M	Junction Block to Cowl Screws	#10-16 TS	25*
6010M	Fuel Economy Switch to Cowl Screws	1/4-14 TS	60*
275M	Headlamp Housing Attaching Screws	1/4-20	75*
6010M	Park Lamp Housing to Headlamp Housing Screw	#8-18 TS	20*
Stainless	Headlamp Bezel Attaching Screws	#8-18 TS	15*
Stainless	Cornering Lamp Attaching Screws	#8-18 TS	15*
6010M	Left Hand Lower Instrument Panel to Support	#8-18 TS	15*
6010M	Left Hand Insert Attaching Screws	#8-18 TS	20*
1022	Climate Control, Cruise Control and Headlamp Switch Housing to L.H. Insert	#10-16 HL	20*
Special	Headlamp Switch Sleeve to Switch or Backplate	7/16-28	45*
6010M	Instrument Panel Top Cover to Defroster Screws	#8-18 TS	12*
6010M	Instrument Panel Top Cover Underside (Except Glove Box)	#8-18 TS	15*
1010	Instrument Panel Top Cover Underside at Glove Box	#10-24	25*
1022	Telltale Housing, Clock, Climate Control Outlet Ducts and In-Car Sensor to Instrument Panel to Cover Screws	#10-16 HL	20*
6010M	R.H. Insert Left and Right Upper Screws	#8-18 TS	15*
6010M	R.H. Insert Center Upper Screw	#8-18 TS	15*
1022	R.H. Insert Right Rear Attaching Screw	#10-16 x 1/2 HL	20*
6010M	R.H. Lower Instrument Panel to Lower Support	#8-18 TS	15*
6010M	R.H. Lower Instrument Panel (Glove Box) to Support	#8-18 TS	15*
1022	Accessory Switch and R.H. Mirror Control Housing to R.H. Insert	#10-16 x 1/2 HL	20*
6010M	Glove Box Liner Attaching Screws	#8-18 TS	15*
1010	Glove Box Hinge to Hinge Support	#10-24	20*
Special	Glove Box Lock Case Escutcheon	—	50*
1010	Glove Box Striker Attaching Screws	#10-24	25*
6010M	Glove Box Door Support Cable Screws	#8-18 x 5/8 TS	15*
6010M	Glove Box Door Inner to Outer Halves Seat Belt Chime to Glove Box Liner	#8-18 x 5/8 TS	15*
6010M	Fuel Injection Electronic Control Unit to Instrument Panel Support	#10-24 TS	25*
6010M	ECU Dust Cover to ECU	#10-24 TS	25*
1010	Windshield Wiper Switch Mounting Screw	#10-24 x 3/8	25*
			*Inch Pounds

HL—Hi-Lo Thread Diameter
TS—Self Tapping Screw
For Hi-Lo applications a #11-16 (oversize) screw is available for repair purposes (1600491 or equivalent)

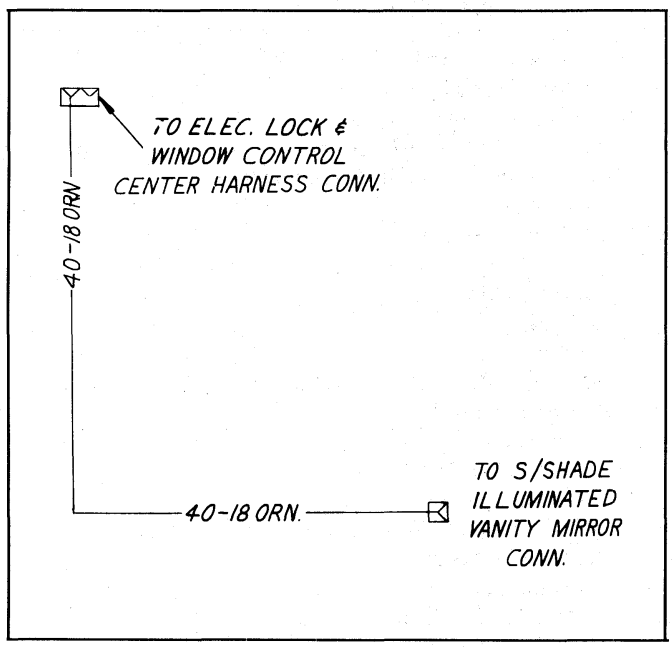


Fig. 8-47 Illuminated Vanity Mirror Circuit Diagram (Seville)

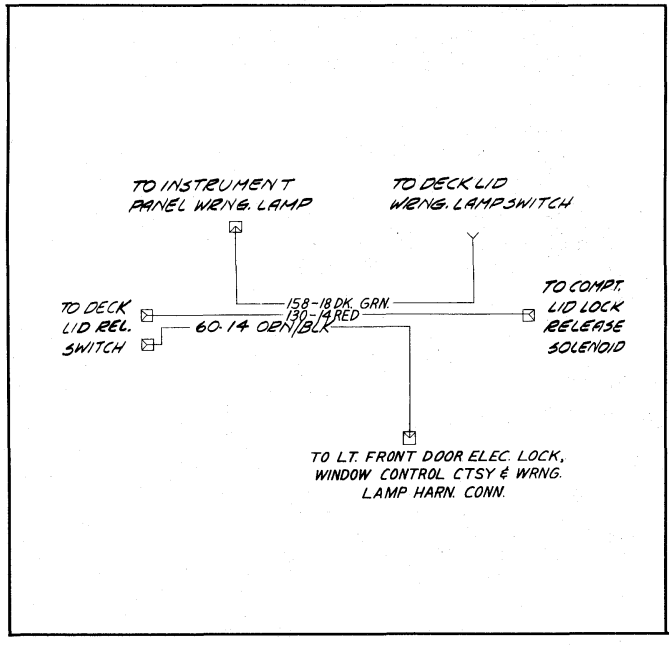


Fig. 8-48 Electric Trunk Release Circiut Diagram (Seville)

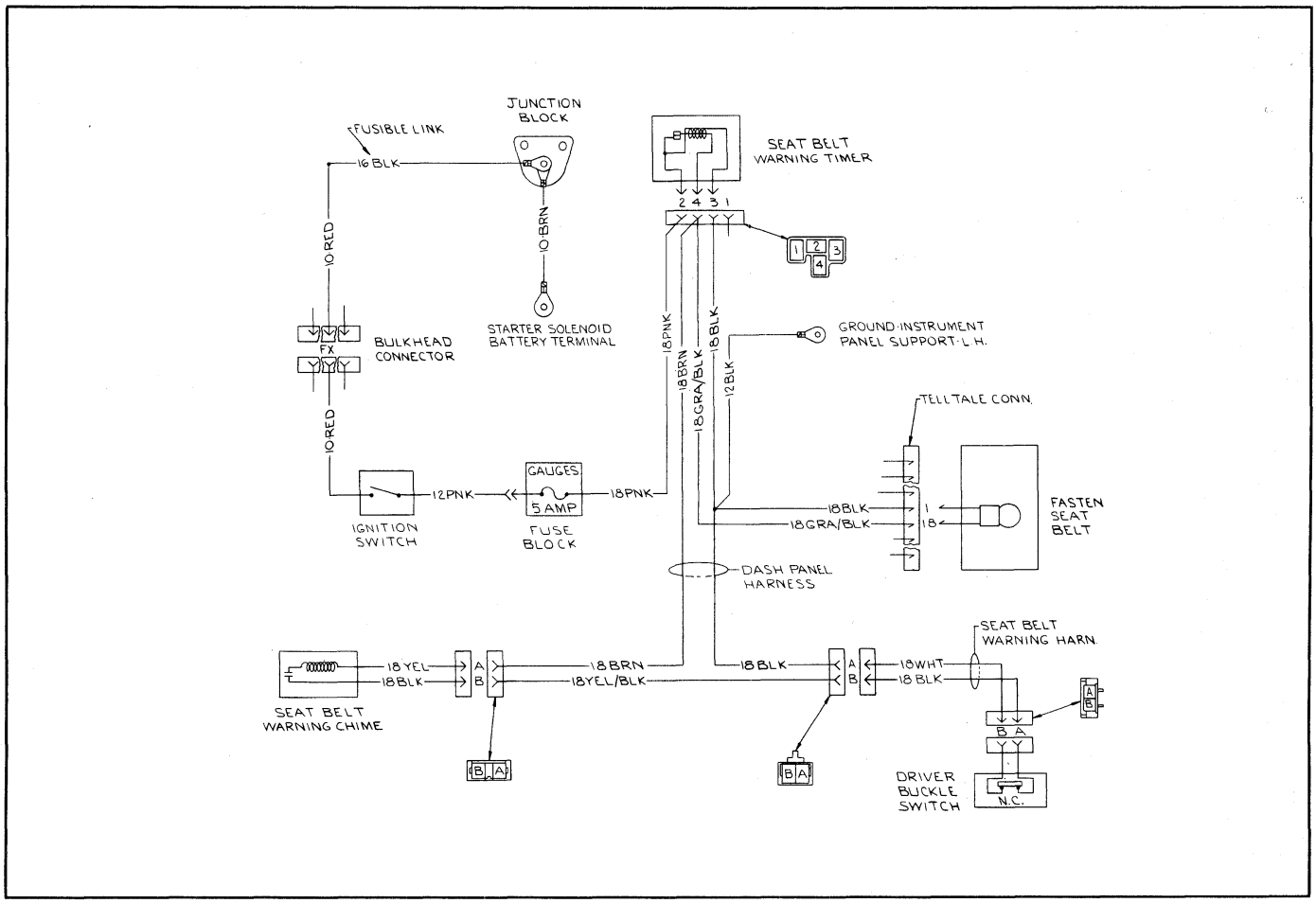


Fig. 8-49 Seat Belt Warning Circuit Diagram (Seville)

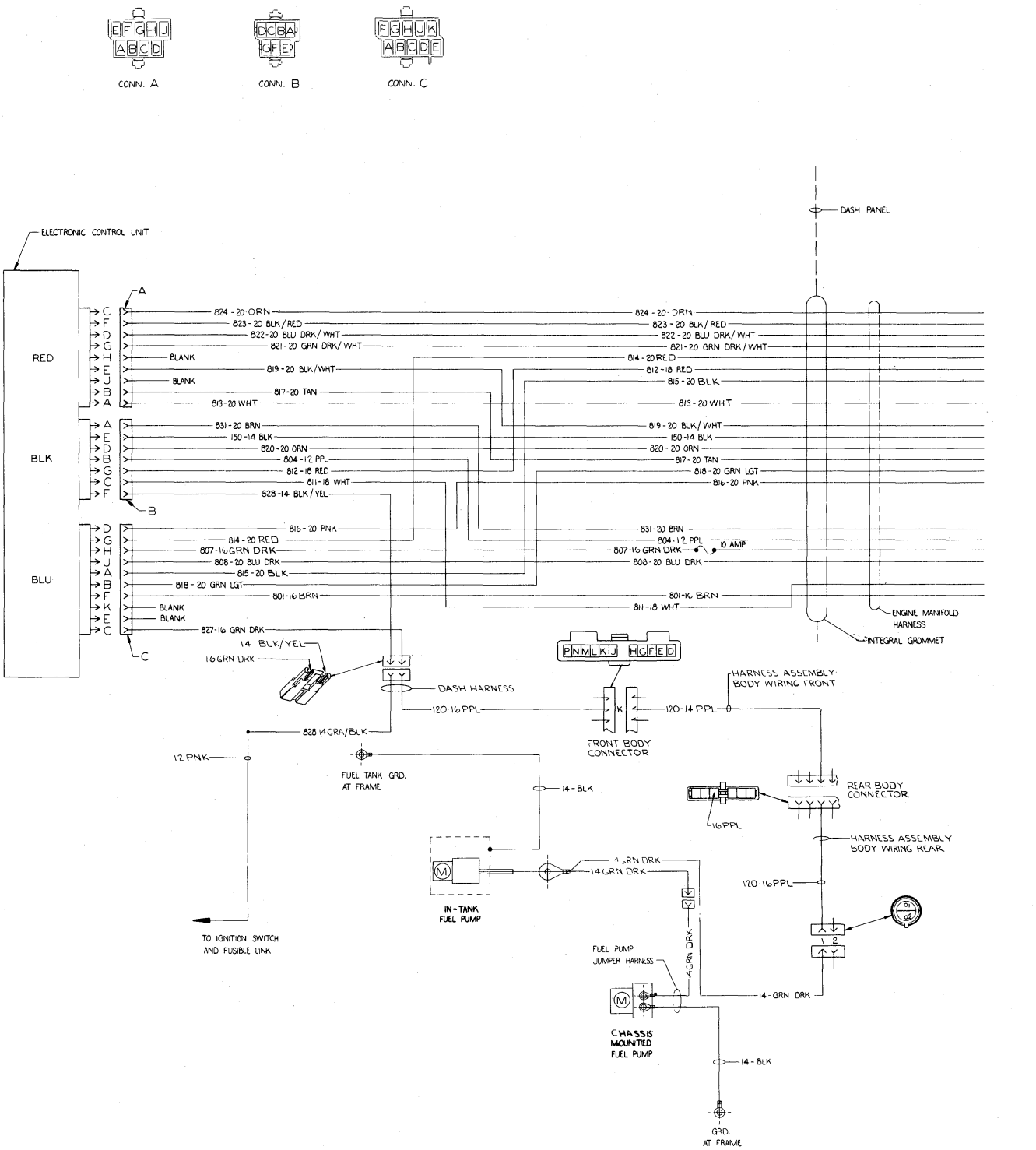


Fig. 8-50 EFI Electrical Circuit (Seville) Page 1

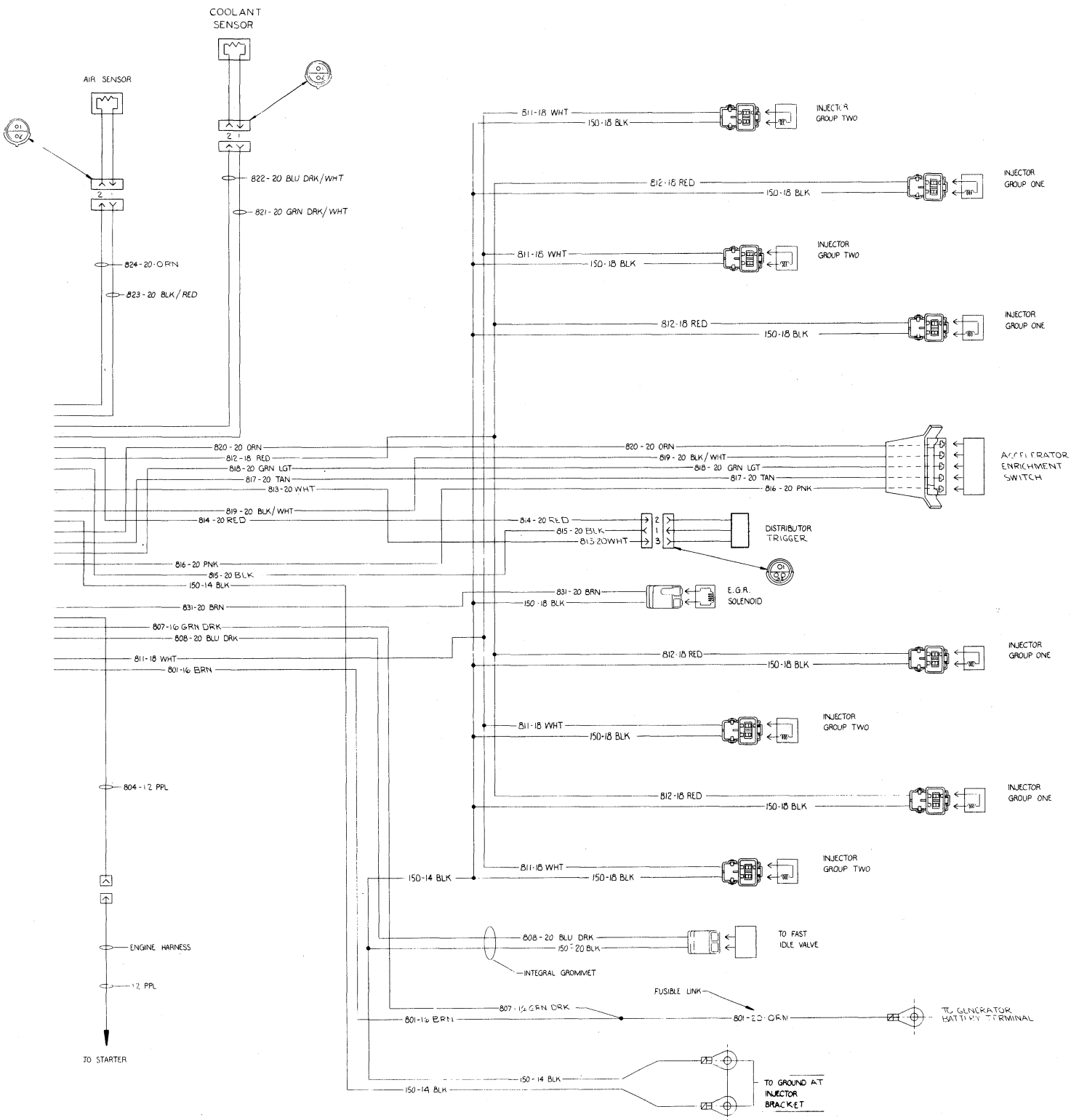


Fig. 8-50 EFI Electrical Circuit - (Seville) Cont.-Page 2

LIGHTING SYSTEMS
GENERAL DESCRIPTION

Headlamps

The rectangular headlamps are approximately six and three-eights inches wide by four inches high.

The rectangular shape offers a distinctive appearance. The lower height allows the possibility of a smaller overall frontal area. This is accomplished with no reduction in total headlamp candlepower output.

Mechanical aiming of the headlamps must be done with J-25300 headlamp aiming tool or equivalent. J-25300-1 and J-25300-2 when used with the two J-25330-6 adapters eliminate the need for a separate transit and target. When used with adapters J-25300-3 the aimers can be used to adjust the rectangular headlamps. Adapters J-25300-5 or J-25300-4 can easily be attached to the aimers to allow the tool to be used on five inch and seven inch round headlamps respectively.

Lamps and Bulbs

Although the rectangular headlamp unit bulb numbers are 4652 low beam and 4651 high beam they may also be identified by a code on the lens. 1A identifies the lamp as an inner or high beam unit while 2A indicates that the lamp is an outer or low beam unit.

The identification is located to the left of the upper headlamp aiming guide point.

Instrument panel courtesy lamp bulbs are the push-in wedge type. A one piece courtesy lamp housing and shield is used.

HEADLIGHTS DIAGNOSIS

POSSIBLE CAUSE	CORRECTIVE ACTION
ONE HEADLIGHT INOPERATIVE OR INTERMITTENT	
Loose connection.	Secure connections to sealed beam including ground (black wire).
Problem in sealed beam.	Replace.
ONE OR MORE HEADLIGHTS ARE DIM	
Open ground connection at headlight.	Repair black wire connection between sealed beam and chassis ground.
Black ground wire mislocated in headlight connector (Type 2A Sealed Beam).	Relocate.
ALL HEADLIGHTS INOPERATIVE OR INTERMITTENT	
Loose connection.	Check and secure connections at foot switch, guide matic relay and headlamp switch and ground wire connections.
Malfunctioning foot switch.	Check voltage at foot switch with test bulb. If bulb lights only at light blue wire terminal, replace foot switch.
Open wiring – light switch to foot switch.	Check voltage at light blue wire with test bulb. If bulb lights at headlamp switch light blue wire terminal but not at foot switch, repair open in light blue wire.
Open wiring – light switch to battery.	Check voltage at headlamp switch yellow wire terminal with test bulb. If bulb fails to light, repair open yellow wire circuit to battery (possible open dark green fusible link at starter).

HEADLIGHTS DIAGNOSIS (CONT'D.)

POSSIBLE CAUSE	CORRECTIVE ACTION
Circuit shorted to ground.	If, after a few minutes operation, headlights cycle on and off and/or a clicking noise can be heard from the headlamp switch (circuit breaker opening and closing), repair short to ground in circuit between headlamp switch, dimmer switch and headlights. After repairing short, check for headlight flickering after one minute operation. If flickering occurs, the circuit breaker has been damaged and headlamp switch must be replaced.
Malfunctioning light switch.	Check voltage at headlamp switch yellow and blue wire terminals with test bulb. If bulb lights at yellow wire terminal but not at light blue, replace light switch.
UPPER OR LOWER BEAM WILL NOT LIGHT OR INTERMITTENT	
Open connection or malfunctioning foot switch.	Check voltage at foot switch headlight terminals with test light. If bulb lights at headlight terminals (light green - High Beam, Tan - Low Beam), repair open wiring between foot switch and headlights. If bulb will not light at one of the foot switch headlight terminals, replace foot switch.
Circuit shorted to ground.	Follow diagnosis shown above under "All Headlights Inoperative or Intermittent."
Problem in sealed beam.	Replace.

TURN SIGNAL AND HAZARD WARNING LAMPS DIAGNOSIS

TURN SIGNAL INOPERATIVE – ONE SIDE	
Bulb out (flasher cannot be heard).	Turn on hazard warning system. If one or more lamps do not operate, check for a malfunctioning bulb.
Open wiring or ground connection.	Turn on hazard warning system. If one or more bulbs do not operate, use 12 volt test lamp to check voltage at lamp socket. If test bulb lights, repair open ground connection. If not, repair open wiring between bulb socket and turn signal switch.
Improper bulb or malfunctioning turn signal switch.	Turn on hazard warning system. If all front and rear lamps operate, check for improper bulb. If bulbs are OK, replace malfunctioning turn signal switch.
Short to ground (flasher can be heard, but no lamps operate).	Locate and repair short to ground by disconnecting front and rear circuits separately.

TURN SIGNAL AND HAZARD WARNING LAMPS DIAGNOSIS (CONT'D.)

POSSIBLE CAUSE	CORRECTIVE ACTION
TURN SIGNALS INOPERATIVE – BOTH SIDES	
Open fuse (turn signal).	Turn on hazard warning system. If all lamps operate, replace turn signal fuse if blown. If new fuse blows, repair short to ground between fuse, turn signal switch and lamps.
Malfunctioning flasher for Eldorado and Seville located on instrument panel lower support between steering column and park brake pedal mechanism, lower RH corner of fuse panel on all except Eldorado and Seville.	If turn signal fuse is OK, and hazard warning system will operate lamps, replace turn signal flasher.
Loose connection.	Secure steering column connector. If test bulb lights only on one side of purple wire terminals in connector, clean or tighten connector contacts.
Open wiring or malfunctioning turn signal switch.	If test bulb lights when connected to both sides of purple wire connection in steering column connector, replace turn signal switch. If test bulb does not light on either side of the connector, repair open circuit between fuse and connector.
HAZARD WARNING LAMPS INOPERATIVE	
Open fuse (stop-hazard).	Switch on turn signals. If lamps operate, replace stop-hazard fuse if blown. If new fuse blows, repair short to ground. (Could possibly be in stop light circuit).
Malfunctioning flasher (located on upper LH corner of fuse panel.)	If stop-hazard fuse is OK, switch on turn signals. If lamps operate, replace hazard flasher.
Open wiring or malfunctioning turn signal switch.	With 12 volt test bulb, check voltage at brown wire in turn signal steering column connector. If test bulb does not light on either side of connector, repair open circuit between flasher and connector. If test bulb lights only on feed side of connector, clean connector contacts. If test bulb lights on both sides of connector, replace turn signal switch assembly.

CORNERING LAMPS DIAGNOSIS

ONE LAMP INOPERATIVE	
Loose connection.	Secure connector near lamp.
Bulb out.	Replace burned out bulb.
Open ground connection.	If bulb is known good and test bulb lights at connector near lamp, repair open ground.
Open wiring.	If test bulb lights on both sides of steering column connector, repair open wiring between connector and lamps. If not, check for open at connector.
Malfunctioning directional signal switch.	If test bulb lights at brown wire terminals of steering column connector but not at gray (left turn) or black/white wire (right turn) terminal, replace directional signal switch.

CORNERING LAMPS DIAGNOSIS (Cont'd.)

BOTH LAMPS INOPERATIVE	
Tail lamp fuse blown.	If tail lamps do not light, replace tail lamp fuse if blown. If new fuse blows, repair short to ground between fuse and lamps.
Cornering-park lamp fuse blown.	If the cornering and park lamps do not light, and the tail lamps do light, replace cornering and park lamp fuse. If new fuse blows, repair short to ground between fuse and lamps.
Loose connection.	Secure connectors at headlamp switch and steering column.
Open wiring.	If tail lamps light, check voltage at steering column connector brown wire. If test bulb lights on lamp side of connector only, repair connector terminal. If tail lamps do not light, check for open wiring between headlamp switch and battery. (Possible open fusible link in yellow wire at starter).
Malfunctioning directional signal switch.	If tail lamps light, and test bulb lights on both sides of steering column connector, replace directional signal switch.
Malfunctioning light switch.	If tail lamps do not light and test bulb lights at light switch terminal #5 but not at #4, replace light switch.

SIDE MARKER LAMPS DIAGNOSIS

POSSIBLE CAUSE	CORRECTIVE ACTION
ONE LAMP INOPERATIVE	
Side marker bulb out.	Replace burned out bulb.
Loose connection or open wiring.	Check for voltage at bulb socket brown wire terminal with test bulb. If bulb lights, repair open ground circuit. If bulb does not light, repair open brown wire circuit.
FRONT OR REAR LAMPS INOPERATIVE	
Loose connection or open ground connection.	If associated tail or park lamps do not operate, check for loose connector or an open in brown wire circuit. If park lamps operate, repair open ground.
Multiple bulbs out.	Replace burned out bulbs.
ALL LAMPS INOPERATIVE	
Tail lamp fuse blown.	If park and tail lamps do not operate, replace tail lamp fuse if blown. If new fuse blows, check for short to ground between fuse panel and tail lamps.
Cornering-park lamp fuse blown.	If the side marker and park lamps do not light, and tail lamps do light, replace cornering and park lamp fuse. If new fuse blows, repair short to ground between fuse and lamps.

SIDE MARKER LAMPS DIAGNOSIS (Cont'd.)

ALL LAMPS INOPERATIVE (Cont'd.)	
POSSIBLE CAUSE	**CORRECTIVE ACTION**
Loose connection.	Secure connector to headlamp switch.
Open wiring.	Check for voltage at tail lamp fuse with test bulb. If bulb lights, repair open wiring between fuse and light switch. If not, repair open wiring between fuse and battery. (Possible open fusible link in yellow wire at starter).
Malfunctioning light switch.	If test bulb lights at light switch terminal #5 but not at terminal #4, replace light switch.

TAIL, PARK, AND LICENSE LAMPS DIAGNOSIS

POSSIBLE CAUSE	**CORRECTIVE ACTION**
ONE SIDE INOPERATIVE	
Bulb out.	Replace.
Open ground connection at bulb socket or ground.	Check for voltage at bulb socket brown wire terminal with test bulb. If bulb lights, repair open ground circuit. If bulb does not light, repair open brown wire circuit.
BOTH SIDES INOPERATIVE	
Tail lamp fuse blown.	Replace fuse. If new fuse blows, repair short to ground in brown wire circuit between fuse panel through headlamp switch to tail lamps.
Cornering-park lamp fuse blown.	If the park lamps do not light and the tail lamps do light, replace cornering-park lamp fuse. If new fuse blows, repair short to ground between fuse and park lamps.
Loose connection.	Secure connector to headlamp switch.
Open wiring.	If test bulb does not light on either side of fuse, repair open circuit between fuse panel and battery. (Possible open fusible link.) If test bulb lights at headlamp switch light green/black wire terminal (5), repair open wiring between headlamp switch and lamps.
Multiple bulb burnout.	If test bulb lights at lamp socket brown wire terminal, replace bulbs.
Malfunctioning headlamp switch.	If test bulb lights at headlamp switch terminal #4 (dark green) but not at terminal #5 (light green/black), replace light switch.

STOP LAMPS DIAGNOSIS

POSSIBLE CAUSE	CORRECTIVE ACTION
ONE BULB INOPERATIVE	
Bulb out.	Replace bulb.
ONE SIDE INOPERATIVE	
Loose connection, open wiring, or malfunctioning bulbs.	Turn on directional signal. If lamp does not light, check bulbs. If bulbs are OK, secure all connections. If lamp still does not light, check with a test bulb at green or yellow wire at bulb socket terminals. If bulb lights, repair open in ground circuit.
Malfunctioning directional signal switch or cancelling cam.	If lamp will operate by turning on directional signal. Replace cancelling cam or directional signal switch.
ALL INOPERATIVE	
Stop-hazard fuse blown.	Replace. If new fuse blows, repair short to ground in circuit between fuse and lamps.
Stop switch misadjusted or malfunctioning.	With test bulb check voltage with brake pedal depressed at white wire terminal in steering column connector. If bulb does not light, check stop switch for proper adjustment. If adjustment is OK, replace stop switch.
WILL NOT TURN OFF	
Stop switch misadjusted or malfunctioning.	Readjust properly. If switch still malfunctions, replace.

BACK-UP LAMPS DIAGNOSIS

POSSIBLE CAUSE	CORRECTIVE ACTION
ONE LAMP INOPERATIVE OR INTERMITTENT	
Open ground connection.	Repair bulb socket (detachable)
Loose connection.	Tighten connectors.
Bulb out.	Replace bulb.
BOTH LAMPS INOPERATIVE OR INTERMITTENT	
Fuse blown.	Replace fuse. If new fuse blows, repair short to ground in circuit from fuse through back-up lamp switch to back-up lamps.
Loose connection or open circuit.	Secure all connectors. If OK, check continuity by voltage checking circuit from fuse to lamps with test bulb. If test bulb does not light on either side of fuse, check for open circuit from ignition switch to fuse.
Back-up lamp switch misadjusted (open when shift lever is in reverse position).	Adjust switch.
Malfunctioning back-up lamp switch.	With ignition on, check voltage at terminals with switch in back-up position. If bulb lights at dark green wire terminal but not at light green wire terminal, replace back-up lamp switch.
Malfunctioning ignition switch.	If test bulb lights at ignition switch battery terminal but not at output terminal, replace ignition switch.
LAMPS WILL NOT TURN OFF	
Back-up lamp switch misadjusted (closed when shift lever is not in reverse position).	Adjust switch.

ON-CAR SERVICE

Headlamp Aiming

Mechanical aimer Tool Number J-25300 (or equivalent) should be used to aim headlamps. Be sure to follow the tool equipment manufacturer's instruction along with observing applicable state and local headlamp aiming regulations.

LAMPS (Exc. Eldorado and Seville)

Headlamp Replacement (Fig. 8-51)

a. Removal

1. Remove 3 screws securing headlamp bezel.
2. Grasp headlamp bezel near front end panel, pivot outward and lift upward to remove.
3. Remove 4 screws securing headlamp retaining ring to mounting ring.
4. Disconnect electrical and lamp monitor connectors and seal and remove lamp.

b. Installation

1. Connect electrical and lamp monitor connectors and seal.
2. Position headlamp into mounting ring.
3. Install headlamp retaining ring and secure with 4 screws.
4. Slide clips on lower edge of headlamp bezel over studs on headlamp housing and pivot bezel inward.
5. Secure bezel with 3 screws. Push in on lower bezel to be sure it is completely in position.
6. Check operation of headlamp and lamp monitors and aim headlamps.

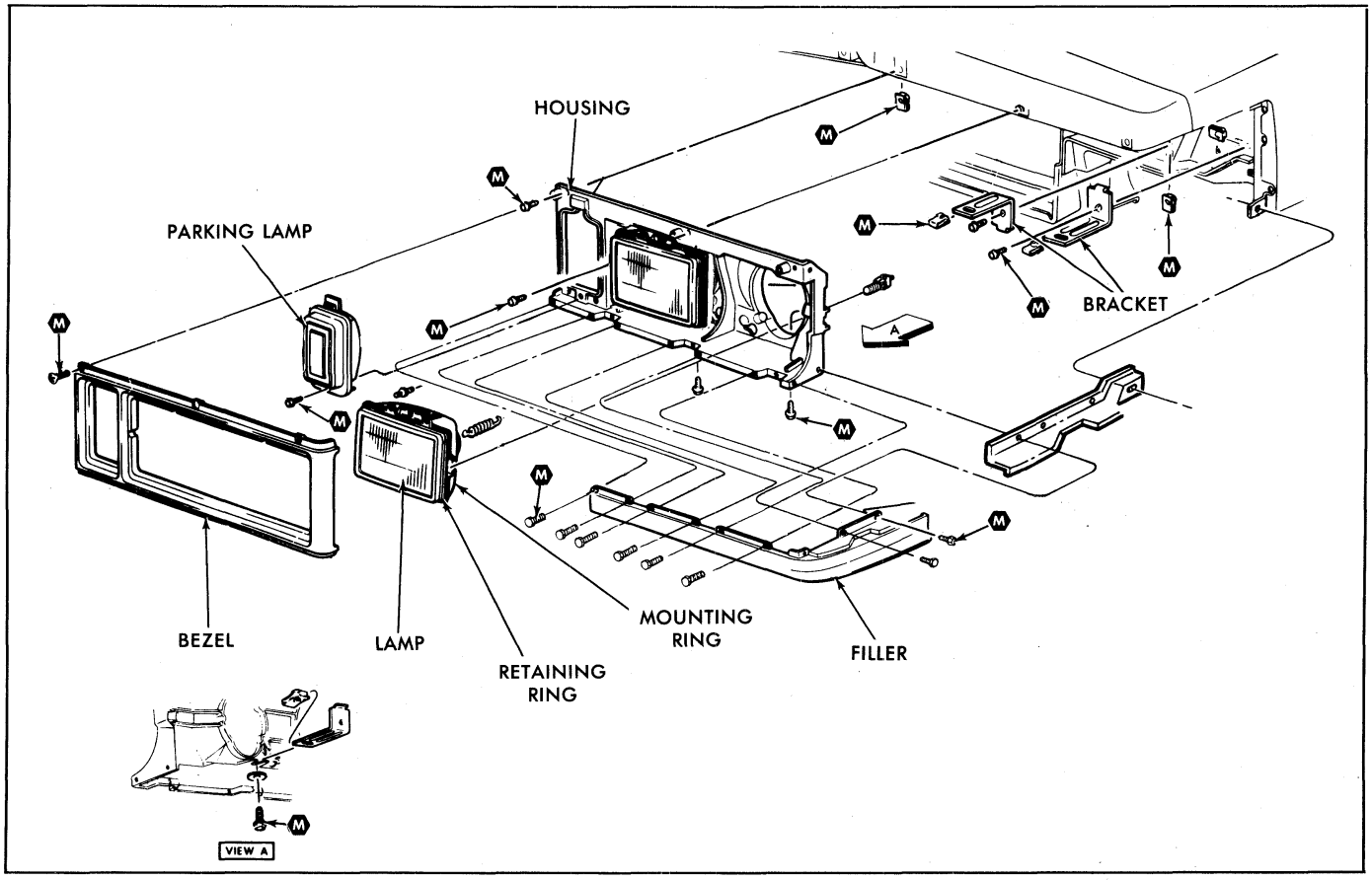


Fig. 8-51 Headlamp, Parking and Directional Signal Lamps (Except Eldorado and Seville)

Parking Lamp Replacement (Fig. 8-51)

a. Removal

1. Remove 3 screws securing headlamp bezel.
2. Grasp headlamp bezel near front end panel, pivot outward and lift upward to remove.
3. Remove 1 clamp retaining screw and disconnect electrical and lamp monitor connectors and remove lamp.

b. Installation

1. Connect electrical and lamp monitor connectors.
2. Position lamp and secure with 2 retaining screws.
3. Slide clips on lower edge of headlamp bezel over studs on headlamp housing and pivot bezel inward.
4. Secure bezel with 3 screws. Push in on lower bezel to be sure it is completely in position.
5. Check operation of lamp and lamp monitors.

Headlamp Housing Assembly (Fig. 8-51)

a. Removal

1. Disconnect negative battery cable.
2. Remove cornering lamp assembly as described below.
3. Remove headlamp bezel.
4. Remove 5 screws securing housing to front end panel.
5. Remove 1 screw securing housing to grille.
6. Remove 2 screws securing housing attaching tabs to radiator cradle brackets and 1 screw attaching filler retainer to fender.
7. Grasp housing at top and pivot outward and disconnect electrical and lamp monitor connectors.
8. Remove headlamp housing.

b. Installation

1. Connect electrical and lamp monitor connectors.

NOTE: The high beam headlamp fiber optic has a blue marking near the end. The low beam headlamp fiber optic has a similar marking which is white.

2. Gently position headlamp housing making certain radiator cradle brackets are on top of housing attaching tabs.
3. Install 5 screws securing housing to front end panel.
4. Install 1 screw securing housing to grille.
5. Install 2 screws securing housing attaching tabs to radiator cradle brackets and 1 screw attaching filler retainer to fender.
6. Install headlamp bezel.
7. Install cornering lamp assembly as described below.
8. Connect negative battery cable and tighten to 70 inch-pounds.
9. Check operation of lamps and lamp monitors and aim headlamps.

CORNERING, SIDE MARKER LAMP AND BEZEL (Fig. 8-52)

NOTE: The lens is permanently assembled to the housing and is not serviceable.

a. Removal

1. Remove 3 screws securing bezel and lamp assembly to fender.
2. Remove assembly.
3. Pull lamp assembly out of position and disconnect 2 bulb and socket assemblies.

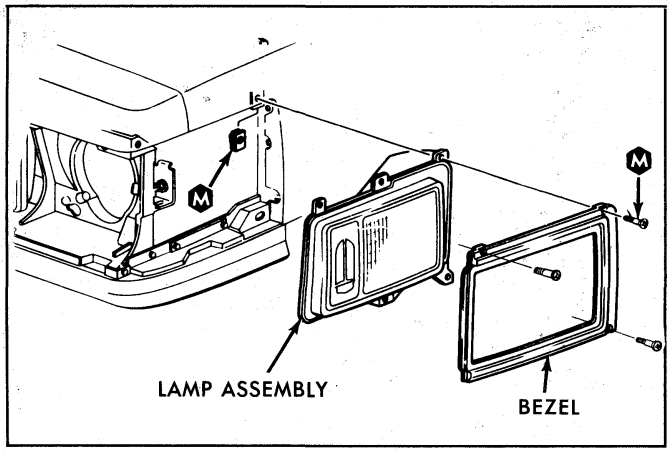


Fig. 8-52 Cornering and Side Marker Lamp (Except Eldorado and Seville)

b. Installation

1. Connect 2 bulb and socket assemblies.
2. Position bezel and lamp assembly to fender and secure with 3 screws.
3. Check operation of cornering lamp and side marker lamp.

FRONT LAMP MONITOR READ-OUT (Fig. 8-53)

a. Removal

1. Remove cornering lamp assembly as described above.
2. Reach under front end panel and remove two nuts from read-out mounting studs and raise read-out from fender.
3. Detach monitor connector from read-out and remove.

b. Installation

1. Install monitor connector on read-out and position read-out on front end panel.
2. Reach under fender and install two nuts on read-out mounting studs to secure read-out to front end panel.
3. Check operation of read-out. If satisfactory, install cornering lamp assembly as described above.

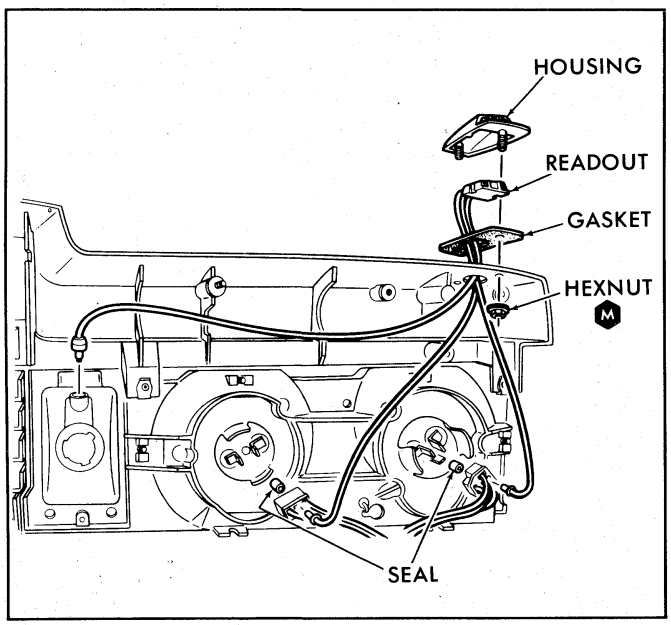


Fig. 8-53 Lamp Monitor Installation (Except Eldorado and Seville)

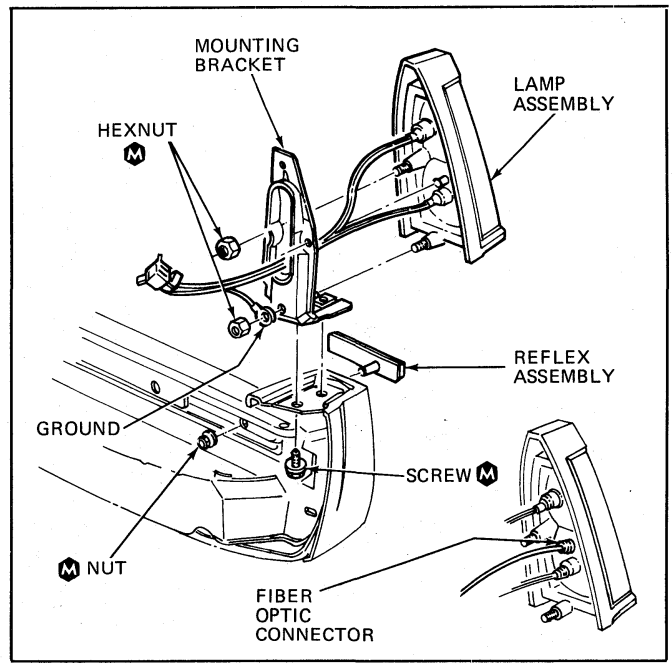


Fig. 8-54 Tail, Stop, Directional and Rear Side Marker Lamps (Except Eldorado and Seville)

FRONT LAMP MONITOR HARNESS (Fig. 8-53)

a. Removal

1. Remove front monitor read-out as described above.
2. Disconnect conductor harness from front lamps.
3. Detach monitor connector from read-out and remove read-out.
4. Remove read-out connector with conductor harness by pulling out through hole in top of fender.

b. Installation

1. Install lamp end of conductors down through hole in top of fender.
2. Route harness and install conductor ends into respective lamps.
3. Install monitor connector to read-out.
4. Check operation of read-out. If satisfactory intall cornering lamp assembly as described above. If not check installation and routing.

TAIL, STOP-SIGNAL LAMPS, REAR SIDE MARKER LAMPS (Fig. 8-54)

Removal

1. Disconnect negative battery cable.
2. Remove rear bumper outer end as described on Page 2B-9.
3. Remove 3 hex nuts securing lamp assembly to mounting bracket and remove.

b. Installation

1. Position lamp assembly to mounting bracket and secure with 3 hex nuts.
2. Install rear bumper outer end as described on Page 2B-9.
3. Connect negative battery cable, tighten to 70 inch lbs. and test operation of lights.

TAIL, STOP-SIGNAL LAMP, BACK-UP LAMP ASSEMBLY (Commercial Chassis Only)

Secure with 4 screws. Washer is installed between lamp assembly and bracket of lower inner mounting screw.

1. Position lamp under bumper and install stop signal and back up connectors.
2. Position lamp assembly to bumper and secure with 2 screws.

BACK-UP LAMPS

a. Removal

1. Remove 2 top and bottom screws securing lamp assembly to body.
2. Disconnect bulb and socket assembly and remove lamp.

b. Installation

1. Install bulb and socket assembly to lamp.
2. Position lamp to body and secure with 2 top and bottom screws.

LICENSE PLATE LAMP

Removal and Installation

Remove 2 screws securing license plate lamp lens to filler and remove lamp.

Replace bulb if necessary by removing detachable socket.

BULB REPLACEMENT

It is necessary to carefully check the parts catalog for correct model application when replacing lamp socket assemblies. If incorrect sockets are used for replacement, the bulb filament will be in the wrong location with respect to the lens and/or reflector. As a result, the lamp may fail to meet the required lighting standards.

CAUTION: *Make certain ignition swtich and headlight switch are off when replacing bulbs.*

a. Front Park - Signal Lamp, Cornering Lamp, Side Marker Lamp

Access to the bulbs is gained by removing headlamp bezel to remove parking and signal lamp housing then removing the bulb and socket from the back side of the lamp assembly. The cornering and side marker lamp assembly must be removed by detaching 3 bezel attaching screws, then removing bulb and socket from back side of lamp assembly.

b. Rear Tail, Stop-Signal and Side Marker Lamp

Access to these bulbs is gained by removing the bezel (one screw) and removing the lens (three screws).

NOTE: Take care not to drop the loose reflectors inside lens, or use tape to secure reflectors as required.

c. Back-Up Lamp

Access to these bulbs can be gained by removing bulb and socket from behind bumper.

d. License Plate Lamp

Access is gained by removing 2 screws in lamp assembly and removing detachable socket.

e. Cruise Control Switch Lamp

Remove switch as described on Page 8-8 for access to this lamp.

f. Headlight Switch Lamp

Remove switch as described on Page 8-7 for access to this lamp.

g. Windshield Wiper Swtich Lamp

Remove switch for access to this lamp as described on Page 8-8.

h. Radio Dial Lamp

Dial lamp is replaced by removing the instrument panel center insert on all radios except AM/FM stereo tape radio.

Access to the stereo AM/FM tape radio dial lamp is through the tape access door.

i. Clock Lamp, Fuel Gage Lamp, and Warning Lamps

Remove instrument panel top cover as described on Page 8-2 for access to all lamps in the telltale assembly.

j. Speedometer Cluster Lamps

Remove speedometer cluster as described on Page 8-6 for access to all lamps in the cluster.

k. Accessory Switch Lamps

Remove center panel insert as described on Page 8-8. for access to these lamps.

LAMPS (Eldorado)

Headlamp Replacement (Fig. 8-55)

a. Removal

1. Remove 4 screws securing headlamp bezel to headlamp housing.
2. Remove 4 screws securing headlamp retaining ring to mounting ring.
3. Disconnect electrical and lamp monitor connector.
4. Remove lamp monitor seal from headlamp and remove headlamp.

b. Installation

1. Install lamp monitor seal onto headlamp.
2. Connect electrical connector and position headlamp into mounting ring.
3. Install headlamp retaining ring and secure with 4 screws.
4. Position headlamp bezel and secure with 4 screws.
5. Check operation of headlamps and lamp monitors.
6. Aim headlamps.

HEADLAMP HOUSING ASSEMBLY (Fig. 8-55)

a. Removal

1. Disconnect negative battery cable.
2. Remove 4 screws and shims securing headlamp bezel to housing and remove bezel.
3. Remove 4 screws and shims securing housing to radiator support.
4. Disconnect electrical and lamp monitor connectors and remove housing assembly.

b. Installation

1. Connect electrical and lamp monitor connectors.
2. Position housing assembly to radiator support and secure with 4 screws and shims.
3. Position headlamp bezel to housing and secure with 4 screws.
4. Connect negative battery cable and test operation of headlamps and monitors and aim headlamps.

Parking Lamp Assembly (Fig. 8-56)

a. Removal

1. Disconnect negative battery cable.
2. Reaching behind bumper remove 2 screws which secure parking lamp to bracket.
3. Disconnect electrical and lamp monitor connectors and remove lamp through front of bumper.

SPECIFICATIONS

BULB DATA CHART
(EXCEPT ELDORADO AND SEVILLE)

Function	Bulb Number	Candle-power
Accessory Switch Bulb	1445	.7
Ashtray Illumination Bulb	1445	.7
Backup Lamp Bulb	1156	32
A.T.C. Control Head Bulbs	168	3
Clock Bulb**	194	2
Convenience Compt. Bulb	563	4
Cornering Lamp Bulb	1156	32
Courtesy Lamp Bulb-Instrument Panel	906	6
Courtesy Lamp Bulb-Rr. Compartment	211-2	12
Courtesy Lamp Bulb-Sail Panel	562	6
Cruise Control (Auto-Lock, Driver Control and Turn-On Bulbs)*	161	1
Dome Lamp Bulb	211-2	12
Door Lock Illumination Bulb	558	2.5
Engine Temperature Telltale Bulb	194	2
Fuel Economy Indicator Bulb	74	.75
Fuel Gauge Bulb	194	2
Generator Telltale Bulb	194	2
Headlamp-Inner	4651	50W
Headlamp-Outer	4652	60W 40W
Headlamps Switch Bulb	161	1
High-Beam Indicator Bulb	194	2
Instrument Panel Compartment Bulb	1816	3
Instrument Cluster Bulb	194	2
License Lamp Bulb	194	2
License Lamp Bulb	67	4
Low Brake Telltale Bulb	194	2
Low Oil Pressure Telltale Bulb	194	2
Low Windshield Washer Fluid Level Telltale Bulb	161	1
Map Lamp Bulb	562	6
Map Spot Bulb	1004	15
Opera Lamp Bulb	756	.3
Parking & Signal Lamp Bulb	1157NA	24/2.2
Radio-Band Indicator Bulb*	**	—
Radio-Stereo Indicator Bulb*	**	—
Radio-Stereo w/Integral Tape Player Dial Bulb	1893	2
Radio Dial Bulb	1893	2
Radio-Rear Control Indicator Bulb	250	1
Rear Compartment Bulb	1003	15
Rear Deck Lid Telltale Bulb	161	1
Rear Window Defogger Indicator Bulb	1445	.7
RH Front Door Ashtray Illumination Bulb	1445	.7
Security System Indicator Bulb	194	2
Seat Belt Telltale Bulb	194	2
Side Marker Lamp Bulb-Front	194	2
Reading Lamp Bulb-Doors	562	6
Spot Lamp Bulb-Reading, Sail Panel	912	12
Stop, Tail & Signal Lamp Bulb	1157	32/3
Turn Signal Indicator Bulb	194	2
Vanity Mirror Lamp Bulb	562	6
W rning & Courtesy Lamp Bulb-Front Doors	562	6
Wa ning & Courtesty Lamp Bulb-Rear Doors	562	6
Water Temperature Telltale Bulb	194	2
Windshield Wiper Switch Bulb	161	1
Radio CB Dial Bulb	1893	2

*Servicable by Radio Technician Only.
**Drake Mfg. No. 66 (or Equivalent).

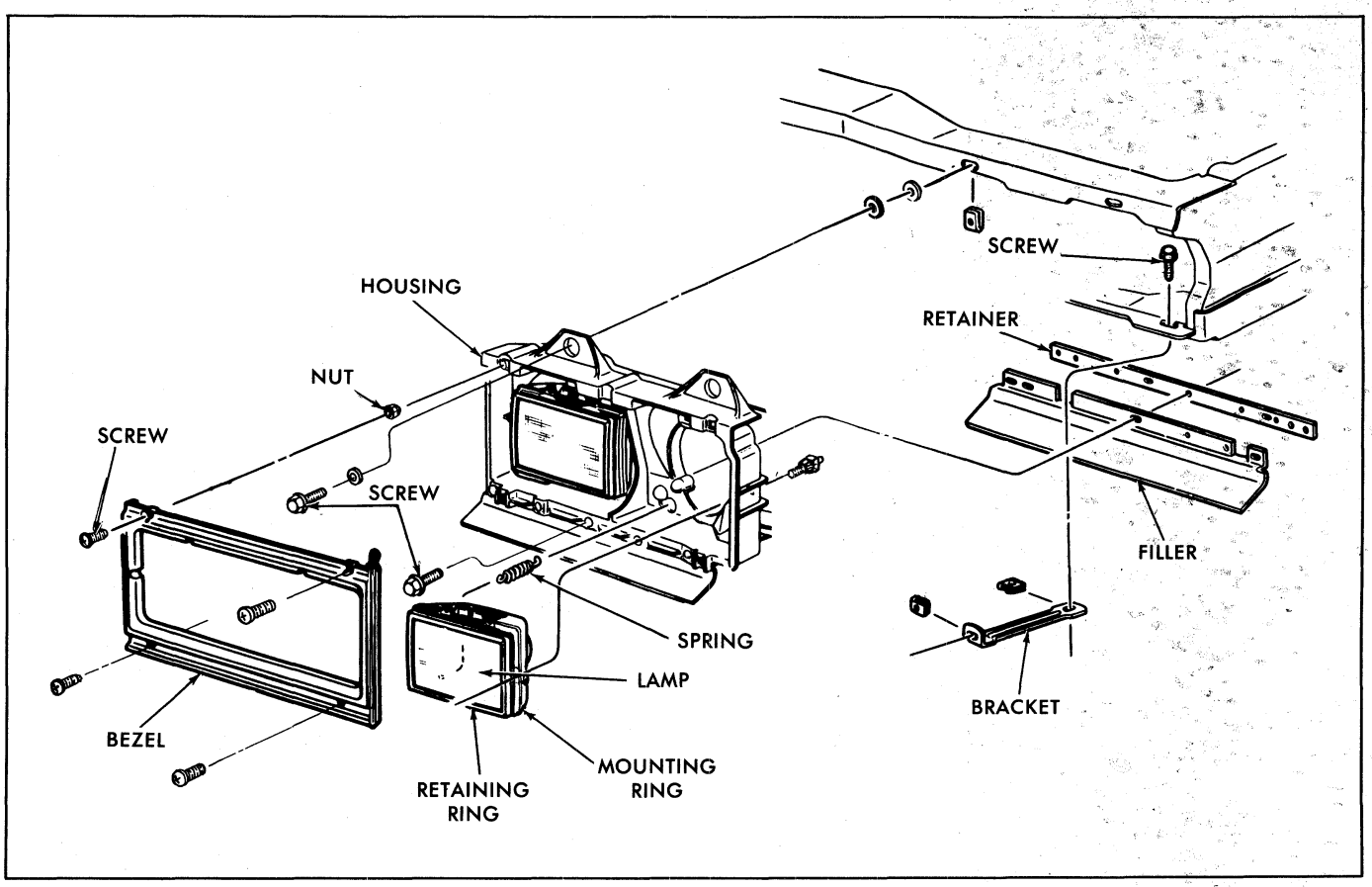


Fig. 8-55 Headlamp and Housing (Eldorado)

b. Installation

1. Install electrical and lamp monitor connectors.
2. Position parking lamp into bumper from front side of bumper. Working from behind bumper secure parking lamp with 2 screws.
3. Connect negative battery cable and tighten to 70 inch-pounds.

FRONT PARKING LAMP BULB LENS, BEZEL AND GASKET REPLACEMENT (Fig. 8-56)

a. Removal

1. Remove 2 screws securing parking lamp bezel to lamp.
2. Remove bezel, lens and gasket from lamp.
3. Remove bulb from socket.

b. Installation

1. Install bulb into socket.
2. Position gasket onto lens and install onto lamp.
3. Install bezel and secure with 2 screws.

Side Marker and Cornering Lamp Assembly and Bezel (Fig. 8-56)

a. Removal

1. Remove 3 screws securing lamp assembly to fender.
2. Remove lamp assembly and disconnect electrical and lamp monitor connectors.
3. Remove 4 screws securing bezel to lamp assembly.

Installation

1. Install bezel to lamp assembly and secure with 4 screws.
2. Connect electrical and lamp monitor connectors.
3. Position lamp assembly into fender and secure with 3 screws.

Front Monitor Harness (Fig. 8-56)

a. Removal

1. Open hood.
2. Disconnect conductor harness from front lamps.
3. Reach under fender and remove two nuts from read-out mounting studs and raise read-out from fender.
4. Detach monitor connector from read-out and remove read-out.
5. Remove read-out connector with conductor harness by pulling out through hole in top of fender.

b. Installation

1. Install lamp end of conductors down through hole in top of fender.
2. Route harness and install conductor ends into respective lamps.
3. Install monitor connector on read-out and position read-out on front fender.
4. Reach under fender and install two nuts on read-out mounting studs to secure read-out to fender.
5. Check operation of read-out. If satisfactory, close hood. If not, check installation and routing.

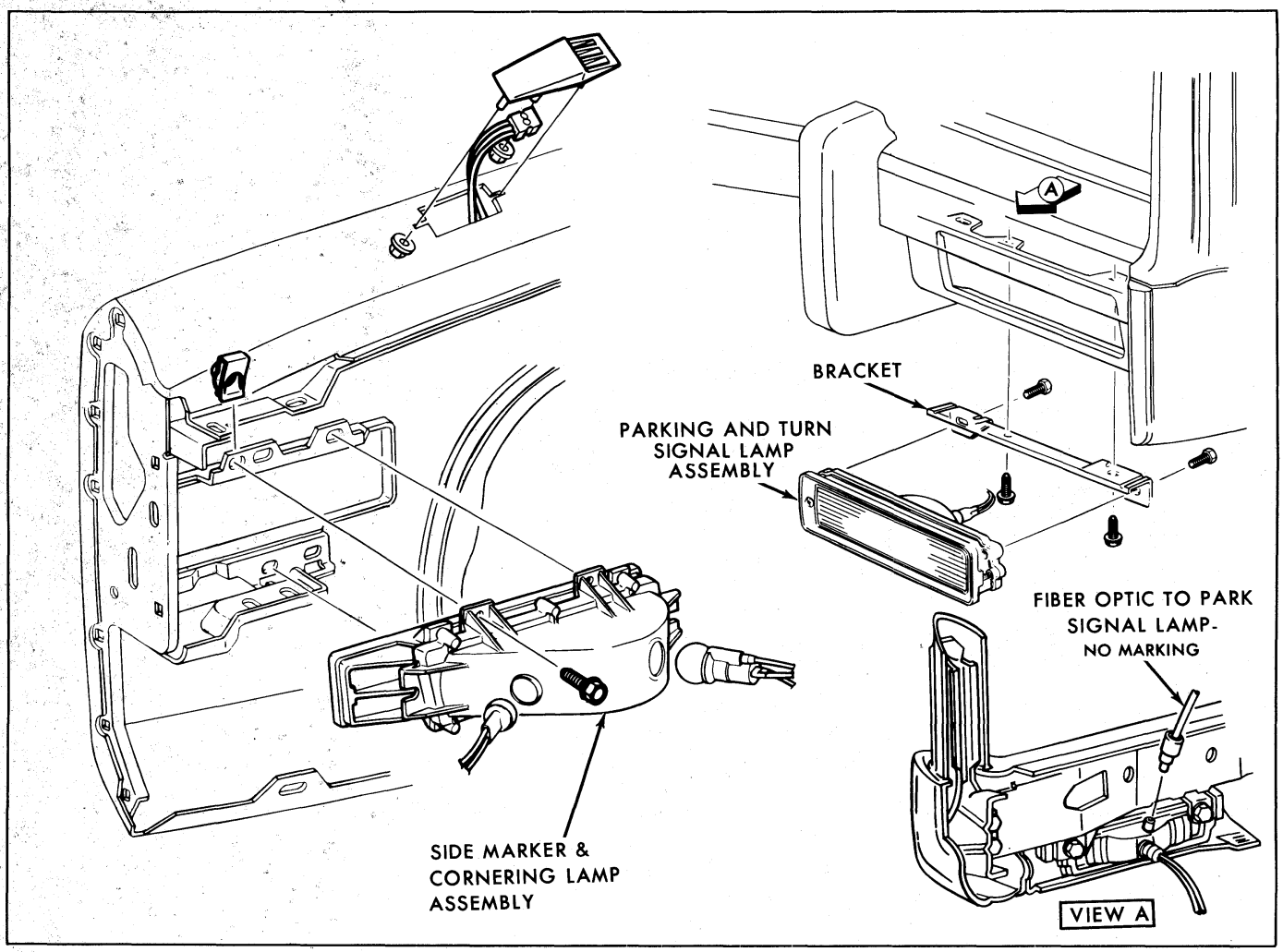


Fig. 8-56 Parking, Cornering, Directional Signal and Side Marker Lamps (Eldorado)

Front Monitor Read-out (Fig. 8-56)

a. Removal

1. Open hood.

2. Reach under fender and remove two nuts from read-out mounting studs and raise read-out from fender.

3. Detach monitor connector from read-out and remove read-out.

Installation

1. Install monitor connector on read-out and position read-out on front fender.

2. Reach under fender and install two nuts on read-out mounting studs to secure read-out to fender.

3. Check operation of read-out. If satisfactory, close hood. If not, recheck installation.

TAIL, STOP AND TURN SIGNAL LAMPS (Fig. 8-57)

a. Removal

1. Remove bumper outer end as described on Page 2B-16.

2. Remove 3 hex nuts securing lamp assembly to bumper outer end and remove.

b. Installation

1. Position lamp assembly to bumper outer end and secure with 3 hex nuts.

2. Install bumper outer end as described on Page 2B-16.

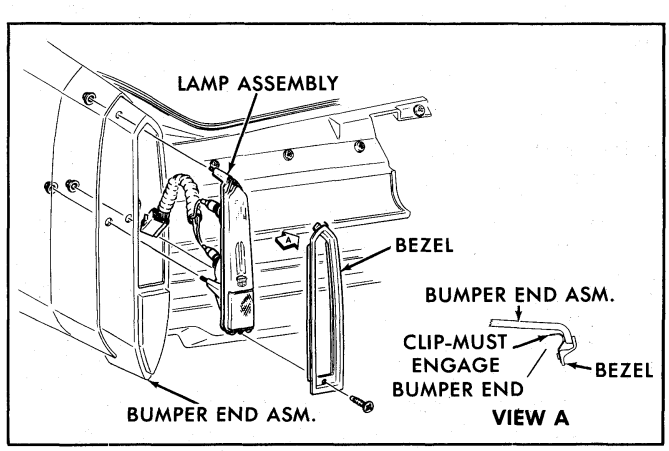


Fig. 8-57 Tail, Stop and Turn Signal Lamps (Eldorado)

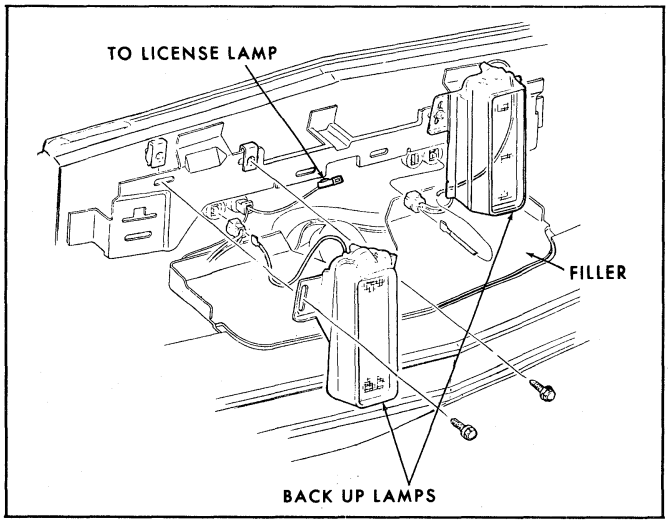


Fig. 8-58 Back-Up Lamps (Eldorado)

REAR SIDE MARKER LAMP ASSEMBLY

a. Removal

1. Disconnect negative battery cable.
2. Open trunk and reposition side liner to gain access to lamp assembly.
3. Remove bulb and socket assembly from lamp.
4. Remove 4 hex nuts securing lamp assembly to quarter panel.
5. Remove lamp assembly by pushing out from inside of trunk.

b. Installation

1. Position lamp assembly to quarter panel and secure with 4 hex nuts.
2. Install bulb and socket assembly.
3. Connect negative battery cable and tighten to 70 inch-pounds.
4. Test operation of lamps.
5. Reposition side liner.

Back-Up Lamp Assembly (Fig. 8-58)

Removal

1. Turn ignition off.
2. Remove four screws securing filler panel to body and remove panel.
3. Remove two screws and star washers securing back-up lamp housing to body bracket and separate housing from bracket. Inboard screw is made accessible by opening fuel filler door.
4. Disconnect wiring harness at connector behind license plate and remove back-up lamp assembly.

b. Installation

1. Open fuel filler door, make sure U-nuts are in place, position lamp assembly on bracket, and secure with two screws and washers, tightening to 60 inch-pounds.

NOTE: Make sure proper alignment is obtained. Vertical adjustment is achieved through slotted holes in housing, horizontal adjustment by slotted holes in body bracket.

2. Connect wiring behind license plate.
3. Secure trim panel with four screws.

Rear License Plate Lamp

a. Removal

1. Remove two screws and star washers securing lamp housing to fuel filler door bracket.
2. Pull lamp housing down to gain access to connector.
3. Remove bulb socket from housing by turning counterclockwise.
4. Remove bulb from socket.

b. Installation

1. Install bulb in socket.
2. Install socket in housing by inserting and turning clockwise.
3. Position housing on fuel filler door bracket and secure with two screws and star washers. Secure ground strap under left U-nut.

BULB REPLACEMENT

It is necessary to carefully check the parts catalog for correct model application when replacing lamp socket assemblies. If incorrect sockets are used for replacement, the bulb filament will be in the wrong location with respect to the lens and/or reflector. As a result, the lamp may fail to meet the required lighting standards.

CAUTION: *Make certain ignition switch and headlight switch are off when replacing bulbs.*

a. Side Marker (Front)

Access to the side marker bulb is gained by opening the hood and removing the front bulb and socket by turning it counterclockwise.

b. Side Marker (Rear)

Open trunk and remove side liner panel to gain access to these lamps.

c. Cornering Lamps

Access to the cornering lamp bulb is gained by opening the hood and removing the rear bulb and socket by turning it counterclockwise.

d. Parking and Directional Signal

Remove lens and bezel as described on Page 8-71 for access to bulb.

e. Back-Up Lamp

Remove lens (2 screws) for access to bulb.

LAMPS (Seville)

Headlamp Housing Assembly (Fig. 8-59)

a. Removal

1. Remove 2 screws securing cornering lamp bezel to headlamp housing, Fig. 8-61.
2. Unsnap 2 fasteners which secure air deflector to rear of bumper to gain access to lower outer headlamp housing attaching screw.
3. Remove lower outer headlamp housing attaching screw from behind bumper.
4. Remove 2 screws which secure the headlamp housing to the radiator grille support bracket.
5. Remove fender to headlamp housing screw and shim(s).
6. Pivot top of headlamp housing forward disconnect electrical and lamp monitor connectors, and remove housing assembly.

NOTE: Be certain headlamp housing filler is clear from behind bumper.

SPECIFICATIONS

BULB DATA CHART (ELDORADO)

Function	Bulb Number	Candle-power
Accessory Switch Bulb	1445	.7
Ashtray Illumination Bulb	1445	.7
Backup Lamp Bulb	1156	32
Clock Bulb	1895	2
Cornering Lamp Bulb	1295	50
Courtesy Lamp Bulb-Instrument Panel	906	6
Courtesy Lamp Bulb-Sail Panel	90	6
A.T.C. Control Head Bulb	1816	3
Cruise Control Driver Control Illumination*	161	1
Cruise Control (Auto Lock and Turn-On Bulbs)*	161	1
Door Lock Illumination Bulb	558	2.5
Engine Temperature Telltale Bulb	194	2
Fuel Economy Indicator Bulb	161	1
Fuel Gauge Bulb	194	2
Generator Telltale Bulb	194	2
Headlamp-Inner	4651	50W
Headlamp-Outer	4652	60W 40W
Headlamps Switch Bulb	1816	3
Windshield Wiper Switch Bulb	194	2
High-Beam Indicator Bulb	194	2
Instrument Panel Compartment Bulb	1816	3
License Lamp Bulb	194	2
Water Temperature Telltale Bulb	194	2
Low Brake Telltale Bulb	194	2
Low Oil Pressure Telltale Bulb	194	2
Low Windshield Washer Fluid Level Telltale Bulb	161	1
Map Lamp Bulb	562	6
Warning & Courtesy Lamp Bulb-Front Doors	562	6
Instrument Cluster Bulb	194	2
Parking & Signal Lamp Bulb	1157NA	24-2.2
Radio-Band Indicator Bulb*	**	—
Radio-Stereo Indicator Bulb*	**	—
Radio-Stereo w/Integral Tape Player Dial Bulb	1893	2
Radio-Dial Bulb	1893	2
Vanity Mirror Lamp Bulb	562	6
Rear Compartment Bulb	1003	15
RH Front Door Ashtray Illumination Bulb	1445	.7
Security System Indicator Bulb	194	2
Seat Belt Telltale Bulb	194	2
Shift Indicator Bulb	161	1
Sidemarker Lamp Bulb-Front	194A	2
Sidemarker Lamp Bulb-Rear	194	2
Stop, Tail & Signal Lamp Bulb	1157	32/3
Rear Deck Lid Telltale Bulb	161	1
Thermometer Illumination Bulb	194	2
Turn Signal Indicator Bulb	194	2
Rear Window Defogger Indicator Defogger	1445	.7
Radio CB Dial Bulb	1893	2

*Servicable by Radio Technician Only.
**Drake Manufacturing No. 66 (or Equivalent)

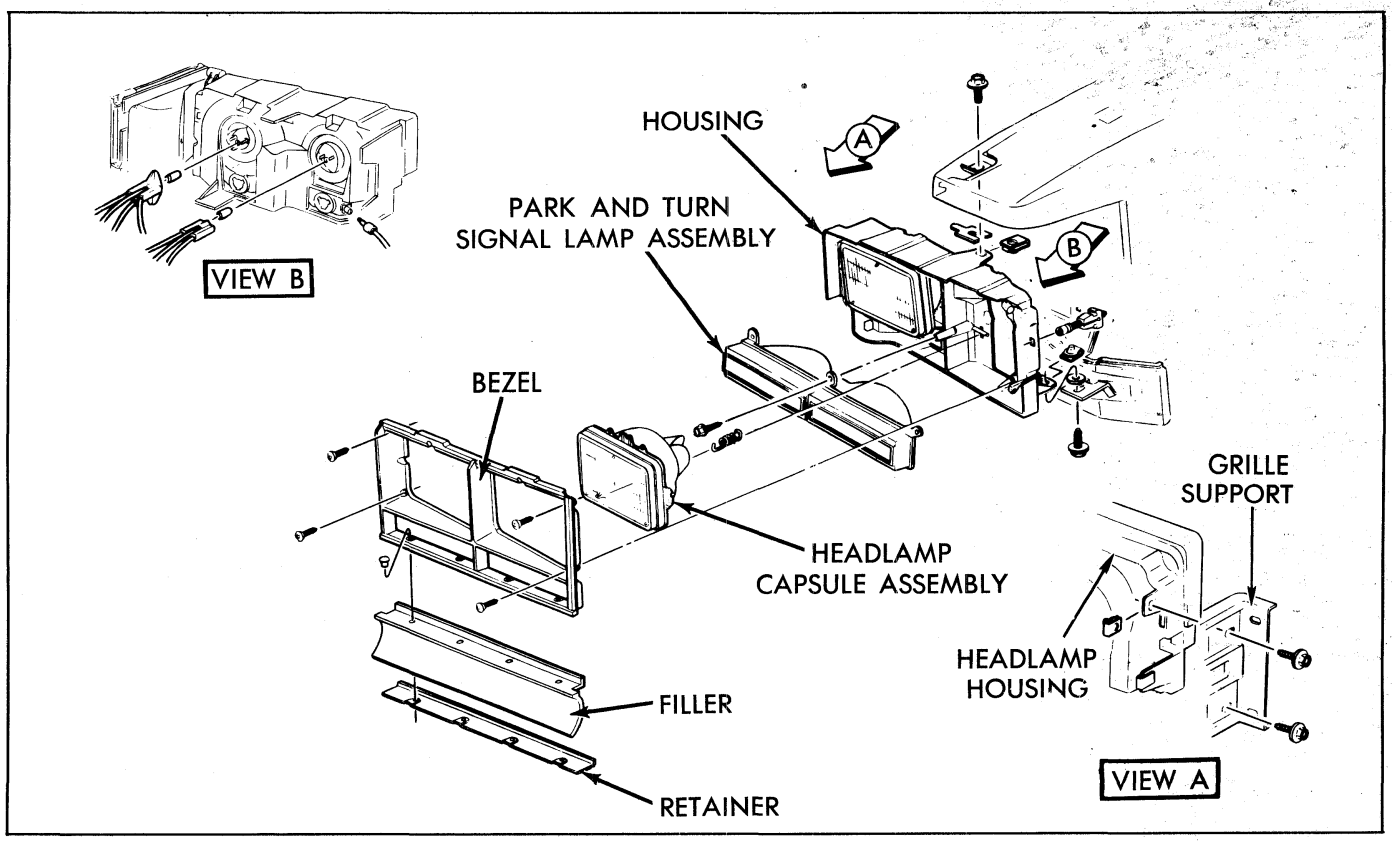


Fig. 8-59 Headlamp, Parking Lamp and Directional Signal (Seville)

b. Installation

1. Position headlamp housing with filler under bumper and attach electrical and lamp monitor connectors.

2. Pivot headlamp housing into installed position and attach fender to headlamp housing screw and shim(s). Tighten to 30-50 inch-pounds.

3. Install 2 screws which secure headlamp housing to radiator grille support bracket. Tighten to 30-50 inch-pounds.

4. Install screw which secures headlamp housing to radiator support (lower) and tighten to 30-50 inch-pounds.

5. Install 2 fasteners securing air deflector to rear of bumper.

6. Install 2 screws which secure cornering lamp bezel to headlamp housing.

7. Check operation of headlamps, parking lamps, directional signals and lamp monitors.

Headlamp Bezel (Fig. 8-59)

a. Removal

1. Remove 4 screws which secure bezel to headlamp housing.

2. Remove bezel by pivoting downward to clear filler from behind bumper.

NOTE: Headlamp housing-to-bumper filler is riveted to the headlamp bezel.

b. Installation

1. Position headlamp housing-to-bumper filler under top edge of bumper and pivot bezel into installed position.

2. Install 4 screws which secure bezel to headlamp housing.

Headlamp Replacement (Fig. 8-59)

1. Remove 4 screws securing headlamp bezel to headlamp housing. Remove bezel by pivoting downward to remove filler from under bumper.

2. Remove 4 screws securing headlamp retaining ring to mounting ring.

3. Disconnect electrical and lamp monitor connectors and seal and remove lamp.

4. Connect electrical and lamp monitor connectors and seal to new headlamp unit and position headlamp onto mounting pads.

5. Install headlamp retaining ring and secure with 4 attaching screws.

6. Install headlamp bezel to headlamp housing (with filler under bumper) and secure with 4 attaching screws.

7. Check operation of headlamps and lamp monitors and aim headlamps.

Front Parking and Turn Signal Lamp (Fig. 8-59)

a. Removal

1. Remove headlamp bezel as described above.

2. Remove top center screw which secures parking and turn signal lamp to headlamp housing.

3. Disconnect bulb and socket assemblies by turning counter-clockwise.

4. Disconnect lamp monitor fiber optic and remove lamp assembly.

b. Installation

1. Connect lamp monitor fiber optic.

2. Install bulb and socket assemblies by turning clockwise.

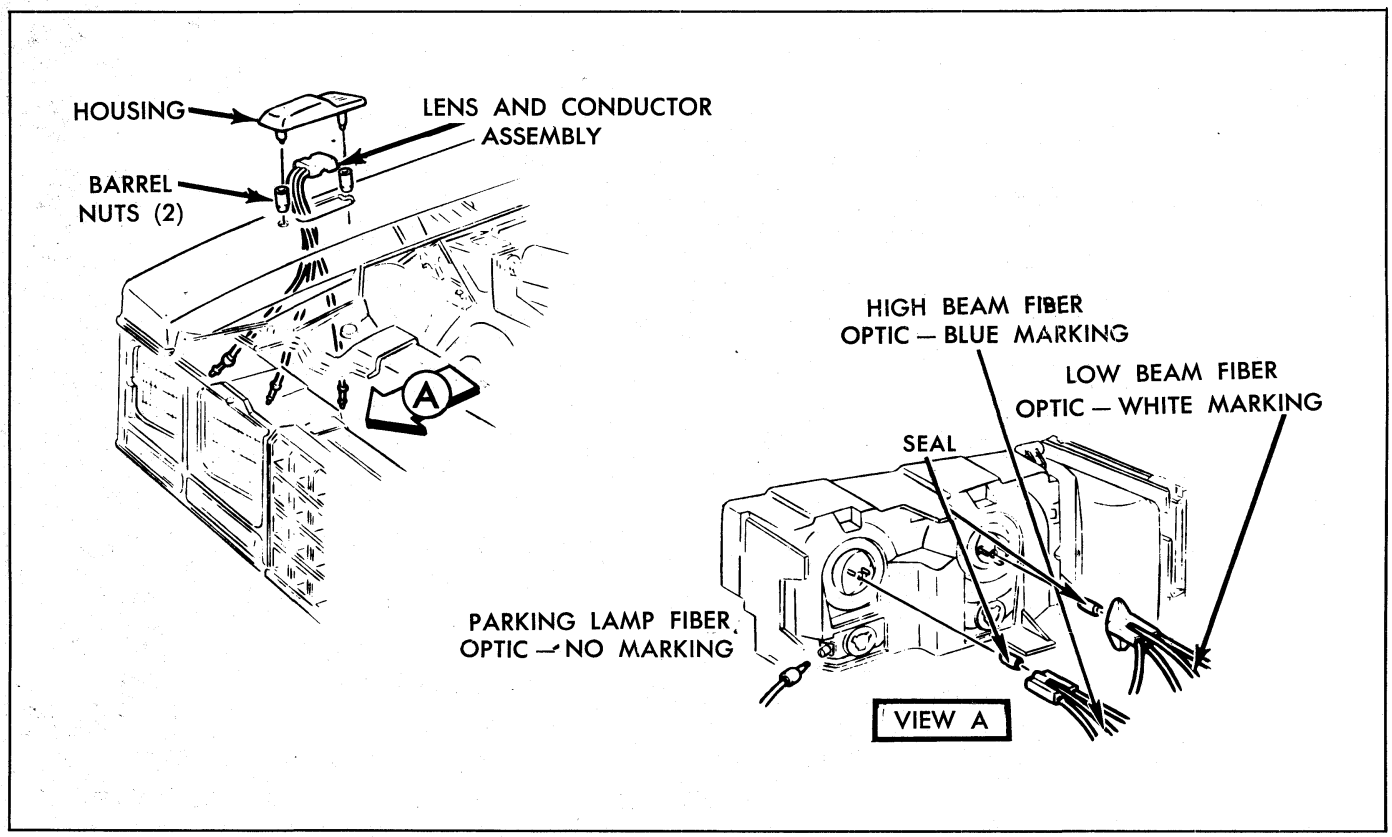


Fig. 8-60 Lamp Monitor Installation (Seville)

3. Position lamp assembly into headlamp housing and secure with screw. Tighten to 20 inch-pounds.

4. Position headlamp bezel and secure with 4 screws.

Front Monitor Harness and Read-Out (Fig. 8-60)

a. Removal

1. Open Hood.

2. Disconnect conductor harness from front lamps.

3. Reach under fender and gently tap read-out mounting studs from barrel nuts and raise read-out from fender.

4. Detach monitor connector from read-out and remove read-out.

5. Remove read-out connector with conductor harness by pulling out through hole in top of fender.

b. Installation

1. Install lamp end of conductors down through hole in top of fender.

2. Route harness and install conductor ends into respective lamps.

3. Install monitor connector on read-out and position read-out on front fender.

4. Push read-out mounting studs into barrel nuts to secure read-out to fender.

5. Check operation of read-out. If satisfactory, close hood. If not, check installation and routing.

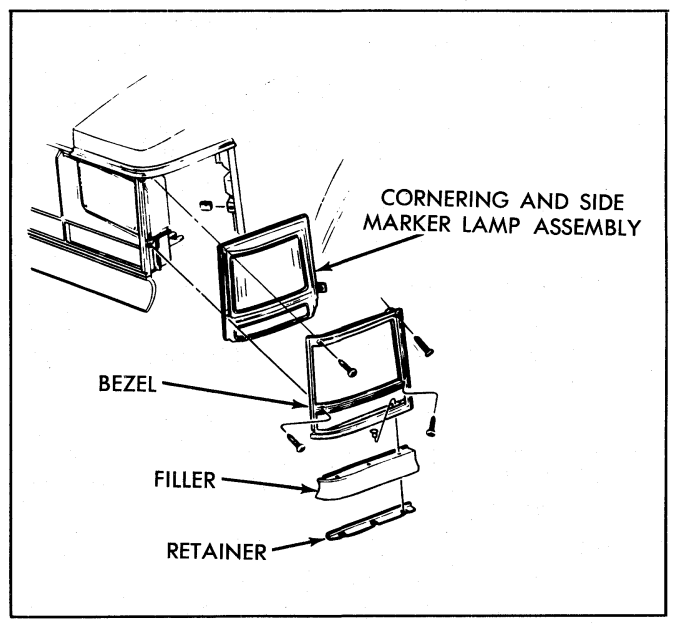


Fig. 8-61 Cornering and Front Side Marker Lamp (Seville)

Cornering and Front Side Marker Lamp (Fig. 8-61)

a. Removal

1. Remove 4 screws which secure cornering lamp bezel to fender and headlamp housing.
2. Pivot bezel downward to clear filler from bumper.
3. Remove cornering lamp assembly and twist bulb and socket assemblies counter-clockwise to remove.

b. Installation

1. Install bulb and socket assemblies into cornering lamp assembly and twist clockwise to secure.
2. Position cornering lamp assembly onto fender.
3. Install cornering lamp bezel by first inserting filler behind bumper and then pivoting bezel upward and securing to headlamp housing and fender with 4 screws.

Tail, Stop and Rear Side Marker Lamp

a. Removal

1. Position trunk interior trim panel out of way.
2. Remove bulb and socket assemblies by turning counter-clockwise.
3. Remove 4 nuts securing lamp assembly to rear quarter panel.

b. Installation

1. Position lamp to rear quarter panel and secure with 4 nuts.
2. Install bulb and socket assemblies by turning clockwise.
3. Reposition trunk interior trim.

Backup Lamp(s)

a. Removal

1. Position trunk interior trim panel out of way.
2. Working behind panel, remove 2 nuts securing backup lamp to body.
3. Disconnect electrical connector located inside trunk.
4. Remove lamp, wire and grommet assembly.

b. Installation

1. Position wire through body and insert grommet into hole.
2. Install backup lamp assembly to body with 2 nuts.

CAUTION: *Be certain backup lamp wire does not become pinched between body and bracket.*

3. Connect electrical connector located inside trunk.
4. Reposition trunk interior trim.

License Lamp(s)

a. Removal

1. Open trunk
2. Remove 2 screws securing lamp to trunk lid.
3. Unplug bulb and socket from lamp housing and remove housing and lens assembly.

b. Installation

1. Plug bulb and socket into license lamp housing assembly.
2. Position into trunk lid and secure with 2 screws.

Exterior Lamp Bulb Replacement

a. Tail-Stoplight and Rear Side Marker Bulbs

Position trunk interior trim panel out of way. Twist socket counter-clockwise and remove bulb.

b. Backup Lamp Bulb

Remove backup lamp lens by flexing filler to gain access to lower lens attaching screw. Remove 2 screws and lens. Replace bulb.

c. License Lamp Bulb

Remove 2 screws securing lamp assembly to trunk lid. Unplug socket and bulb from lamp.

d. Front Side Marker Lamp Bulb (Fig. 8-61)

Remove side marker and cornering lamp assembly as described above. Twist socket counter-clockwise to remove from housing.

e. Cornering Lamp Bulb

Right side - reach over battery and turn socket counter-clockwise to remove from housing.

Left side remove side marker and cornering lamp assembly as described above. Twist socket counter-clockwise to remove from housing.

f. Front Parking and Turn Signal Lamp Bulb

Open hood. Reach between headlamp housing and radiator cradle to gain access to parking and turn signal lamp sockets. Twist socket counter-clockwise and remove.

Interior Bulb Replacement

a. Telltale Bulb Replacement

Access to the following telltale bulbs may be gained by removing the lower steering column cover and speedometer cluster bezel as described on Pages 8-41 and 8-42 respectively.

1. Washer Fluid
2. Trunk Open
3. Fuel Economy Indicator - Green
4. Generator

Access to the amber fuel economy indicator bulb may be gained by removing the above plus the left 3 lower top cover screws. The top cover may then be flexed slightly and the bulb removed.

Replacement of the remaining telltale bulbs requires removal of the instrument panel top cover screws and lifting of top cover. Connectors need not be disconnected.

b. Fuel Gage Bulb

Loosen instrument panel top cover.

c. Clock Illumination Bulb

Loosen instrument panel top cover.

d. Ash Tray Bulb (Instrument Panel)

Remove ash tray receptacle. Reach through opening and squeeze shield to remove from lighter clamp.

e. Accessory Switch Illumination Bulb

Remove right hand insert and applique as described on Page 8-47.

Connectors need not be disconnected to gain access to bulb.

f. Windshield Wiper Switch Bulb

Remove windshield wiper switch as described on Page 8-42. Connector need not be disconnected to gain access to bulb.

g. Headlamp Switch Illumination Bulb

Remove left hand lower instrument panel as described on Page 8-50. Connectors need not be disconnected to gain access to bulb.

h. Cruise Control Switch Illumination and Indicator Bulbs.

Reach under lower edge of instrument panel to snap bulb and socket assemblies from switch. The upper bulb is for switch illumination.

i. Climate Control Illumination Bulb

Reach under lower edge of instrument panel to disconnect bulb and socket from right hand side of climate control housing.

j. Illuminated Entry System Bulbs

Right Hand

a. Removal

1. Remove glove box liner as described on Page 8-49.
2. Disconnect fiber optic-to-lamp socket connector by pressing slightly and rotating counter-clockwise.

NOTE: Connector is located on right hand body bracket near hinge pillar.

3. Remove bulb.

b. Installation

1. Install bulb into socket.
2. Connect fiber optic-to-lamp socket connector by pressing connectors together and turning clockwise.
3. Install glove box liner as described on Page 8-49.

Left Hand

c. Removal

1. Remove left hand lower instrument panel as described on Page 8-50.
2. Disconnect fiber optic-to-lamp socket connector by pressing slightly and rotating counter-clockwise.

NOTE: Connector is above and outboard of the park brake pedal mechanism near the hinge pillar.

d. Installation

1. Install bulb into socket.
2. Connect fiber optic-to-lamp socket connector by pressing connectors together and turning clockwise.
3. Install left hand lower instrument panel as described on Page 8-50.

SPECIFICATIONS

BULB DATA CHART (SEVILLE)

Function	Bulb Number	Candle-power
Accessory Switch Bulb	1445	.7
Ashtray Illumination Bulb	1445	.7
Backup Lamp Bulb	1156	32
A.T.C. Control Bulb	168	3
Clock Bulb	1895	2
Cornering Lamp Bulb	1156	32
Courtesy Lamp Bulb-Instrument Panel	906	6
Courtesy Lamp Bulb-Front Doors	562	6
Courtesy Lamp Bulb-Rear Doors	562	6
Cruise Control (Auto Lock & Turn-On Bulbs)	161	1
Cruise Control Driver Control Bulb	161	1
Door Lock Illumination Bulb	558	2.5
Engine Temperature Telltale Bulb	194	2
Fuel Economy Indicator Bulb	161	1
Fuel Gauge Bulb	194	2
Generator Telltale Bulb	194	2
Headlamp-Inner	4651	50W
Headlamp-Outer	4652	60W 40W
Headlamp Switch Bulb	1816	3
High-Beam Indicator Bulb	194	2
Instrument Cluster Bulb	194	2
Instrument Panel Compartment Bulb	1816	3
License Lamp Bulb	194	2
Low Brake Telltale Bulb	194	2
Low Oil Pressure Telltale Bulb	194	2
Low Windshield Washer Fluid Level Telltale Bulb	161	1
Sail Panel Reading Lamp Bulb	912	12
Parking & Signal Lamp Bulb	1157	32/3
Radio-Band Indicator Bulb*	**	—
Radio-Dial Bulb	1893	2
Radio-Stereo Indicator Bulb*	**	—
Radio-Stereo w/Integral Tape Player Dial Bulb	1893	2
Rear Compartment Bulb	1003	15
Rear Deck Lid Teltale Bulb	161	1
Rear Window Defogger Indicator Bulb	1445	.7
Seat Belt Telltale Bulb	194	2
Security System Indicator Bulb	194	2
Shift Indicator Bulb	161	1
Sidemarker Lamp Bulb-Front	194A	2
Sidemarker Lamp Bulb-Rear	194	2
Spot Lamp Bulb-Front Compartment	1004	15
Stop, Tail & Signal Lamp Bulb	1157	32/3
Turn Signal Indicator Bulb	194	2
Vanity Mirror Lamp Bulb	562	6
Windshield Wiper Switch Bulb	194	2
Water Temperature Telltale Bulb	194	2
Thermometer Illumination Bulb	194	2
Dome Lamp Bulb	562	6
Radio-Citizens Band Dial Bulb	1893	2

*Servicable by Radio Technician Only
**Drake Manufacturing No. 66 (or Equivalent)

SPECIAL TOOLS



Special Tools (Lighting Systems)

WIRING AND CIRCUIT PROTECTION GENERAL DESCRIPTION

Wiring

Solid core aluminum wire is used in the forward body harness. The aluminum wiring is encased in brown conduit (copper is in black conduit). A special service procedure and repair kit is required for aluminum wire splices. The repair procedure is described under "On-Car Service" in this section.

In place of some pack-con positive retention type wiring connectors, inertia type wiring connectors are used. This type of connector, like the pack-con type, require that the connector retaining lock be released before the two halves of the connector can be separated.

Optional equipment wiring circuit diagrams are located in Section 9. Complete chassis circuit wiring diagrams can be found on the rear gatefold.

Circuit Protection

All electrical circuits are protected against excessive loads which might occur due to shorts or overloads in the wiring system. Such protection is provided by either a fuse, circuit breaker, or fusible link.

Fuses

The most common method of automotive wiring circuit protection is the fuse. Whenever there is an excessive amount of current flowing through a circuit the fusible element will melt and create an open or incomplete circuit. Fuses are a one time protection device and must be replaced each time the circuit is overloaded.

The fuseblock used on all models except Eldorado and Seville is shown in Fig. 8-62 and incorporates auto-fuses.

Auto-fuses are color coded with the same color identification as standard fuses. The following table illustrates these color codes.

Fuse	Color Stripe/Body
3	Violet
5	Tan
7.5	Brown
10	Red
20	Yellow
25	White

For service replacement, non-color coded fuses of the same respective amperage can be used. The amperage value of each fuse is molded into its head, Fig. 8-62.

To determine whether or not a auto-fuse is blown, it is necessary to remove the suspect fuse and examine the element in the fuse for a break. If the element is broken replace the fuse with one of equal amperage rating.

The fuseblock used on Eldorado and Seville is shown in Fig. 8-63 and contains most fuses which protect the various circuits.

There are, however, additional specific circuits. In-line fuses are located on a wire within an individual wiring harness. They are usually housed in spring loaded, twist type receptacles.

Factory installed unstriped fuses are 20 amp. For service replacement common unstriped fuses of the same respective amperage may be used. The amperage rating on an unstriped replacement fuse is listed on the metal end cap. Fuses should be replaced with one of **exactly** the same amperage as listed in Figs. 8-62 and 8-63.

RELAY CENTER

An added convenience on all cars except Eldorado and Seville is the relay panel shown in Fig. 8-64 and located to the left of the fuseblock. Each relay is marked as shown and can be removed by unplugging it from the panel.

Circuit Breakers

A circuit breaker is a protective device designed to open the circuit when a current load is in excess of rated breaker capacity. If there is a short or other type of overload condition in the circuit, the excess current will open the circuit breaker terminals, thus, indicating there is something wrong in the system. The circuit breaker will remain open until the trouble is found and corrected. Circuit breaker locations, circuit protection and capacity are listed in the charts on Pages 8-87 thru 8-89 and in the fuse panel illustrations, Fig. 8-62 and 8-63.

Fusible Links

In addition to circuit breakers and fuses, some circuits incorporate fusible links to protect the wiring. Links are used rather than a fuse in wiring circuits that are not normally fused, such as the ignition circuit. Each fusible link is four gauge sizes smaller than the cable it is designed to protect. Links are marked on the insulation with wire gauge size because the heavy insulation makes the link appear to be a heavier gauge than it actually is. The same size wire with special hypalon insulation must be used when replacing a fusible link. Fusible link location is listed in the charts on Pages 8-87 thru 8-89.

The appearance of a fusible link before and after a short circuit is shown in Fig. 8-65.

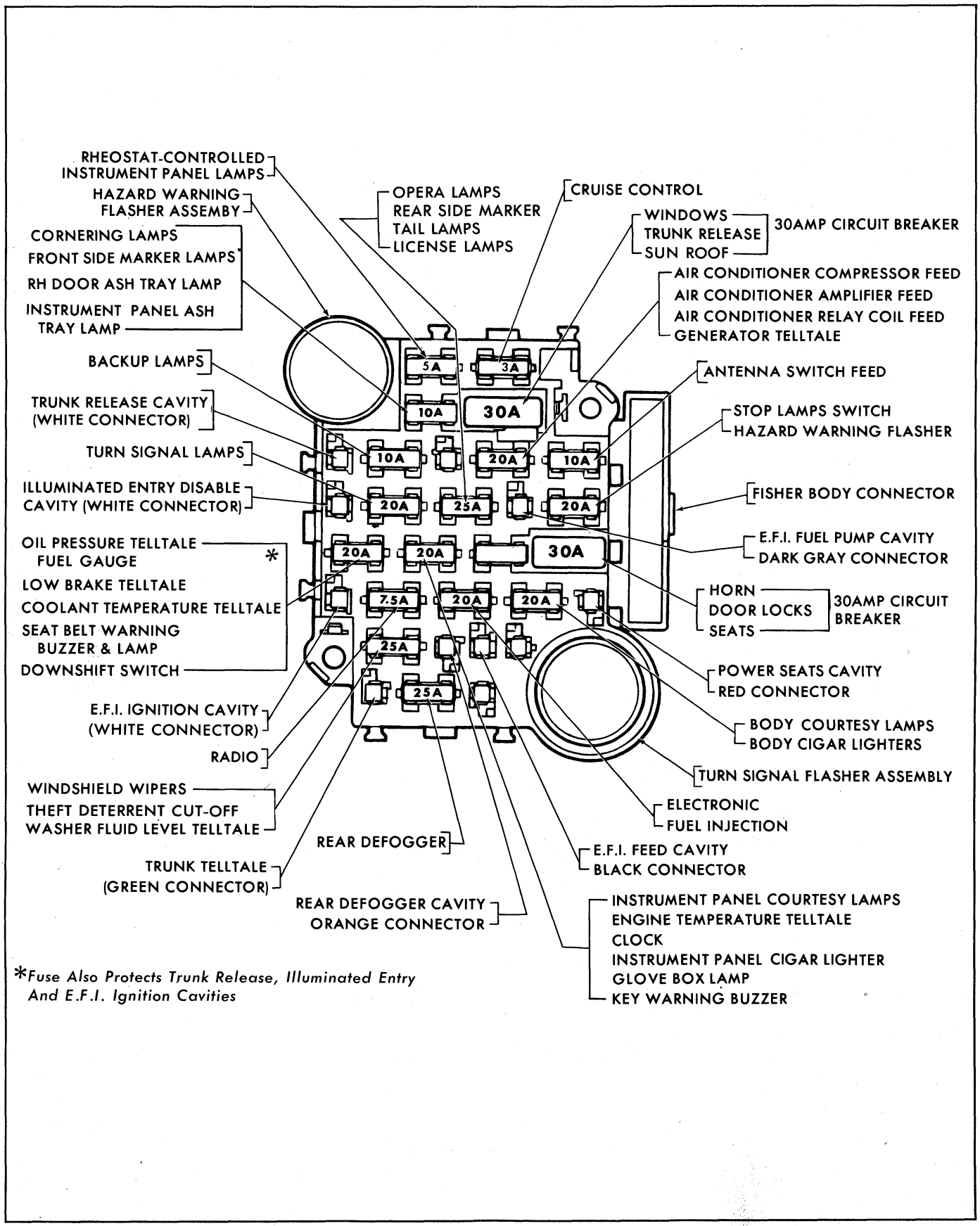


Fig. 8-62 Fuses and Fuseblock (Except Eldorado and Seville)

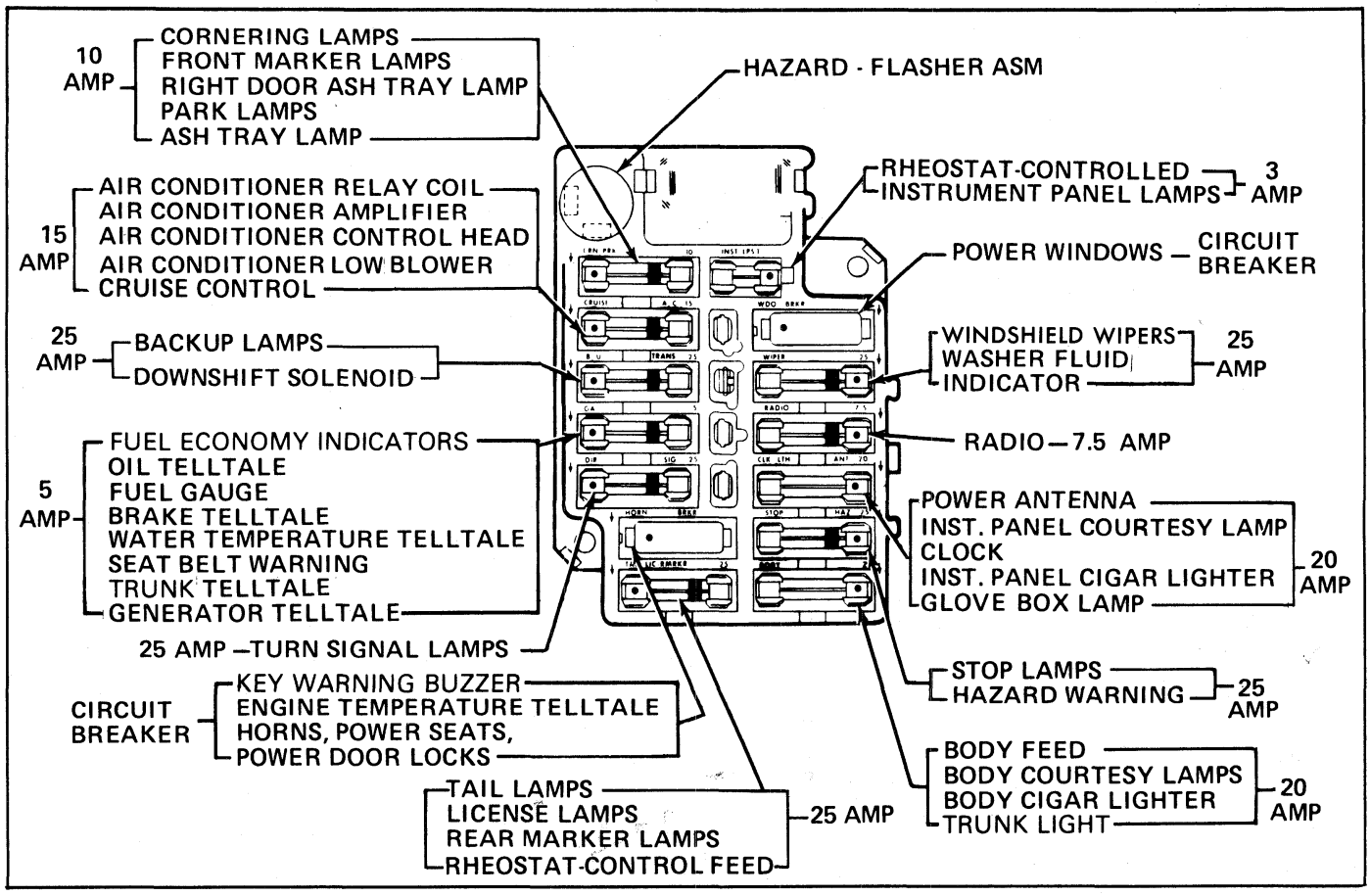


Fig. 8-63 Fuses and Fuseblock (Eldorado and Seville)

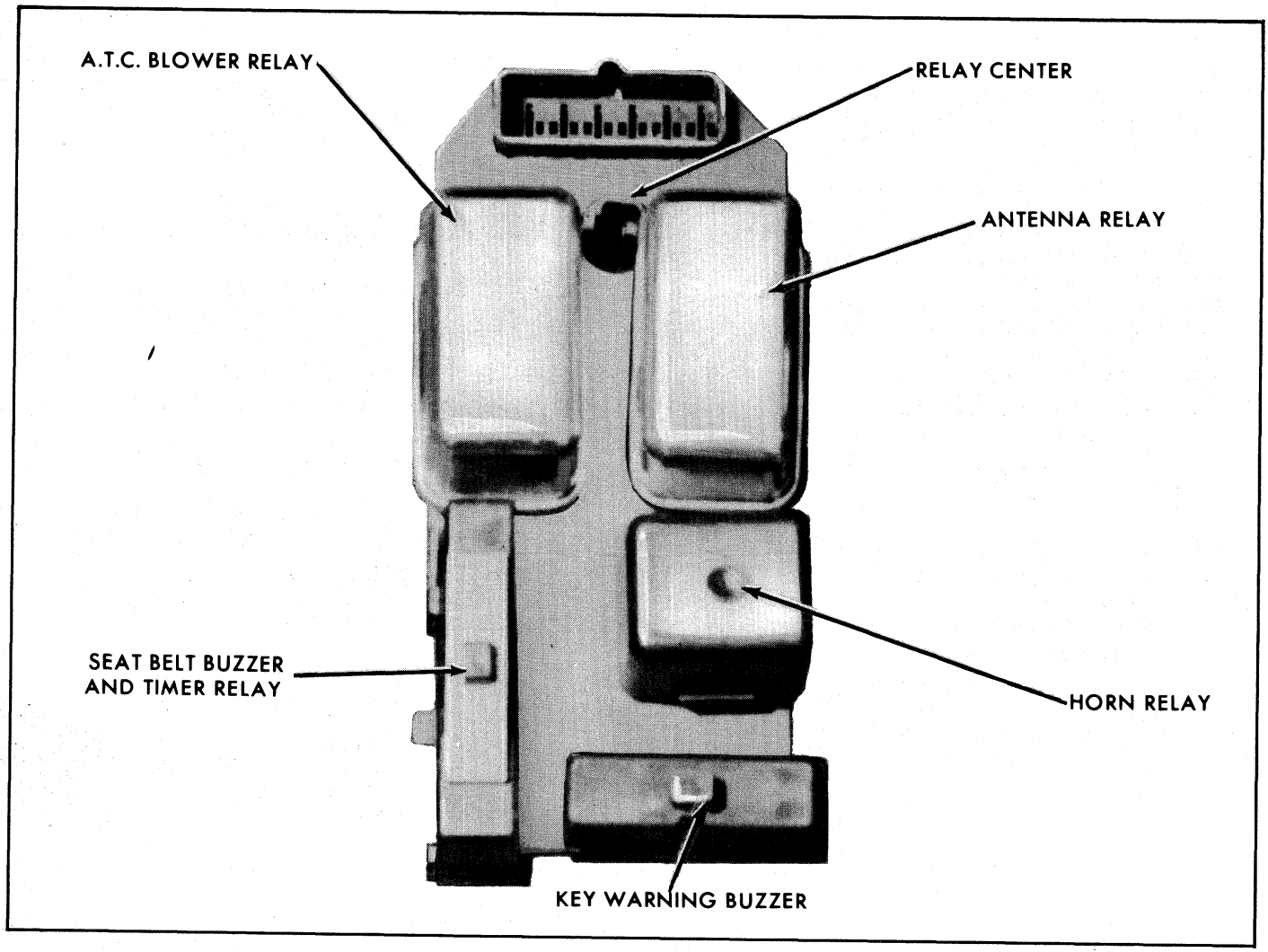


Fig. 8-64 Relay Panel (Except Eldorado and Seville)

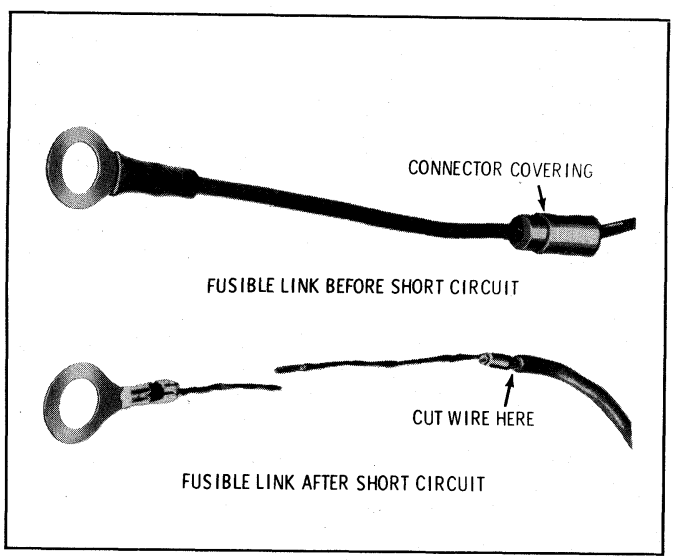


Fig. 8-65 Fusible Link Identification

DIAGNOSIS

Malfunctions in a circuit are usually caused by shorted or open circuits. Open circuits are usually caused by breaks in the wiring, improper connections or a mechanical problem in a component such as a switch or circuit breaker. Short circuits are usually caused by wires from different components of the circuit contacting one another or by a wire or component grounding to the metal of the body due to a screw driven through the wires, insulation cut through by a sharp metal edge, etc.

The following information may aid in locating and correcting a malfunction in the body wiring electrical system.

1. If a major portion of the electrical circuit becomes inoperative simultaneously, the problem may be due to improper connections between the front and rear harness or between a forward harness and the bulkhead connector on the back of the fuse block.

2. If only one of the circuits is inoperative, the problem is due to an open circuit or short in the affected circuit. Short circuits usually result in blown fuses or in the case of power equipment circuits, in the circuit breaker opening the circuit. If the fuse is not blown and the circuit affected is a lamp circuit, check the bulb before proceeding with any checking procedures.

3. The dome lamp, courtesy lamp and park brake warning lamp circuits are designed so that the switches are in the "ground" side of the circuit. If a condition is encountered where the lamps remain "on" even though the jamb or courtesy lamp switches are not actuated, the problem is probably due to malfunctioning switches, or to the wire leading to the switches being grounded to the metal body.

ON-CAR SERVICE

Splicing Procedure for Aluminum Solid Core Wires

1. Using proper gage wire stripper tool, strip a quarter inch of insulation from the ends of the wires to be spliced. Use caution to avoid damaging the core to prevent weakening the completed assembly.

2. Place one wire into special splice clip. Using ten-inch locking-type pliers or equivalent tool, Fig. 8-66, clip firmly to the wire. *Do not solder.*

3. Repeat Step 2 for Second wire.

4. After completing splice, apply a generous coating of petrolatum (petroleum jelly) over the clip and over approximately the first quarter inch of insulation on each side of clip.

NOTE: Petrolatum is helpful in reducing wire oxidation.

5. Wrap splice and area covered with petrolatum with electrical tape, Fig. 8-67.

Fusible Link Replacement (Fig. 8-68)

A new fusible link can be installed, after the short circuit is located and repaired, as follows:

1. Disconnect battery ground cable.

2. Disconnect fusible link from starter or terminal.

3. Cut harness directly behind connector to remove damaged fusible link, Fig. 8-65.

4. Strip harness wire approximately 1/2".

5. Position clip around new fusible link and harness wire. Crimp so that all wires are securely fastened, Fig. 8-66.

6. Solder connection using rosin core solder. Use sufficient heat to obtain a good solder joint.

7. Tape all exposed wires with plastic electrical tape to prevent corrosion and shorting, Fig. 8-68.

8. Connect fusible link to starter or terminal.

9. Connect negative battery cable and tighten to 90 inch pounds torque.

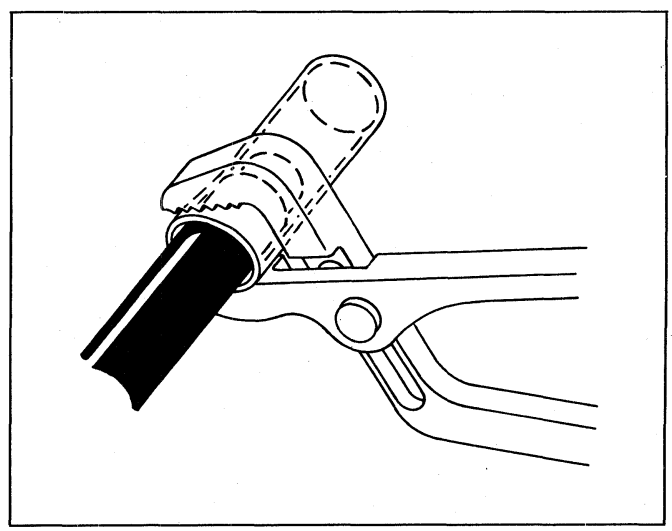


Fig. 8-66 Crimping Aluminum Wire Splice Clip

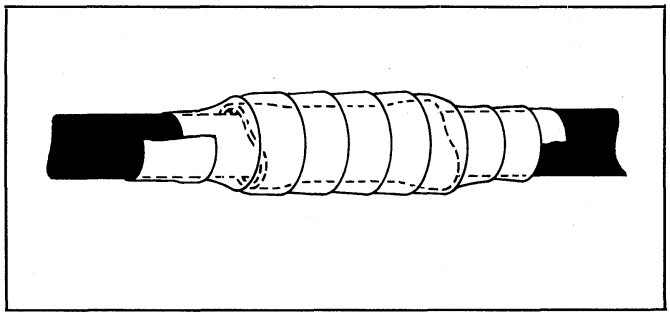


Fig. 8-67 Completed Aluminum Wire Splice

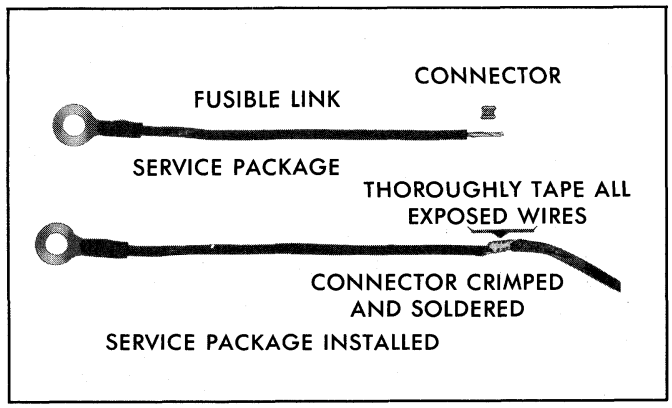


Fig. 8-68 Replacing Fusible Link

SPECIFICATIONS

FUSES, RELAYS, CIRCUIT BREAKERS, FLASHERS AND FUSIBLE LINKS (EXCEPT SEVILLE)

Circuit	Location	Device
Rear Window Defogger (Except Eldorado)	On top of fuse panel	Relay
Rear Window Defogger (Eldorado)	On left side of lower steering cover reinforcement	Relay
Sunroof (Eldorado)	L.H. Body Bracket at left end of lower steering column cover reinforcement	25 amp Circuit Breaker
Sunroof (Except Eldorado)	Upper left corner fuse block	30 amp Circuit Breaker
Twilight Sentinel - (Eldorado)	On lower steering column cover reinforcement	Circuit Breaker in headlamp switch amplifier
Twilight Sentinel - (Except Eldorado)	Behind instrument panel below Cruise Control switch	Circuit breaker in headlamp switch amplifier
Windshield Wiper	Integral with wiper motor	Circuit Breaker
Turn Signal Flasher - (Eldorado)	On left hand side of lower steering column cover reinforcement	#323 Flasher
Turn Signal Flasher - (Except Eldorado)	Lower right corner of fuse block	#323 Flasher

FUSES, RELAYS, CIRCUIT BREAKERS, FLASHERS AND FUSIBLE LINKS (SEVILLE) (Cont'd.)

Circuit	Location	Device
Hazard Warning Flasher	Upper left corner of fuse block	#552 Flasher
EFI Fuel Pump (Eldorado)	In-Line — left of fuel injection ECU-16 gage brown wire	10 amp fuse - use ONLY AGC-10 or 3AC-10. Others could damage ECU.
EFI Fuel Pump (Except Eldorado)	On fuse panel - lower mid-section	20 amp fuse
Vanity Mirror	Behind Mirror	2 amp fuse
A/C Compressor	In rear head of compressor	Low pressure switch
A/C Blower - (Eldorado)	On evaporator near accumulator	Relay
A/C Blower - (Except Eldorado)	To left of fuse block in relay panel	Relay
Theft Deterrent - (Eldorado)	In-line above radio - yellow wire - black/red stripe wire A/C center outlet support	20 amp fuse (lights) 25 amp fuse (horn) Controller
Theft Deterrent - (Except Eldorado)	In-line above speedometer cluster In-line above speedometer cluster On lower instrument panel to left of radio receiver	20 amp fuse (lights) 25 amp fuse (horn) Controller
Horn Actuating - (Eldorado)	Below and to right of fuse block	Relay with key buzzer
Horn Actuating - (Except Eldorado)	At left of fuse block in relay panel	Relay
Illuminated Entry	Lower left instrument panel reinforcement	Relay-Time Delay

FUSES, RELAYS, CIRCUIT BREAKERS, FLASHERS AND FUSIBLE LINKS (EXCEPT SEVILLE) (CONT'D.)

Circuit	Location	Device
Guide-Matic	On bottom of fuse block	Relay
Antenna - (Eldorado)	On right hand side above litter receptacle	Relay
Antenna - (Except Eldorado)	To left of fuse block in relay panel	Relay
Seat Belt Warning - (Eldorado)	On L.H. body bracket behind left side of lower steering column cover	Timer Relay (4 to 8 seconds) with integral buzzer
Seat Belt Warning - (Except Eldorado)	At left of fuse block in relay panel	Time Relay (4 to 8 seconds) with integral buzzer
Automatic Door Locks	On shroud above L.H. kick pad Below body wiring cross car conduit Taped to logic module	Locking Relay Logic Module Unlicking Relays (2)
Key Warning - (Eldorado)	In horn relay — below and to right of fuse block	Buzzer
Key Warning - (Except Eldorado)	In relay panel at left of fuse block	Buzzer
Cruise Control - (Eldorado)	Behind instrument panel between speedometer cluster and head lamp switch	Electronic controller
Cruise Control - (Except Eldorado)	Back side of instrument panel near headlamp switch	Electronic controller
Fuel Injection Electronic Control Unit (Eldorado)	Dark Green 14 Gage wire on "Bat" terminal of generator	18 Gage Fusible Link (Dark Green)
Fuel Injection Electronic Control Unit (Except Eldorado)	On fuse panel — lower mid-section	20 amp fuse
Ignition	Red 10 gage wire at starter solenoid	16 Gage Fusible Link (Black)
Headlamps	Yellow 14 gage wire at starter	18 Gage Fusible Link (Dark Green)
Accessories and Body Feed	Black/red stripe 10 gage wire at starter	16 Gage Fusible Link (Black)

FUSES, RELAYS, CIRCUIT BREAKERS, FLASHERS AND FUSIBLE LINKS (SEVILLE)

Circuit	Location	Device
Rear Window Defogger	On left hand side of power steering column cover reinforcement	25 amp Circuit Breaker
Twilight Sentinel	Headlamp switch	Circuit Breakers
Windshield Wiper	Integral with wiper motor	Circuit Breaker
Turn Signal Flasher	On left hand side of lower steering column cover reinforcement	#323 Flasher
Hazard Warning Flasher	Upper left corner of fuse block	#552 Flasher
EFI Fuel Pump	In-line – left of fuel injection ECU-16 gage orange wire	10 amp fuse - Use only AGC-10 or 3AC-10. Others could damage ECU
Vanity Mirror	Behind Mirror	2 amp Fuse
A/C Compressor	In Rear Head of compressor	Low pressure switch
Theft Deterrent	In-line above glove box-yellow wire black/yellow stripe wire	20 amp fuse (lights) 25 amp fuse (horn)
Horn Actuating	Under hood on horn mounting bracket	Relay
A/C Auto	On evaporator case-side	Relay
Rear Defogger	In trunk-on support behind trim panel above left wheelhouse	Relay
Guide-Matic	Underhood on cowl – right of vehicle identification plate	Relay
Antenna	On right hand side of lower steering column cover reinforcement	Relay
Seat Belt Warning	Taped to dash harness – near transmission downshift switch	Timer Relay 4 to 8 seconds
	Rt. of center A/C outlet behind top cover	Chime
Key Warning	Taped dash harness – near windshield wiper switch	Buzzer
Fuel Injection Electronic Control Unit	Dark Green 14 Gage wire on "Bat" terminal of generator	18 Gage Fusible Link (Dark Green)
Ignition	Red 10 gage wire at junction block	16 Gage Fusible Link (Black)
Headlamps	Yellow 14 gage wire at junction block	18 Gage Fusbile Link (Dark Green)
Accessory and Body Feed	Black/red stripe 10 gage wire at junction block	16 Gage Fusible Link (Black)

ELECTRICAL INSTRUMENTS
GENERAL DESCRIPTION

Ignition Switch

The starter switch is combined with the steering column and shift lever lock located on the right side of the steering column below the lower steering column cover and is mechanically connected to the ignition switch located on the steering column jacket below the instrument panel. Fig. 8-69.

The engine is started by turning the key clockwise against spring tension to energize the starter solenoid. When the engine starts, releasing the key permits it to return to the Run position. All accessories (except Twilight Sentinel) are disconnected in the Start position.

The ignition lock has five key positions - Accessory Lock - Off - Run - and Start. The Lock position is clearly marked on the left side of the lock cylinder and is coordinated with the pointer on the ignition knob. The transmission shift lever must be in Park position and the ignition knob in Lock position before the key can be inserted or removed. This locks the steering wheel and transmission shift lever as well as the ignition system.

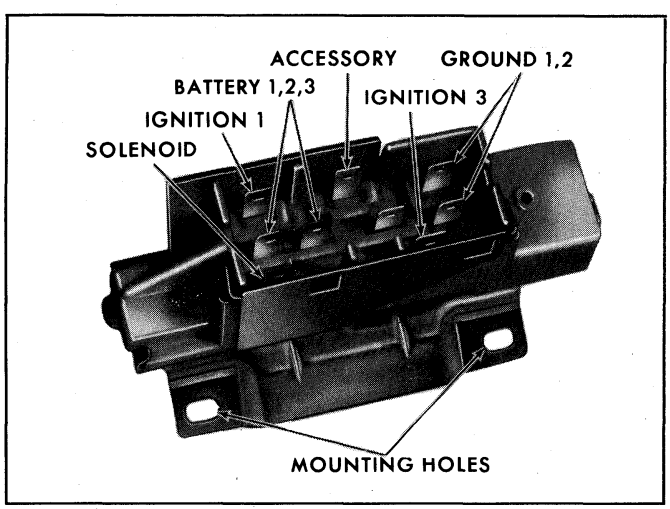


Fig. 8-69 Ignition Switch

The Off position allows the engine to be shut off without locking the steering wheel or transmission shift lever, so that the car can be steered or towed in case of any problem requiring turning off the ignition. The Run position completes the ignition circuit and activates all instruments and accessories.

The Accessory position allows the use of accessories with the ignition off.

The switch also features a buzzer system to warn the driver to remove the key from the lock. If the driver's door is opened with the key in the lock and the switch in the Off, Lock, or Accessory position, a relay buzzes and the Engine Temperature Warning light is illuminated as a reminder that the key has not been removed from the lock.

Electrical Accessory Installation

When installing additional electrical equipment, such as Rear Window De-Fogger or Twilight Sentinel, connect this equipment to the proper terminals in the wiring harness or the accessory terminal on the fuse panel in accordance with the instructions provided with the accessory. Care should be exercised in installing accessories other than those that are Cadillac designed to avoid overloading the electrical circuits.

DIAGNOSIS

Fuel Gage

On all models except Eldorado the fuel gage and bulb is fed through the telltale printed circuit. The gage is serviced after removing the instrument panel top cover.

The Eldorado fuel gage and bulb are fed through a separate connector on the rear of the gage rather than through the printed circuit. The connector is serviced after removing the instrument panel pad (Page 8-21) and positioning the L.H. A/C hose out of the way.

When checking the fuel gage circuit, first determine whether the tank unit, wiring, or fuel gage is problem area.

Although the following conditions may occur in a fuel indication system, they should not be considered as malfunction.

1. Pointer does not move below "F" after fill-up until considerable distance has been driven.

2. Gage does not always register full after fill-up. (This may result from fueling when the vehicle is not level or when the fuel is stopped by the first automatic shutoff of the pump nozzle. The last few gallons must be slowly hand-delivered to the tank.)

3. Tank is not empty when the pointer is on "E" .(The tank contains approximately 1-1/2 gallons reserve by design when the gage reads empty.)

The following checks of the fuel indication system will determine quickly whether incorrect fuel gage readings are the result of an improperly operating fuel gage, fuel tank sending unit, or circuit wiring.

NOTE: One important feature of the following procedures, is the absence of any checks that would place battery current in the system by use of "hot" jumper wires.

Fuel Gage and Sending Unit Diagnosis (Except Seville)

1. Locate fuel tank sending unit connector (18-tan wire) in trunk at right side of lock mechanism and disconnect from license plate side. With a jumper wire, connect a known good float in body side of connector, grounding float unit to chassis. Slowly move float arm from full to empty position. If instrument panel gage follows float, proceed to step 6.

2. If gage on instrument panel does **not** follow,

disconnect known good float and reconnect trunk connector. Inspect circuit wiring between instrument panel gage and trunk connector for damage.

3. If fuel gage remains pegged in full position, re-check for open in circuit wiring, such as disconnects, insulation in terminal crimps, rusted or loose connections, open wires, and terminals loosely seated or bypassed in connector.

4. If fuel gage remains pegged in empty position, re-check for grounds in circuit wiring, including pinched wires, damaged wire insulation, and broken wires that touch chassis ground.

5. Check for electrical continuity at the tan wire in:

a. Connector in left rear quarter trunk area.

b. Body wiring connector to fuse block.

c. Chassis harness connector to fuel gage.

6. If all connections ae sound and no wire damage exists, replace the instrument panel fuel gage. Check system for proper operation after replacing gage.

7. If fuel gage operates correctly in step 1, problem is between trunk connector and tank sending unit ground. Examine trunk connector terminal and clean if required. Also inspect ground wire (18 black) for good connection on chassis; if loose or rusted, clean and reinstall.

8. If problem still exists, fuel tank sending unit must be inspected. Tank must now be lowered as described on Page 6C-34(except Eldorado and Seville)or Page 6C-34(Eldorado).

9. After lowering tank, check both feed wire (18 tan) and ground wire (18 black) for loose connections and continuity. If rusted, clean and reinstall; if open, repair.

10. Remove sending unit from tank, reconnect feed and ground wires to float unit. If fuel gage follows float arm movement, check baffle in gas tank for improper position, causing interference with float.

11. If fuel gage will not follow float arm movement, replace with new sending unit. Check new unit to see that fuel gage follows float arm movement; reinstall gas tank as described on Page 6C-34 (except Eldorado and Seville) or Page 6C-34 (Eldorado).

Fuel Gage Diagnosis and Sending Unit (Seville)

1. Locate fuel tank sending unit wire (18-tan) under car near in-line fuel pump from wiring harness. With a jumper wire connect a known good float from the sender terminal (10-32 stud to the sending wire (18-tan). Ground float unit to chassis. Slowly move float arm from full to empty position. If instrument panel gage follows float, proceed to step 6.

2. If gage on instrument panel does not follow known good float inspect circuit wiring between instrument panel gage and the under car connector for damage.

3. If fuel gage remains pegged in full position, re-check for open in circuit wiring, such as disconnects, insulation in terminal crimps, rusted or loose connections, open wires, and terminals loosely seated or bypassed in connector.

4. If fuel gage remains pegged in empty position, re-check for grounds in circuit wiring, including printed circuit pinched wires, damaged wire insulation, and broken wires that touch chassis ground.)

5. Check for electrical continuity at the 18-tan wire in:

a. Connector near in-line fuel pump.

b. Body wiring connector to fuse block.

c. Remove instrument panel top cover and check chassis harness connector to telltale printed circuit.

d. Inspect printed circuit to fuel gage studs to be certain that the nuts are tight.

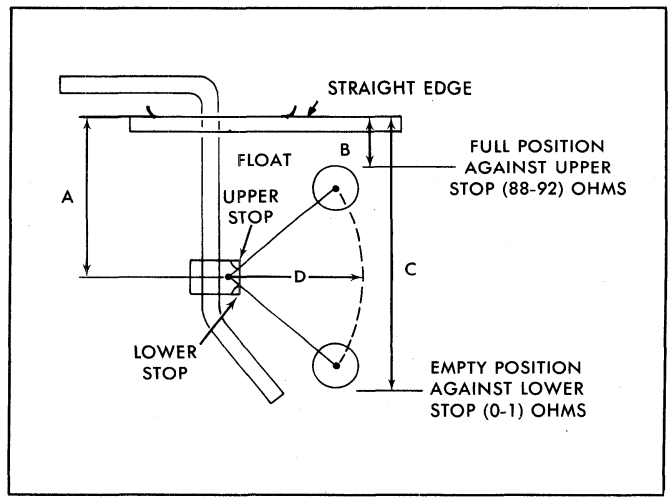


Fig. 8-70 Checking for Bent Float Arm

6. If all connections are tight and no wire damage exists, replace the instrument panel fuel gage with a known good unit. Check system for proper operation after replacing gage. If good, reconnect under car.

7. If fuel gage operates correctly in step 1, problem is between under car connector and tank sending unit ground. Examine under car connector terminal and clean if required. Inspect ground wire (18 black) for good connection to chassis. If loose or corroded, clean and reintall.

8. If problem still exists, fuel tank sending unit must be inspected. Tank must be lowered as described on Page 6C-34.

9. After lowering tank, check feed wire (18 tan) and ground wire (18 black) for loose connection and continuity. If 18 tan wire is corroded, clean and reinstall; if open, repair. If 18 black wire (ground) is not attached to sending unit, resolder.

10. Remove sending unit from tank, reconnect feed wire and ground float unit. If fuel gage follows float arm movement, check baffle in gas tank for improper position, causing interference with float.

11. If fuel gage will not follow float arm movement, replace with new sending unit. Check new unit to see that fuel gage follows float arm movement; reinstall gas tank as described on Page 6C-34.

Bent Float Arm Check (Fig. 8-70)

1. Establish a fixed reference point when checking for a bent float arm by placing a straight edge on surface of cover plate, extending it outward.

2. Measure distance from top of float (with float horizontal) to top of straight edge, with float in "Full" position against upper stop, "B".

3. Measure distance from bottom of float (with float horizontal)to top of straight edge, with float in "Empty" position against bottom stop, "C".

4. Check distance "D".

5. Refer to chart on page 8-92 for dimensions. Bend float arm as required and recheck distance "C" (bottom of float to straight edge.

TELLTALE LAMP DIAGNOSIS (Except Seville)

Diagnosis of the generator lamp is found in Section 6, on Page 6D-8. Diagnosing the washer fluid lamp is discussed on Page 8-120.

Theft deterrent lamp diagnosis is in Section 9.

CHECKING FUEL GAGE FLOAT ARM DIMENSION CHART

	Except Eldorado and Seville		Eldorado		Seville	
	MM	IN.	MM.	IN.	MM	IN.
A	157±1	6.18±.04	159±1	6.25±.04	191±1	7.50±.04
B	69±1	2.72±.04	75±1	2.94±.04	90±1	3.56±.04
C	230±2	9.06±.08	233±2	9.19±.08	259±2	10.19±.08
D	94±1	3.70±.04	97±1	3.81±.04	1.02±1	4.0±.04

Proper operation of the remaining indicator lamps is described in the following notes. A malfunction in only one of the indicator lamps should be diagnosed as described in the appropriate note. More than one inoperative lamp may be caused by a blown fuse or a mispositioned printed circuit connector. These areas should be investigated prior to individual lamp diagnosis. Telltale indicator lamp locations for all models except Eldorado and Seville are shown in Fig. 8-71.

High Beam Indicator Circuit

High beam indicator lamp should be ON whenever the high beam headlights are on.

1. Turn headlights ON. On cars equipped with Guide-Matic, rotate sensitivity control to OFF. Switch to high beam with dimmer switch.
2. If high beams come ON but indicator lamp does not glow, either bulb is burned out, connector is off at speedometer cluster printed circuit, 18 light green wire between left hand bulk head connector ("AU") and cluster connector is open or printed circuit is open.
3. If **neither** high beams nor indicator lamp come on, dimmer switch is malfunctioning or Guide-Matic is inoperative. Refer to Section 9 for Guide-Matic diagnosis.

Turn Signal Indicator Lamp

1. Turn ignition switch to "RUN" position.
2. Move lever down (left turn) or up (right turn) until it clicks into position.
3. Applicable parking and tail light along with indicator lamp should flash continuously.
4. Check fuse, lamps and flashers. If indicator bulb still remains out, check for burned out indicator bulb.

Trunk Lid Warning Lamp ("Trunk Open")

The "trunk open" warning light should glow (amber) with the trunk lid open and the ignition switch in the "ON" position.

a. Trunk Lid Open - Lamp Off

1. Remove cover panel from lock mechanism in trunk compartment.
2. Remove 18 dark green wire from behind lock mechanism and ground wire using a jumper wire (ignition swtich on).
3. If lamp comes on, remove lock mechanism and inspect jamb switch. Repair as required.
4. If lamp remains off, disconnect single dark green wire connector near fuse block and ground the male connector.
5. If lamp comes on, there is an open in the 18 dark green wire between that connector and the lock mechanism.
6. If lamp remains off, remove instrument panel pad, Page 8-21 (Eldorado) or top cover Page 8-2 (exc. Eldorado and Seville) and check for burned out bulb.
7. If bulb is okay, remove instrument panel top cover page 8-22 (Eldorado) enough to check for proper connection of printed circuit connector and proper position of terminals in connector.
8. If bulb and connector are both okay, remove connector and check 18 dark green wire (#15 terminal) for continuity between printed circuit connector and single connector near fuse block.
9. If wire is continuous, replace instrument cluster printed circuit.

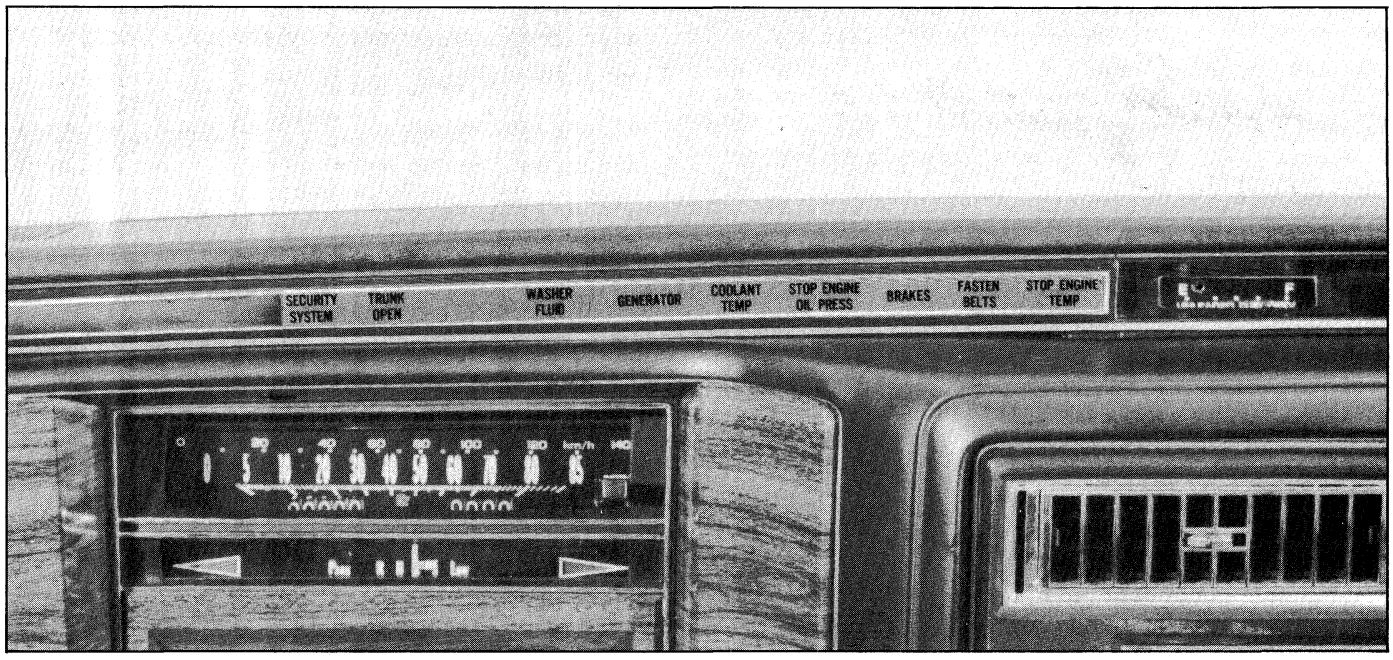


Fig. 8-71 Telltale Lamp Locations (Except Eldorado and Seville)

b. Trunk Lid Closed - Lamp On

1. Open trunk lid and short across latch mechanism to move lock to closed position.

2. Turn ignition switch on. Remove cover panel from lock mechanism and remove 18 dark green wire from behind lock mechanism.

3. If lamp goes off, remove lock mechanism and inspect jamb switch for grounded condition.

4. If lamp remains on, disconnect single dark green connector near fuse block.

5. If lamp goes off, the 18 dark green wire is grounded between the connector and the lock mechanism.

6. If lamp remains on, remove instrument panel pad and partially remove top cover, Page 8-22 (Eldorado), and remove top cover Page 8-2 (exc. Eldorado and Seville) until printed circuit connector may be inspected for proper connection.

7. If connector is okay, remove connector and check the 18 dark green wire (#15 terminal) for a grounded condition between printed circuit connector and single connector near fuse block.

8. If wire checks okay, replace printed circuit.

Brake Combination Valve and Park Brake Lamp ("Brakes")

The "brakes" warning lamp should glow (red) during engine cranking or when the park brake is applied and ignition is "on" and be off at all other times.

a. Lamp Off During Cranking

1. Check for blown 5 amp (Eldorado) or 20 amp (except Eldorado and Seville) "gages" fuse.

2. Turn ignition switch on. Remove 18 black wire from brake combination valve and ground wire. If lamp comes on, proceed to step 7.

3. If lamp remains off, remove instrument panel pad Page 8-21 (Eldorado) or top cover Page 8-2 (exc. Eldorado and Seville) and check for burned out indicator bulb.

4. If bulb is okay, partially remove instrument panel top cover Page 8-22 (Eldorado) and inspect printed circuit connector.

5. If bulb and connector are okay, remove printed circuit connector and check the 18 tan wire (terminal #11) for continuity between the connector and the brake combination valve wire.

6. If wire is continuous, replace printed circuit.

7. If lamp comes on as a result of grounding the combination valve wire (Step 2), remove screws securing steering column to mounting bracket and lower column until access to ignition switch is gained.

8. Ground the 18 tan/white wire at the ignition switch (ignition switch on).

9. If lamp comes on, replace ignition switch.

10. If lamp remains off, the 18 tan/white wire between the ignition switch and telltale connector is open.

b. Lamp On With Ignition Switch On and Park Brake Released

1. Disconnect the 18 black wire from the brake combination valve.

2. If lamp goes out, the combination valve or brake system has malfunctioned.

3. If lamp remains on, disconnect park brake warning switch connector.

4. If lamp goes out, replace switch.

5. If lamp remains on, leave 18 tan wire at park brake switch and 18 black wire at combination valve disconnected and remove screws securing steering column to support bracket and allow column to drop for access to ignition switch.

6. Disconnect multiple connector at ignition switch.

7. If lamp goes out, replace ignition switch.

8. If lamp remains on, remove instrument panel pad Page 8-21 (Eldorado) or top cover Page 8-2 (exc. Eldorado and Seville). Disconnect the printed circuit connector and check the following wires for a ground condition:

a. 18 black wire between left bulkhead connector "DU"

terminal and brake combination valve.

b. 18 tan wire between printed circuit connector and the "DU" terminal of the left bulkhead connector and the 18 tan/white wire at the ignition switch.

c. 18 tan wire between left bulkhead connector and the brake warning switch.

9. If wires check okay, replace printed circuit.

Oil Pressure Indicator Circuit ("Stop Engine Oil Pressure")

The oil pressure indicator light is connected in a circuit with the ignition switch and a pressure operated switch threaded into the oil header galley at rear of engine. Indicator light warns driver when oil pressure is below (4 ± 1-1/2) pounds per square inch.

The lamp should glow (red) when the ignition switch is on but the engine is not running. The lamp should go out immediately after the engine is started and remain out during engine operation.

a. Ignition On - Lamp Off - Engine Not Running

1. Check for blown 5 amp. (Eldorado) 20 amp. (except Eldorado and Seville) "gages" fuse.

2. Disconnect 18 dark blue wire at oil pressure switch and ground wire using jumper wire. If lamp glows, oil pressure switch is open and should be replaced.

NOTE: Sealing compound on threads of switch may cause this condition and should never be used.

3. If lamp remains off, remove instrument panel pad Page 8-21 (Eldorado) or top cover Page 8-2 (exc. Eldorado and Seville) and check for burned out indicator bulb.

4. If bulb is okay, partially remove top cover Page 8-22 (Eldorado) until printed circuit connector may be inspected for proper connection.

5. If connector is okay, remove connector and check the 18 dark blue wire (terminal #5) for continuity between connector and oil pressure switch.

6. If wire has continuity, replace printed circuit.

7. If an open condition is indicated by the continuity, check inspect engine harness connector. Repair wire as required.

b. Engine Running - Lamp On

1. Disconnect 18 dark blue wire at oil pressure switch.

2. If indicator lamp goes off, the oil pressure switch is shorted or the engine has low oil pressure. If a new switch does not provide proper indicator lamp operation, remove switch and test engine oil pressure using a reliable pressure gage. If pressure is okay, replace switch.

3. If lamp remains on, remove instrument panel pad and partially remove top cover Page 8-22 (Eldorado), and remove top cover Page 8-2 (exc. Eldorado and Seville) until printed circuit connector is serviceable.

4. Inspect printed circuit connector for proper connection.

5. If connector is okay, remove connector and test 18 dark blue wire (terminal #5) for continuity between printed circuit connector and oil pressure switch connector.

6. If wire is okay, replace printed circuit.

Water Temperature Indicator Circuit ("Coolant Temperature")

The amber "coolant temperature" lamp should glow during engine cranking and whenever coolant temperature is excessive 132°C (269°F) or higher.

a. Lamp Off During Cranking

1. Check for blown 5 amp. (Eldorado) 20 amp (except Eldorado and Seville) "gages" fuse.

2. Turn ignition switch on. Disconnect 18 dark green wire to temperature sender at connector near A/C compressor and ground wire from bulkhead connector.

3. If lamp comes on, replace temperature sender.

4. If lamp remains off, remove instrument panel pad Page 8-21 (Eldorado) or top cover Page 8-2 (exc. Eldorado and Seville) and inspect for burned out lamp.

5. If lamp is okay, partially remove top cover Page 8-22 (Eldorado) and inspect printed circuit connector.

6. If lamp and connector are okay, remove screws securing steering column to bracket and lower column to gain access to ignition switch.

7. Ground the 18 dark green wire at the ignition switch.

8. If lamp comes on, replace ignition switch.

9. If lamp remains off, check the following wires for continuity:

a. 18 dark green wire between printed circuit connector (terminal #3) and ignition swtich.

b. 18 dark green wire between printed circuit connector (terminal #3) and temperature sender connector.

10. If wires are continuous, replace printed circuit.

b. Lamp Is On When Ignition Is On

1. Disconnect 18 dark green wire to temperature sender at connector near A/C compressor.

2. If lamp goes out, replace temperature sender.

3. If lamp remains on, remove screws securing steering column to bracket and lower column to gain access to ignition switch.

4. Disconnect 18 dark green wire from ignition switch.

5. If lamp goes out, replace ignition switch.

6. If lamp remains on, remove instrument panel pad and partially remove top cover (Page 8-22 (Eldorado), and remove top cover Page 8-2 (exc. Eldorado and Seville) for access to printed circuit connector.

7. Disconnect printed circuit connector and check the following wires for a grounded condition:

a. 18 dark green wire between printed circuit connector (terminal #3) and temperature sender connector.

b. 18 dark green wire between printed circuit connector (terminal #3) and ignition switch.

8. If wires are okay, replace printed circuit.

Seat Belt Warning Light and Buzzer ("Fasten Belts")

NOTE: A cool down period of approximately 30 seconds should be allowed between successive functional checks of the system. If the cool-down is not allowed, the system may be inoperative.

Operation of System

1. With driver's seat belt buckled, and the ignition "on", the telltale "seat belt" **light** should come on for approximately 4-8 seconds.

2. With the driver's seat belt unbuckled and the ignition

in "on", the "seat belt" **light and the seat belt warning buzzer** should come on for 4-8 seconds.

a. Light Does Not Come On

1. Remove instrument panel pad Page 8-21 (Eldorado) or top cover Page 8-22 (exc. Eldorado and Seville) and check for burned out bulb.

2. If bulb is okay, inspect printed circuit for an open conductor or connector and for proper connection. Replace if damaged.

3. If properly connected, remove connector from printed circuit and check for voltage at terminal #13 (pink/white wire) with ignition on.

4. If voltage is **not** available, the pink/white wire is open between the timer and the #13 terminal of the printed circuit connector.

5. If voltage **is** available, check the 18 black wire (terminal #12) for continuity between the connector and the timer.

b. Light Will Not Go Out

1. Remove instrument panel pad Page 8-21 (Eldorado) or top cover Page 8-2 (exc. Eldorado and Seville.) Remove printed circuit connector.

2. Check 18 pink/white wire (terminal #13) for grounded condition.

3. If wire is okay, check printed circuit or timer for a shorted condition.

c. Buzzer Does Not Operate (Telltale Light Operates)

1. Check for voltage at 18 wire at timer/buzzer connector. Connect test light to ground. Sit in driver's seat, seat belt unbuckled and turn ignition on.

2. If voltage is **not** available repair open in 18 wire, Turn Ignition off.

3. If voltage **is** available connect a jumper wire from the 18 pink/white wire at the buzzer to ground. Turn ignition on.

4. If buzzer does **not** operate, replace timer/buzzer.

5. If buzzer **does** operate check for open in 18 pink/white wire.

6. If wire is not open, connect a self powered test light to seat belt retractor connector. Do **not** sit on seat.

7. If test light does not glow, replace seat belt retractor switch.

8. If test light glows check 18 black wire (body side) at seat belt retractor connector to make certain it **is** grounded.

9. Replace timer/buzzer if all above tests do not indicate a problem.

Engine Metal Temperature Indicator Circuit ("Stop Engine Temperature") (Fig. 8-72 and 8-73)

In addition to indicating an engine overheating condition, the red "stop engine temperature" warning lamp should come on whenever the ignition key warning buzzer sounds (key in lock, ignition off and driver's door is open.

System Circuitry

When engine metal temperature exceeds 160°C (320°F) the engine temperature switch closes. Current from the horn circuit breaker flows through the orange with black stripe wire, through the relay coil, through the normally closed contact points, through the 18 white wire to the bulkhead connector. The current then flows through the left bulkhead connector "DX" cavity, through the 18 light green wire to the engine temperature sending unit switch, and then through the switch to ground.

When the engine metal temperature switch is closed, the ground is also completed for the engine metal temperature tell-tale light that is fed from the horn circuit breaker through the 16 orange with black stripe wire. Current flows through the engine metal temperature tell-tale light, illuminating this light, through the light green wire to the left bulkhead connector, through the 18 light green wire to ground at the switch.

When the relay coil is energized, the normally closed contacts open, breaking the circuit and de-energizing the coil. This, in turn, allows the normally closed contacts to close again, completing the circuit and energizing the coil again. As the normally closed contacts open and close in rapid succession, the buzzer sound is produced.

NOTE: When engine metal temperature exceeds 160°C (320°F) energizing the warning buzzer coil, it will continue to buzz until the engine cools below 116°C (240°F) even with the ignition switch turned Off.)

a. Lamp Fails To Come On

1. Disconnect the 18 light green wire from the metal temperature switch at the rear of the left cylinder head and ground the wire.

2. If lamp comes on and buzzer sounds, replace temperature switch.

3. If lamp remains off, check for an open horn circuit breaker.

4. If circuit breaker is okay, remove instrument panel pad (Page 8-21 (Eldorado) or top cover Page 8-2 (exc. Eldorado and Seville) and check for burned out bulb.

5. If bulb is okay, partially remove top cover page 8-22 (Eldorado) and inspect printed circuit connector.

6. If bulb and connector are okay, remove printed circuit connector and check for continuity between terminal #6 and temperature switch (18 light green).

7. If continuity is indicated, check for voltage at the #7 terminal of the printed circuit connector (16 orange/black wire).

8. If voltage **is** indicated, there is an open in the 18 light green wire between the #6 printed circuit connector and the "DX" cavity of the left bulkhead connector and the temperature switch.

9. If voltage is **not** indicated, there is an open in the 16 orange/black wire between the connector and the fuse block.

b. Lamp Fails To Go Out

1. Disconnect 18 light green wire at metal temperature switch at rear of left cylinder head.

2. If lamp goes out, replace temperature switch.

3. If lamp remains on, the 18 light green wire between the temperature switch, the "DX" cavity of the left bulkhead connector and terminal #6 of the printed circuit connector is grounded.

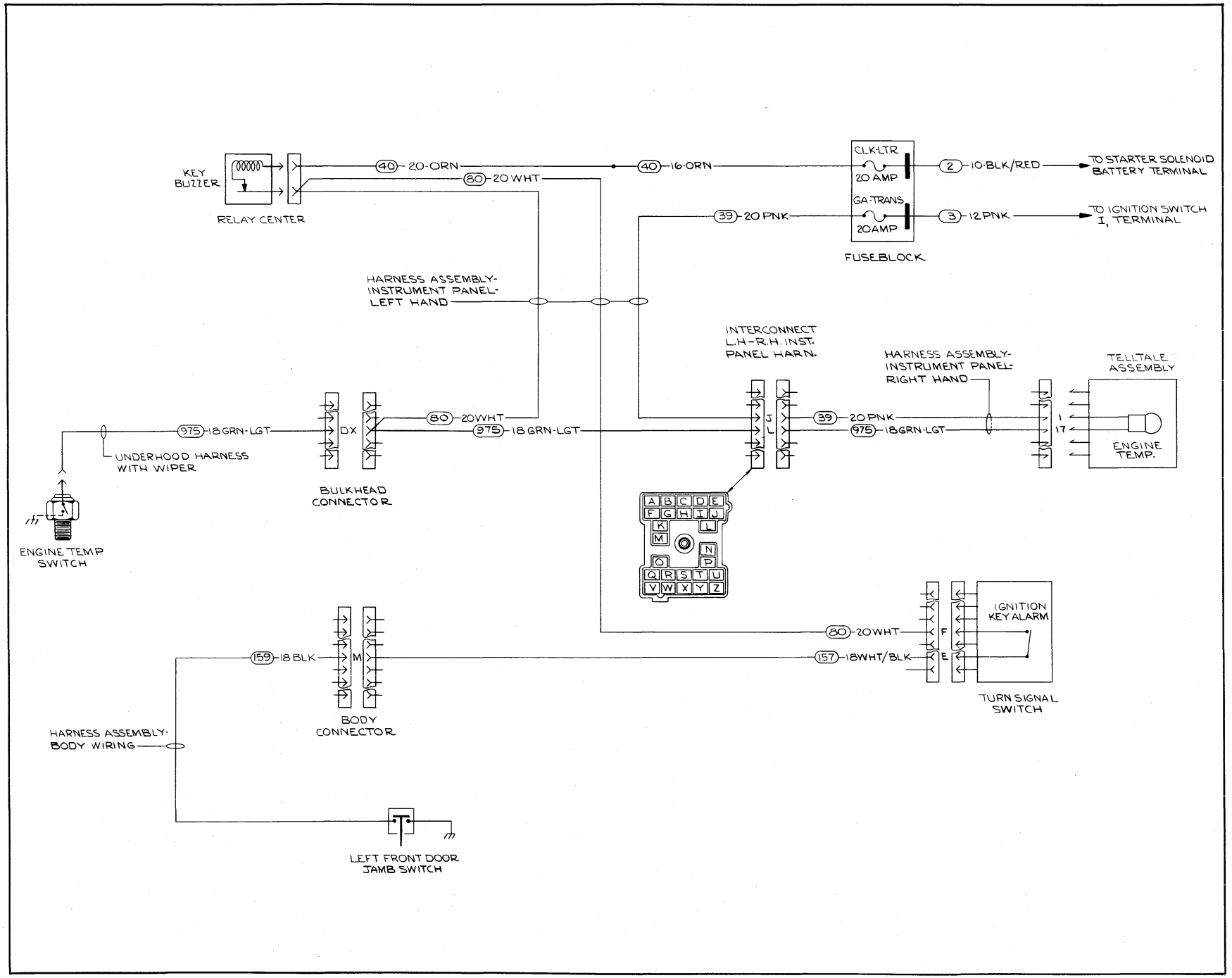


Fig. 8-72 Engine Metal Temperature Warning Circuit (Except Eldorado and Seville)

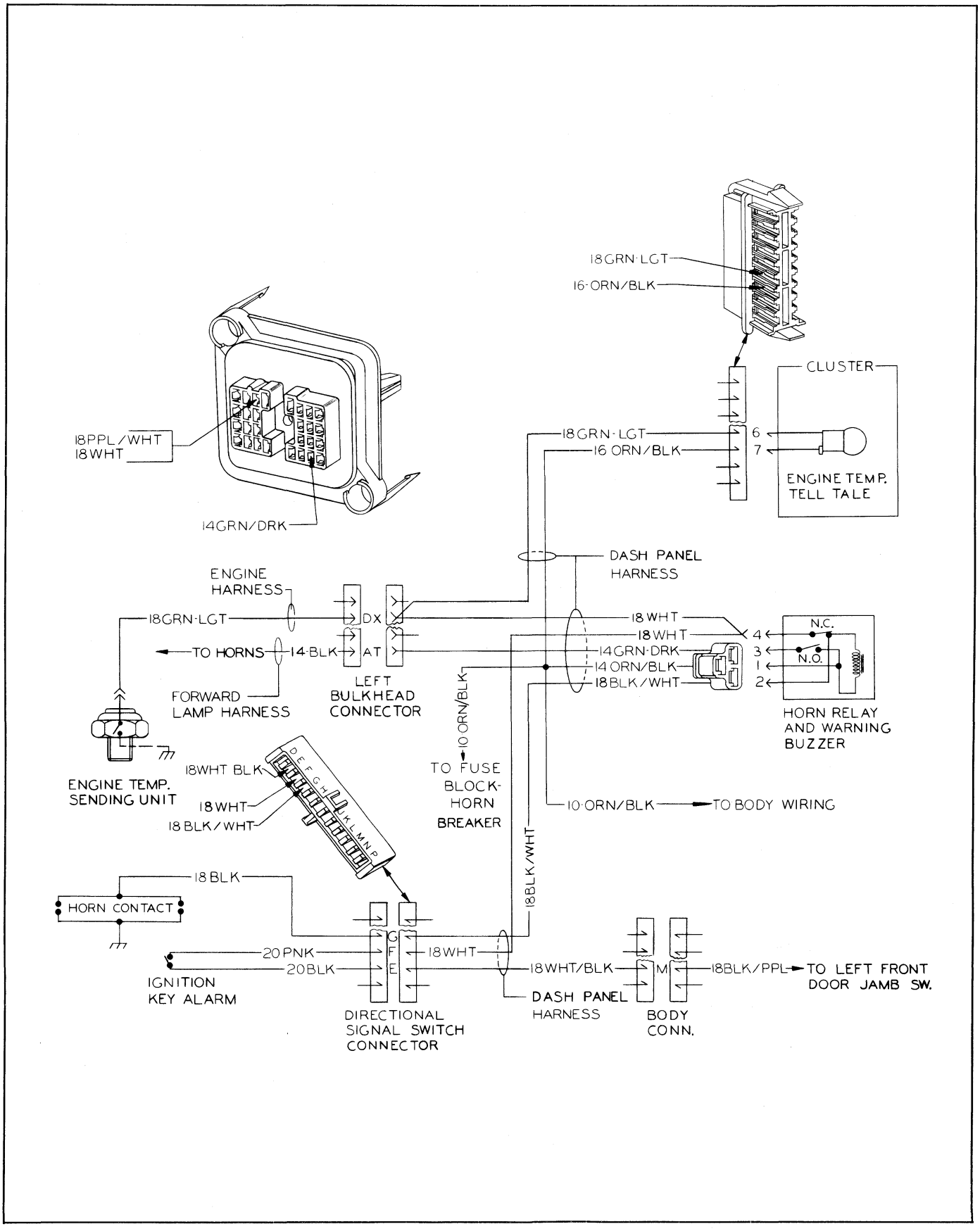


Fig. 8-73 Engine Metal Temperature Warning Circuit (Eldorado)

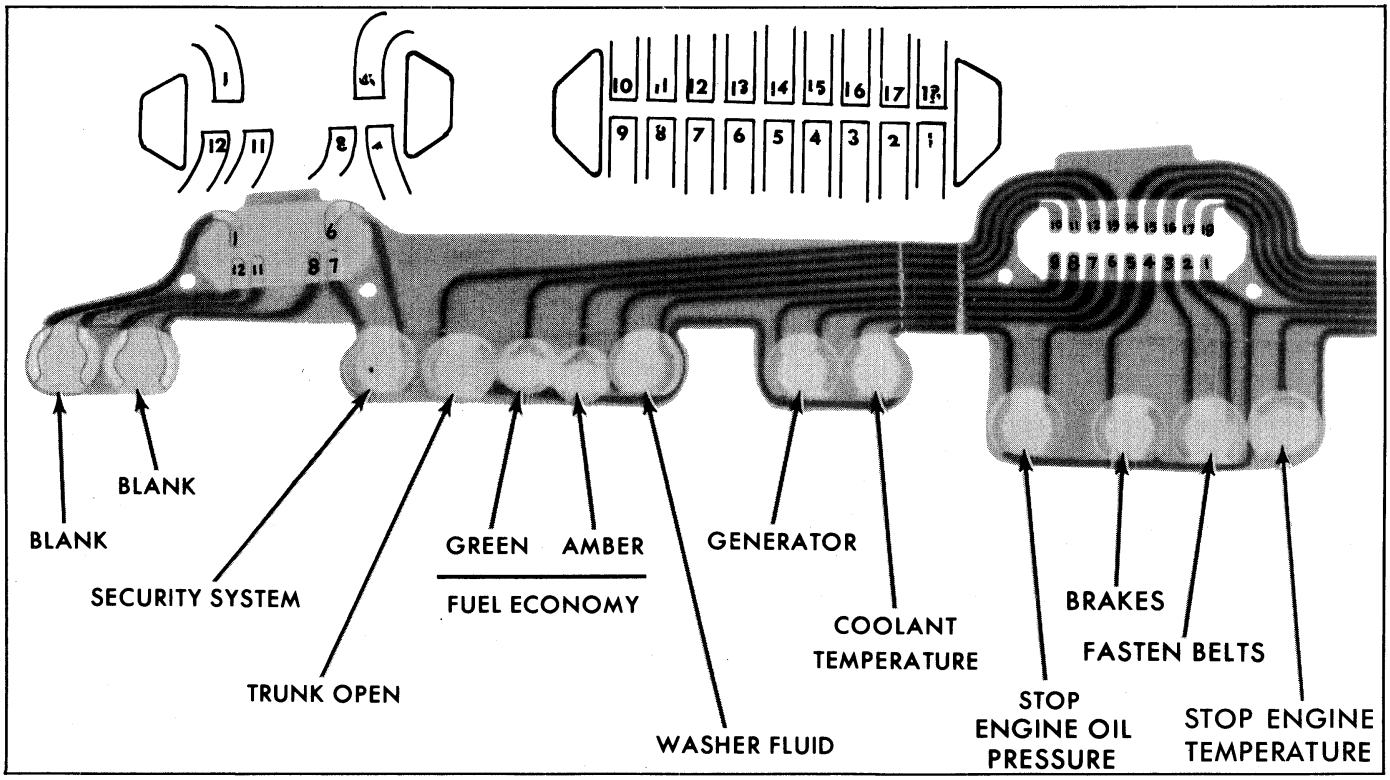


Fig. 8-74 Telltale Cluster Printed Circuit (Except Eldorado and Seville)

TELLTALE CLUSTER PRINTED CIRCUIT LEGEND (EXC. ELDORADO AND SEVILLE)

No. and Circuit	Wiring Color Code
18 WAY CONNECTOR	
1 Ignition Common	20 Pink
2 Fasten Belts	20 Pink/White
3 Fasten Belts	20 Black
4 Brakes	20 Tan/White
5 Stop Engine Oil Pressure	20 Dark Blue
6 Coolant Temperature	20 Dark Green
7 Generator	16 Brown
8 Ignition B-Gen.	20 Yelow
9 Washer Fluid	20 Blue/Lt. Yellow
10 Washer Fluid	20 Black/White
11 Min. Fuel Economy	20 Yellow
12 Max. Fuel Economy	20 White
13 Trunk Open	20 Dark Green
14 Ground	20 Black
15 Illumination	20 Gray
16 Ignition B-Clock	20 Orange
17 Stop Engine Temperature	18 Lt. Green
18 Fuel Gage Sender	20 Tan
12 WAY CONNECTOR	
1 Blank Tell-Tale	
2 Blank	
3 Blank	
4 Blank	
5 Blank	
6 Security System	18 Dark Green
7 Security System	18 Orange
8 Blank Tell-Tale	
9 Blank	
10 Blank	
11 Blank Tell-Tale	
12 Blank Tell-Tale	

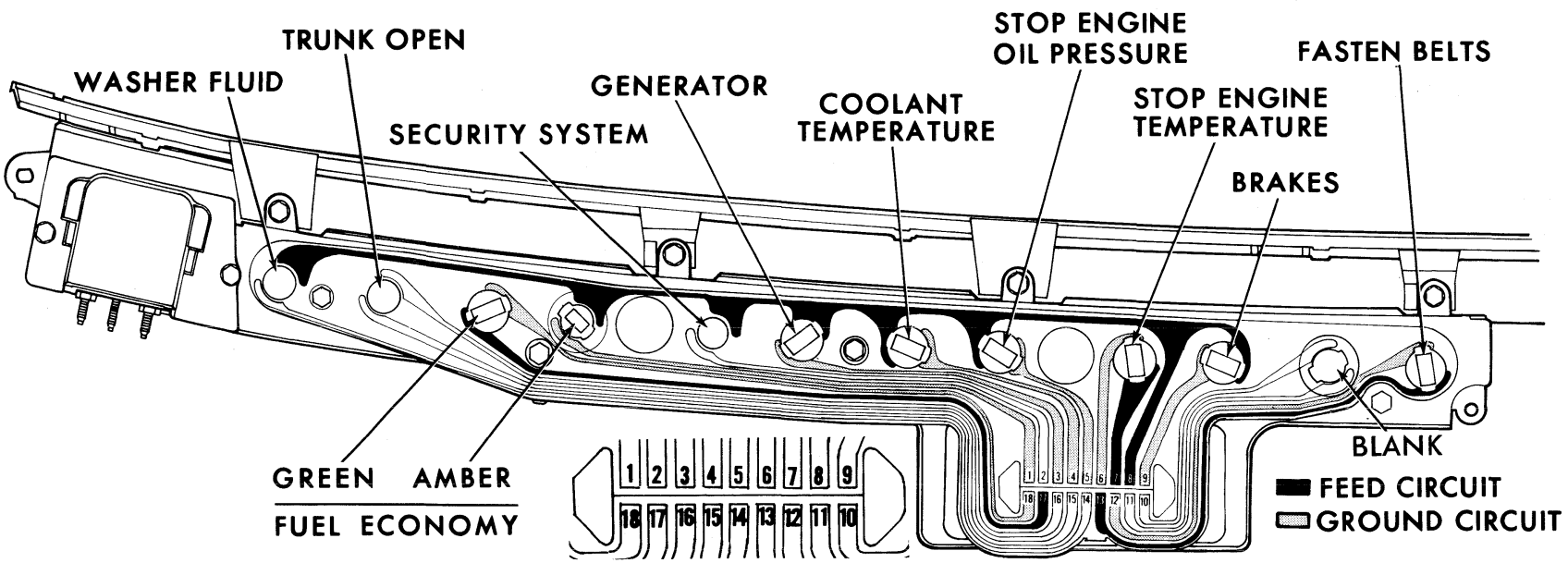


Fig. 8-75 Telltale Cluster Printed Circuit (Eldorado)

TELLTALE CLUSTER PRINTED CIRCUIT LEGEND (ELDORADO)

No. and Circuit	Wiring Color Code
1 — Generator	16 Brown
2 — Ignition	18 Yellow
3 — Coolant Temp.	18 Dark Green
4 — Blank	
5 — Stop Engine Oil Pressure	18 Dark Blue
6 — Stop Engine Temperature	18 Light Green
7 — Stop Engine Temperature	16 Orange/Black
8 — Ignition	18 Pink
9 — Blank	
10 — Blank	
11 — Brakes	18 Tan/White
12 — Fasten Belts	18 Pink/White
13 — Fasten Belts	18 Black
14 — Washer Fluid	18 White
15 — Trunk Open	18 Dark Green
16 — Blank	
17 — Max. Fuel Economy	18 Yellow
18 — Min. Fuel Economy	18 White

TELLTALE LAMP DIAGNOSIS (SEVILLE)

Diagnosis of the generator lamp is found on Page 6D-8. Diagnosis of the washer fluid lamp is described on page 8-119.

Proper operation of the remaining indicator lamps Fig. 8-78 is described in the following notes. A malfunction in only one of the indicator lamps should be diagnosed as described in the appropriate note. More than one inoperative lamp may be caused by a blown fuse or a mispositioned printed circuit connector. These areas should be investigated prior to individual lamp diagnosis.

High Beam Indicator Circuit

High beam indicator lamp should be ON whenever the high beam headlights are on.

1. Turn headlights ON. On cars equipped with Guide-Matic, rotate sensitivity control to OFF. Switch to high beam with dimmer switch.

2. If high beams come ON but indicator lamp does not glow, either bulb is burned out, connector is off at instrument cluster printed circuit, 18 light green wire between bulk head connector and cluster connector is open or printed circuit is open.

3. If **neither** high beams nor indicator lamp come on, dimmer switch is malfunctioning or Guide-Matic is inoperative. Refer to Section 9 for Guide-Matic diagnosis.

Turn Signal Indicator Lamp

1. Turn ignition switch to "RUN" position.

2. Move lever down (left turn) or up (right turn) until it clicks into position.

3. Applicable parking and tail light along with indicator lamp should flash continuously.

4. Check fuse, lamps and flashers. If indicator bulb still remains out, check for burned out indicator bulb.

Trunk Lid Warning Lamp ("Trunk Open")

The "trunk Open" warning light should glow (amber) with the trunk lid open and the ignition switch in the "ON" position.

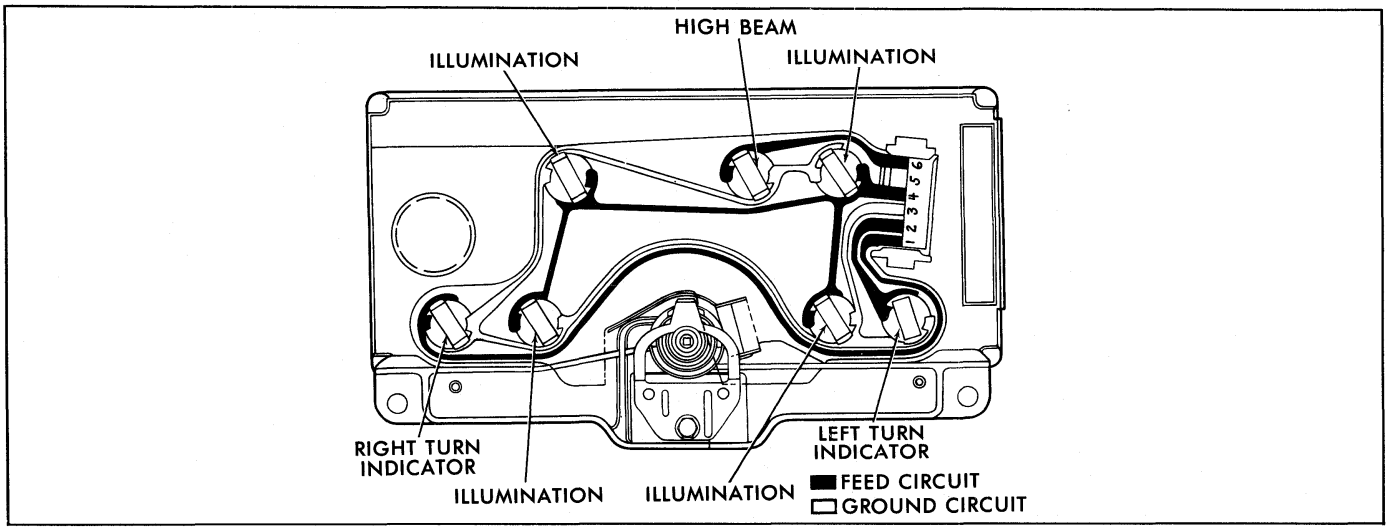


Fig. 8-76 Speedometer Cluster Printed Circuit (Except Eldorado and Seville)

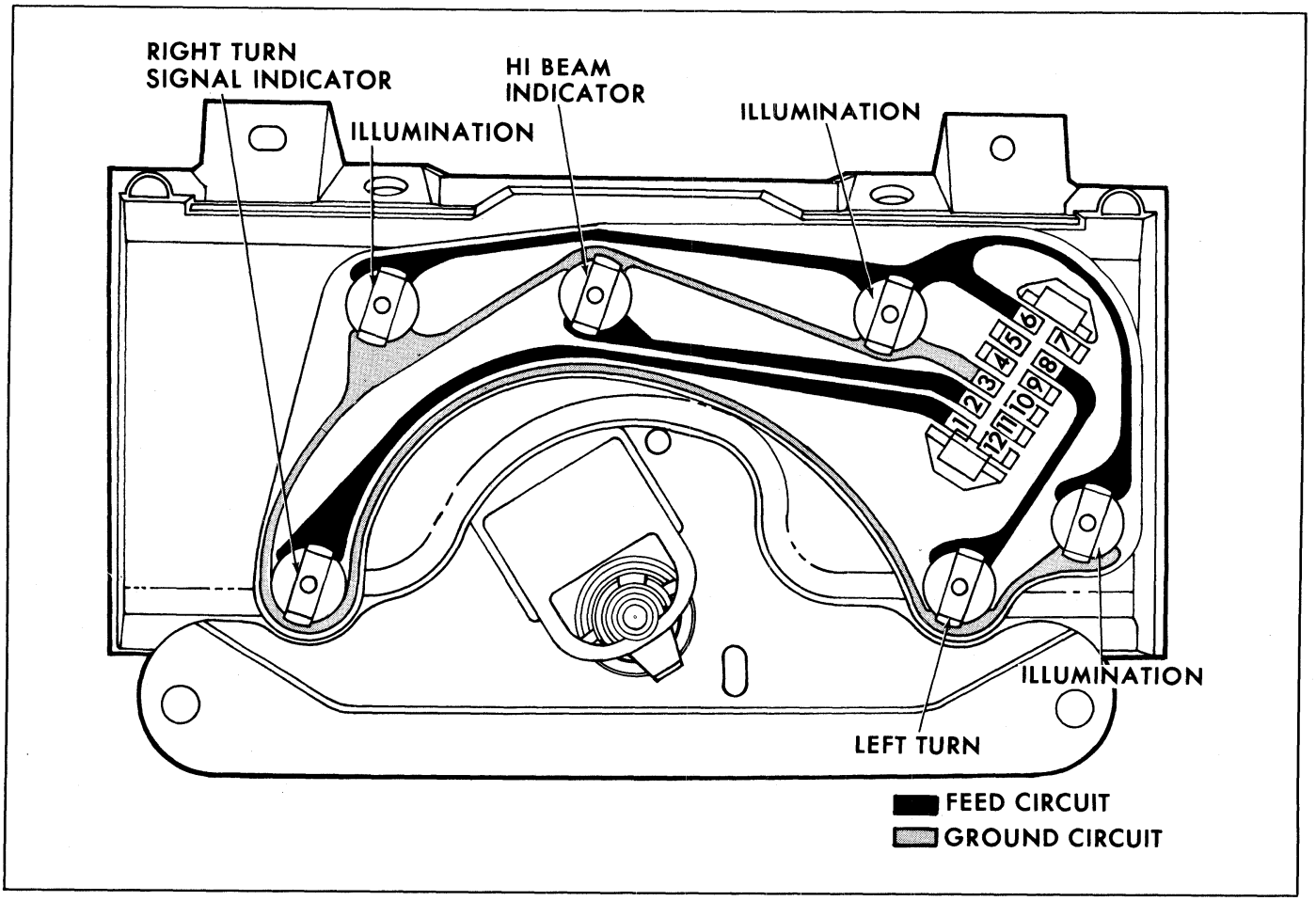


Fig. 8-77 Speedometer Cluster Printed Circuit (Eldorado and Seville)

a. Trunk Lid Open - Lamp Off

1. Remove cover panel from lock mechanism in trunk compartment.

2. Remove 18 dark green wire from behind lock mechanism and ground wire using a jumper wire (ignition switch on).

3. If lamp comes on, remove lock mechanism and inspect jamb switch. Repair as required.

4. If lamp remains off, disconnect single dark green wire connector near fuse block and ground the male connector.

5. If lamp comes on, there is an open in the 18 dark green wire between that connector and the lock mechanism.

6. If lamp remains off, remove lower steering column cover and speedometer cluster bezel (Page 8-41 and 8-42)and check for burned out bulb.

7. If bulb is okay, remove instrument panel top cover (Page 8-44) enough to check for proper connection of printed circuit connector and proper position of terminals in connector.

8. If bulb and connector are both okay, remove

SPEEDOMETER PRINTED CIRCUIT LEGEND

ELDORADO AND SEVILLE	EXCEPT ELDORADO AND SEVILLE
1. R. H. Turn Indicator ..... 18 Dark Blue	1. R.H. Turn Indicator ..... 18 Dk. Blue/White
2. HiBeam Indicator ..... 18 Light Green	2. L.H. Turn Indicator ..... 18 Lt. Blue
3. Ground ..... 16 Black	3. Ground ..... 12 Black
4. Not Used	4. Illumination ..... 20 Gray
5. Not Used	5. Blank .....
6. Illumination ..... 18 Gray	6. Hi-Beam ..... 18 Lt. Green
7. Not Used	
8. L.H. Turn Indicator ..... 18 Light Blue	
9. Not Used	
10. Not Used	
11. Not Used	
12. Not Used	

connector and check 18 dark green wire (#13 terminal) for continuity between printed circuit connector and single connector near fuse block.

9. If wire is continuous, replace instrument cluster printed circuit.

b. Trunk Lid Closed - Lamp On

1. Open trunk lid and short across latch mechanism to move lock to closed position.

2. Turn ignition switch on. Remove cover panel from lock mechanism and remove 18 dark green wire from behind lock mechanism.

3. If lamp goes off, remove lock mechanism and inspect jamb switch. Repair as required.

4. If lamp remains on, disconnect single dark green connector near fuse block.

5. If lamp goes off, the 18 dark green wire is grounded between the connector and the lock mechanism.

6. If lamp remains on, remove instrument panel top cover (Page 8-44) until printed circuit connector may be inspected for proper connection.

7. If connector is okay, remove connector and check the 18 dark green wire (#13 terminal) for a grounded condition between printed circuit connector and single connector near fuse block.

Brake Combination Valve and Park Brake ("Brakes")

The "brakes" warning lamp should glow (red) during engine cranking or when the parking brake is applied and be off at all other times.

a. Lamp Off During Cranking

1. Check for blown 5 amp "gages" fuse.

2. Turn Ignition switch on. Remove 18 black wire from brake combination valve and ground wire. If lamp comes on, proceed to step 7.

3. If lamp remains off, remove instrument panel top cover (Page 8-44) and check for burned out indicator bulb.

4. If bulb is okay, inspect printed circuit and connector for an open.

5. If bulb circuit and connector are okay, remove printed circuit connector and check the 18 tan wire (terminal #9) for continuity between the connector and the brake combination valve wire.

6. If lamp comes on as a result of grounding the combination valve wire (Step 2), remove nuts securing steering column to support bracket and allow column to drop until access to ignition switch is gained.

7. Ground the 18 tan/white wire at the ignition switch (ignition switch on).

8. If lamp comes on, replace ignition switch.

9. If lamp remains off, the 18 tan/white wire between the ignition switch and bulkhead connector is open.

b. Lamp On With Ignition Switch On and Park Brake Released

1. Disconnect the 18 black wire from the brake combination valve.

2. If lamp goes out, the combination valve or brake system has malfunctioned.

3. If lamp remains on, disconnect park brake warning switch connector.

4. If lamp goes out, replace switch.

5. If lamp remains on, leave 18 tan wire at park brake switch and 18 black wire at combination valve disconnected and remove nuts securing steering column to support bracket allowing column to drop for access to ignition switch.

6. Disconnect multiple connector at ignition switch.

7. If lamp goes out, replace ignition switch.

8. If lamp remains on, remove instrument panel top cover (Page 8-44). Disconnect the printed circuit connector and check the following wires for a ground condition:

a. 18 black wire between bulk head connector and brake combination valve.

b. 18 tan wire between printed circuit connector (terminal #9) and the 18 tan/white wire at the ignition switch.

c. 18 tan wire between bulkhead connector and the brake warning switch.

Oil Pressure Indicator Circuit ("Stop Engine Oil Pressure")

The oil pressure indicator light is connected in a circuit with the ignition switch and a pressure operated switch threaded into the oil header galley at front of the engine. An indicator light warns the driver when oil pressure is below (4±1-1/2) pounds per square inch.

The lamp should glow (red) when the ignition switch is on but the engine is not running. The lamp should go out

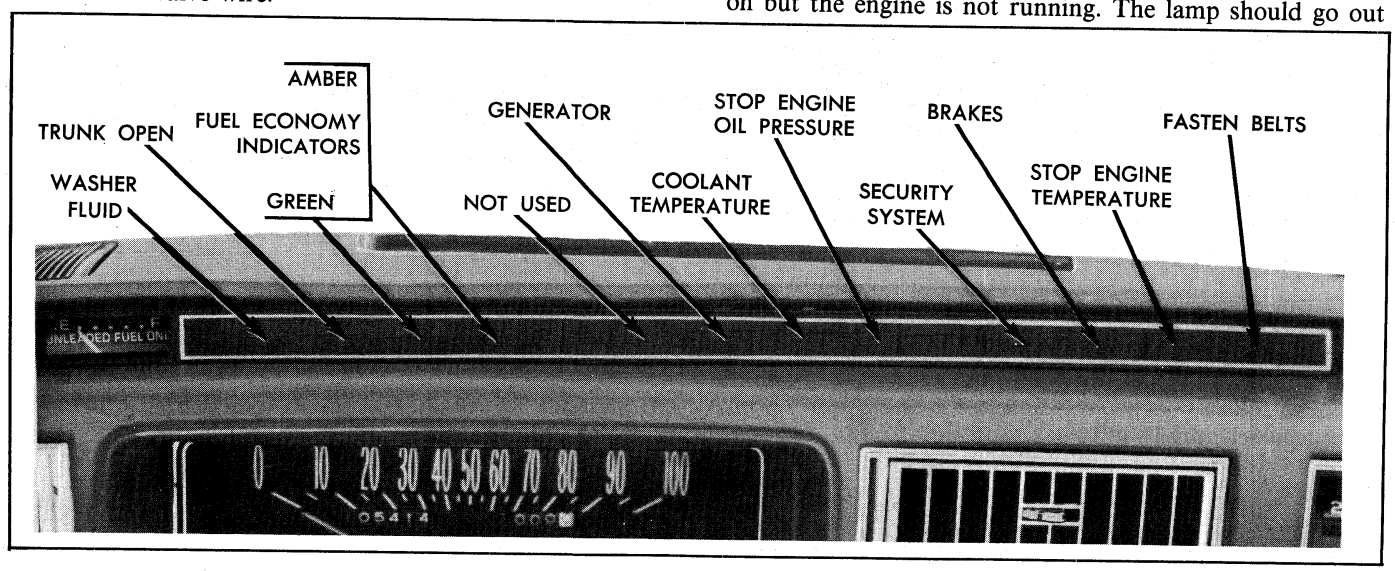


Fig. 8-78 Telltale Indicator Location (Seville)

immediately after the engine is started and remain out during engine operation.

a. Ignition On - Lamp Off - Engine Not Running

1. Check for blown 5 amp "gages" fuse.
2. Disconnect 18 dark blue wire at oil pressure switch and ground wire using jumper wire. If lamp glows, oil pressure switch is open and should be replaced.

NOTE: Sealing compound on threads of switch may cause this condition and should never be used.

3. If lamp remains off, remove instrument panel top cover (Page 8-44) and check for burned out indicator bulb.
4. If bulb is okay, inspect for proper connection.
5. If connector is okay, remove connector and check the 18 dark blue wire (terminal #8) for continuity between connector and oil pressure switch.
6. If wire has continuity, replace printed circuit.
7. If an open condition is indicated by the continuity check, inspect engine harness connector. Repair wire as required.

b. Engine Running - Lamp On

1. Disconnect 18 dark blue wire at oil pressure switch.
2. If indicator lamp goes off, the oil pressure switch is shorted or the engine has low oil pressure. Remove switch and test engine oil pressure using a reliable pressure gage. If pressure is okay replace switch.
3. If lamp remains on, remove instrument panel top cover (Page 8-44).
4. Inspect printed circuit connector for proper connection.
5. If connector is okay, remove connector and test 18 dark blue wire (terminal #8) for continuity between printed circuit connector and oil pressure switch connector.

Water Temperature Indicator Circuit ("Coolant Temperature")

The amber "coolant temperature" lamp should glow during engine cranking and whenever coolant temperature is excessive.

a. Lamp Off During Cranking

1. Check for blown 5 amp "gages" fuse.
2. Turn ignition switch on. Disconnect 18 dark green wire to temperature sender at connector near front of intake manifold and ground wire.
3. If lamp comes on, replace temperature sender.
4. If lamp remains off, remove instrument panel top cover (Page 8-44) and inspect for burned out lamp.
5. If lamp is okay, inspect printed circuit and connector for an open.
6. If lamp and connector are okay, remove 2 nuts which secure steering column to bracket and lower column to gain access to ignition switch.
7. Ground the 18 dark green wire at the ignition switch.
8. If lamp comes on, replace ignition switch.
9. If lamp remains off, check the following wires for continuity:

a. 18 dark green wire between printed circuit connector (terminal #7) and ignition switch.

b. 18 dark green wire between printed circuit connector (terminal #7) and temperature sender connector.

b. Lamp Is On When Ignition Is On

1. Disconnect 18 dark green wire to temperature sender at connector near front of intake manifold.
2. If lamp goes out, replace temperature sender.
3. If lamp remains on, remove 2 nuts which secure steering column to bracket and allow column to lower column for access to ignition switch.
4. Disconnect electrical connector from ignition switch.
5. If lamp goes out, replace ignition switch.
6. If lamp remains on, remove instrument panel top cover, (Page 8-44) for access to printed circuit and connector. Check for an open in the printed circuit. Replace if open.
7. Disconnect printed circuit connector and check the following wires for a grounded condition:

a. 18 dark green wire between printed circuit connector (terminal #7) and temperature sender connector.

b. 18 dark green wire between printed circuit connector (terminal #7) and ignition switch.

Seat Belt Warning Light and Chime ("Fasten Belts") (Fig. 8-78)

Operation of System

1. With driver's seat belt buckled, and the ignition "on", the telltale "seat belt" **light** should come on for approximately 4-8 seconds.
2. With the driver's seat belt unbuckled and the ignition in "on", the "seat belt" **light and** the seat belt warning **chime** should come on for 4-8 seconds.

NOTE: A cool down period of approximately 3 minutes should be allowed between successive functional checks of the system. If the cool-down is not allowed, the system may be inoperative.

WARNING: DO NOT TOUCH TIMER AFTER IGNITION IS ON. THE TIMER HOUSING REACHES TEMPERATURES OF (66-82)°C (150°-180°F).

a. Light Does Not Come On

1. Remove instrument panel top cover (Page 8-44) and check for burned out bulb.
2. If bulb is okay, inspect printed circuit for an open conductor or connector and for proper connection. Replace if damaged.
3. If properly connected, remove connector from printed circuit and check for voltage at terminal #18 (gray/black wire) with ignition on.
4. If voltage is **not** available, the gray/black wire is open between the timer and the #18 terminal of the printed circuit connector.
5. If voltage **is** available, check the 18 black wire (terminal #1) for continuity between the connector and the timer.

b. Light Will Not Go Out

1. Remove instrument panel top cover (Page 8-44). Remove printed circuit connector.
2. Check 18 gray/black wire (terminal #1) for grounded condition.
3. If wire is okay, check printed circuit or timer for a shorted condition.

c. Chime Does Not Operate (Telltale Light Operates)

1. Check for voltage at 18 brown wire at chime connector. Connect test light to ground. Sit in driver's seat, seat belt unbuckled and turn ignition on.

2. If voltage is **not** available repair open in 18 brown wire. Turn Ignition off.

3. If volatage **is** available connect a jumper wire from the 18 yellow/black wire at the chime to ground. Turn ignition on.

4. If chime does **not** operate, replace chime.

5. If chime **does** operate check for open in 18 yellow/black wire.

6. If wire is not open, connect a self powered test light to seat switch connector. Do **not** sit on seat.

7. If test light does **not** glow, replace seat switch.

8. If test light glows check 18 black wire (body side) at seat switch connector to make certain it **is** grounded.

9. Replace timer if all above tests do not indicate a problem.

Engine Metal Temperature Indicator Circuit ("Stop Engine Temperature")

When engine metal temperature exceeds 216°C (420°F) the engine temperature switch closes.

In addition to indicating an engine overheating condition, the red "stop engine temperature" warning lamp should come on whenever the ignition key warning buzzer sounds (key in lock, ignition off and driver's door open).

a. Lamp Fails To Come On

1. Disconnect the 18 light green wire from the metal temperature switch at the side of the left cylinder lead and ground the wire.

2. If lamp comes on and buzzer sounds, replace temperature switch.

3. If lamp remains off, check for an open horn circuit breaker.

4. If circuit breaker is okay, remove instrument panel top cover (Page 8-44) and check for burned out bulb.

5. If bulb is okay, inspect printed circuit and connector for an open.

6. If bulb circuit and connector are okay, remove printed circuit connector and check for continuity between terminal #14 and temperature switch.

7. If continuity is indicated, check for voltage at the #15 terminal of the printed circuit connector (16 orange/black wire).

8. If voltage is indicated, there is an open in the 18 black/pink wire between the #14 printed circuit connector and the "FX" terminal or twe 18 light green wire between the "FX" terminal and the temperature switch.

9. If voltage is **not** indicated, there is an open in the 16 orange/black wire between the connector and the fuse block.

b. Lamp Fails To Go Out

1. Disconnect 18 light green wire at metal temperature switch at side of left cylinder head.

2. If lamp goes out, replace temperature switch.

3. If lamp remains on, the 18 light green wire between the temperature switch the "FX" terminal of the bulkhead connector is grounded or the 18 black/pink wire between the bulkhead connector "FX" terminal and terminal #14 of the printed circuit connector is grounded.

Horn Operation and Testing (Fig. 8-81 thru 84)

Conditions that may affect horn performance and procedures for checking these conditions are listed below:

1. Actuate horn by depressing the steering wheel pad in any area. Horn should blow. If horn fails to blow, proceed to Step 2.

2. While horn is energized, tap horn lightly. If horn blows, proceed to Step 3. If horn fails to blow, refer to Step 6 of this procedure.

3. Release cushion so that horn will stop blowing.

4. Energize horn again. If horn blows normally, a particle of foreign material between the contact points caused the trouble and no adjustment is necessary.

5. If horn still fails to blow when tapped, turn adjustment screw. Fig. 8-84, one full turn **counterclockwise.**

NOTE: This adjustment is sensitive. Do not turn screw more than one full turn or in wrong direction (clockwise). Misadjustment will require removing horn for adjustment on bench as described in Part d. below.

6. Check horn for normal operation. If still inoperative, inspect circuit breaker to assure power is available, then perform the following checks.

a. On all models connect a jumper lead to number "3" and number "1" terminals of horn relay. If horn blows, trouble is in relay, steering wheel pad switching or wiring. Remove jumper lead.

b. To determine whether steering wheel pad switches or wiring is at fault, ground number "2" (number "3" on Seville) terminal of relay. If horn blows, pad contacts or wiring is at fault.

c. Use a jumper from an area cleared of paint on horn bracket to grounded metal on radiator cradle (wheelhouse on Seville).

Check for no ground due to corrosion or paint on bolt threads. If horn blows, clean bolt threads and horn bracket surfaces which mate with radiator cradle (fender and wheelhouse on Seville).

d. If horn does not blow and wiring between battery and relay is okay, connect a voltmeter between terminal on the horn and a paint free area on the radiator cradle (wheelhouse on Seville).

Connect a jumper lead to number "3" and number "1" terminals of relay and note voltmeter reading.

e. If no voltmeter reading is obtained, wiring between relay and horn is open.

f. If voltmeter reading is less than 7.0 volts, trouble is due to high resistance connections in battery connection or wiring.

g. If voltmeter reading is above 7.0 volts, trouble is due to a faulty horn. In this case, test horn for current draw.

7. If no trouble is located during these checks and horn is still inoperative, remove horn for a bench check.

a. Horn Tone Poor

1. Harsh tone - caused by loose bolts in sheet metal mounting area.

2. Low pitch moan - sounds like "moo-ing" and is caused by too high a current. Horn needs adjusting.

3. Weak tone - caused by too low a current. Horn needs adjusting.

4. Weak strained tone - foreign body in horn that should be shaken out or removed.

5. Harsh vibration - caused by horn touching sheet metal. Bracket should be bent to give horn clearance and freedom from interference.

b. Horn Blows Constantly

1. This can be caused by sticking horn contacts in the relay, or horn pad.

2. Horn relay may be energized by grounded or shorted wiring.

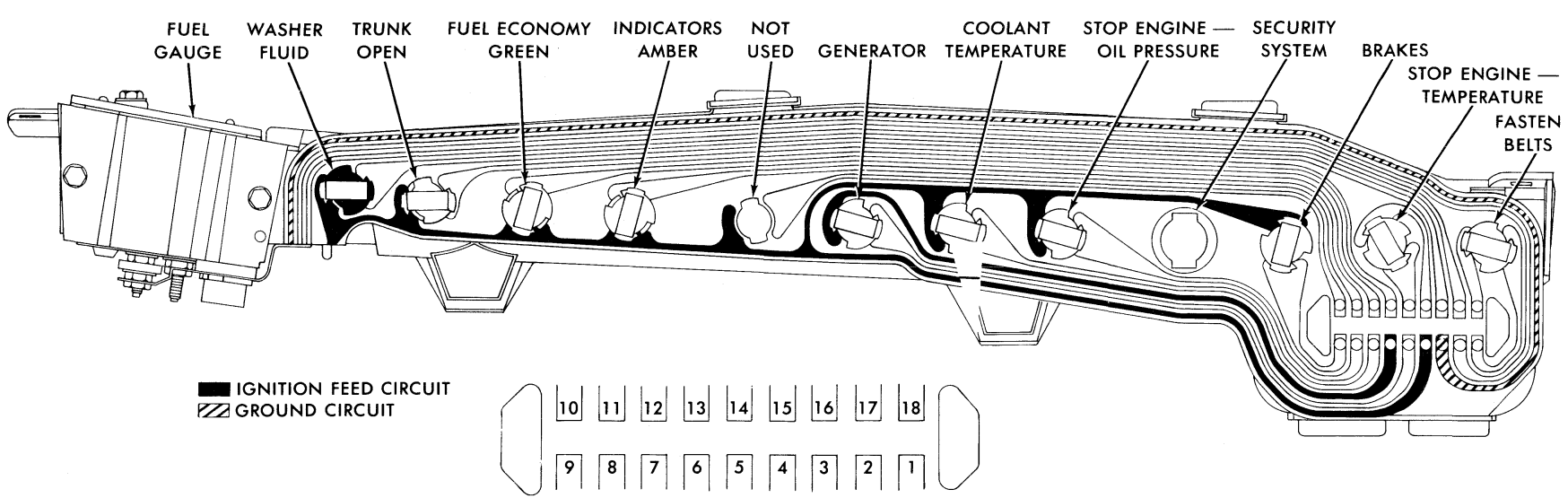


Fig. 8-79 Telltale Cluster Printed Circuit (Seville)

TELLTALE WARNING CLUSTER PRINTED CIRCUIT LEGEND (SEVILLE)

No. and Circuit		Wiring Color Code
1	Fasten Seat Belts (Ground)	18 Black
2	Fuel Gage Illumination (Feed)	18 Gray
3	Ground	18 Black
4	Ignition (Feed Circuit)	18 Pink
5	Generator (Ground)	16 Brown
6	Generator (Feed) (Ignition B+)	18 Yellow
7	Coolant Temperature	18 Dark Green
8	Stop Engine - Oil Pressure	18 Dark Blue
9	Brakes	18 Tan
10	Not Used	
11	Amber Dot - Economy	18 Natural White
12	Green Dot - Economy	18 Yellow
13	Trunk Open	18 Dark Green
14	Engine Metal Temperature (Ground)	18 Black w/Pink Stripe
15	Engine Metal Temperature (Feed)	16 Orange w/Black Stripe
16	Washer Fluid	18 Black w/White Stripe
17	Fuel Gage Sender	18 Tan
18	Fasten Seat Belts (Feed)	18 Gray w/Black Stripe

NOTE: Burned open windings on most horns are caused by one of the above malfunctions. Before horns with open windings are replaced by new horns, make sure that none of the above conditions exist, or the horn windings will again burn open.

c. Bench Checks

1. Measure current draw of horn while horn is operating. Current draw for each horn should be between (4.5 and 5.5) amperes at (11.5 to 12.5) volts.

2. No current may indicate a broken connection or an

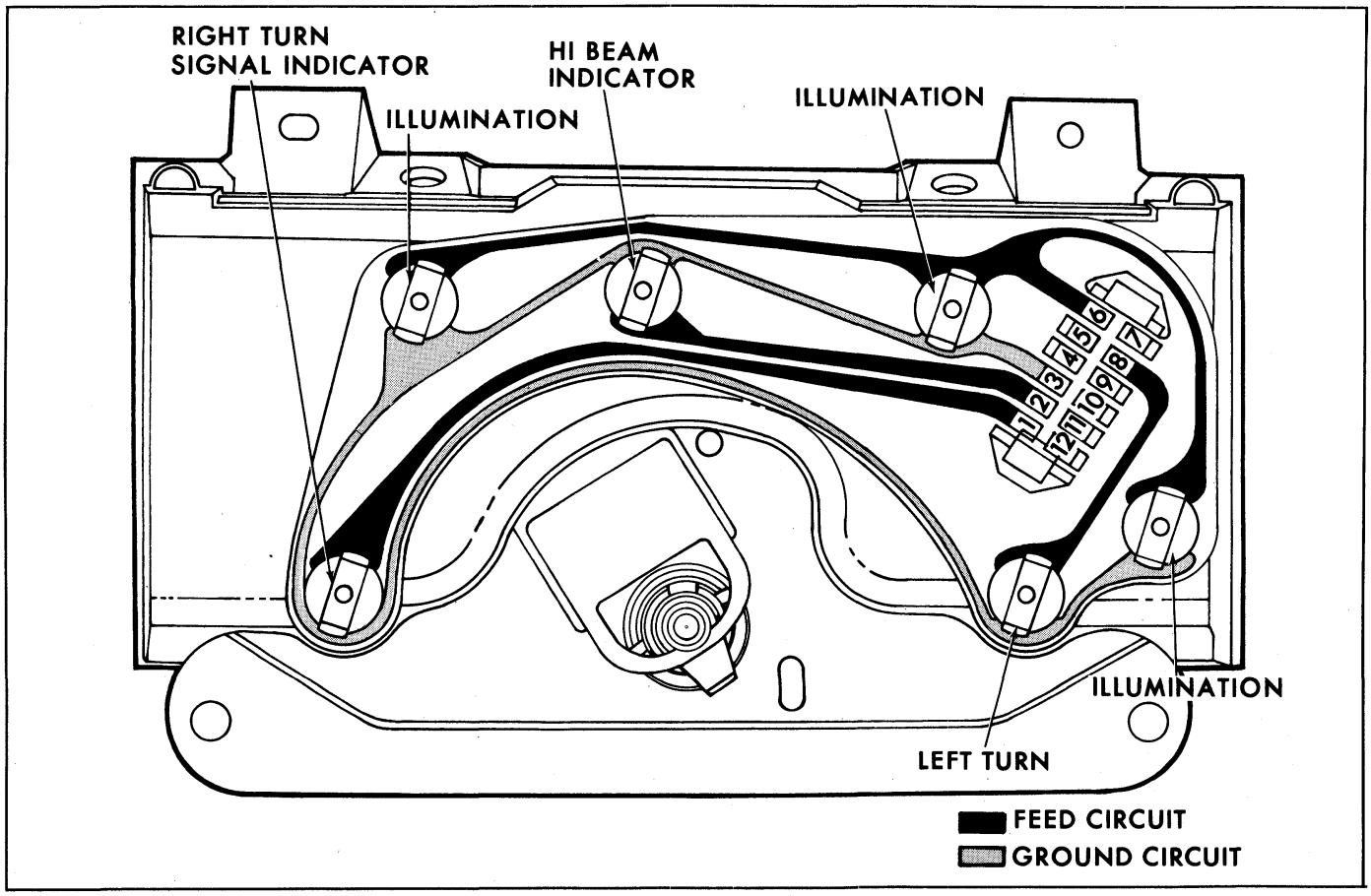


Fig. 8-80 Speedometer Cluster Printed Circuit (Eldorado and Seville)

SPEEDOMETER PRINTED CIRCUIT LEGEND (ELDORADO AND SEVILLE)

No. and Circuit		Wiring Color Code
1	R.H. Turn Indicator	18 Dark Blue
2	HiBeam Indicator	18 Light Green
3	Ground	16 Black
4	Not Used	
5	Not Used	
6	Illumination	18 Gray
7	Not Used	
8	L.H. Turn Indicator	18 Light Blue with Black Stripe
9	Not Used	
10	Not Used	
11	Not Used	
12	Not Used	

open circuit due to a broken lead or to overheating. Most horn problems are caused by horns being operated continuously, which develops sufficient heat to melt the wires in the winding, causing an open circuit.

Overheating is accompanied by a characteristic odor which indicates that horn has overheated and should be replaced.

3. No current can also indicate that the contact points are open and a current adjustment is required. Turn adjusting screw counterclockwise.

4. High current, over 20 amperes, indicates an overheated winding or shorted horn which should be replaced.

5. A reading of approximately 18 amperes for a 12-volt horn indicates a condition in which the contact points are not opening. A current adjustment is required by turning the adjustment screw clockwise.

d. Current Adjustment

Turn adjusting screw, Fig. 8-84, counterclockwise to increase current or clockwise to decrease current until specified current is reached. Care must be taken not to turn the adjusting screw too far. Turn screw 1/4 of a turn at one time. If adjustment loosens the screw excessively, it may be staked with a punch.

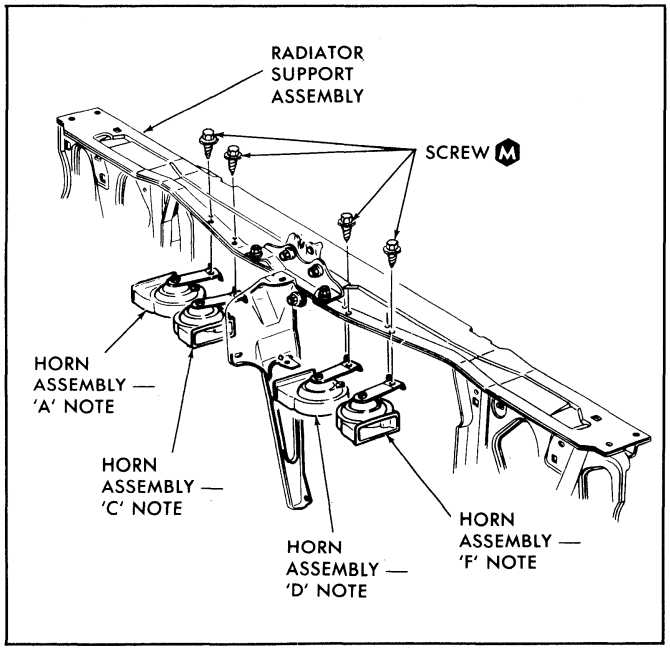


Fig. 8-81 Horn Location and Attachment (Except Eldorado and Seville)

e. Cold Weather Adjustment

If horn fails to blow in cold weather, it is possible that current limit is set too low although still within (4.5 and 5.5)

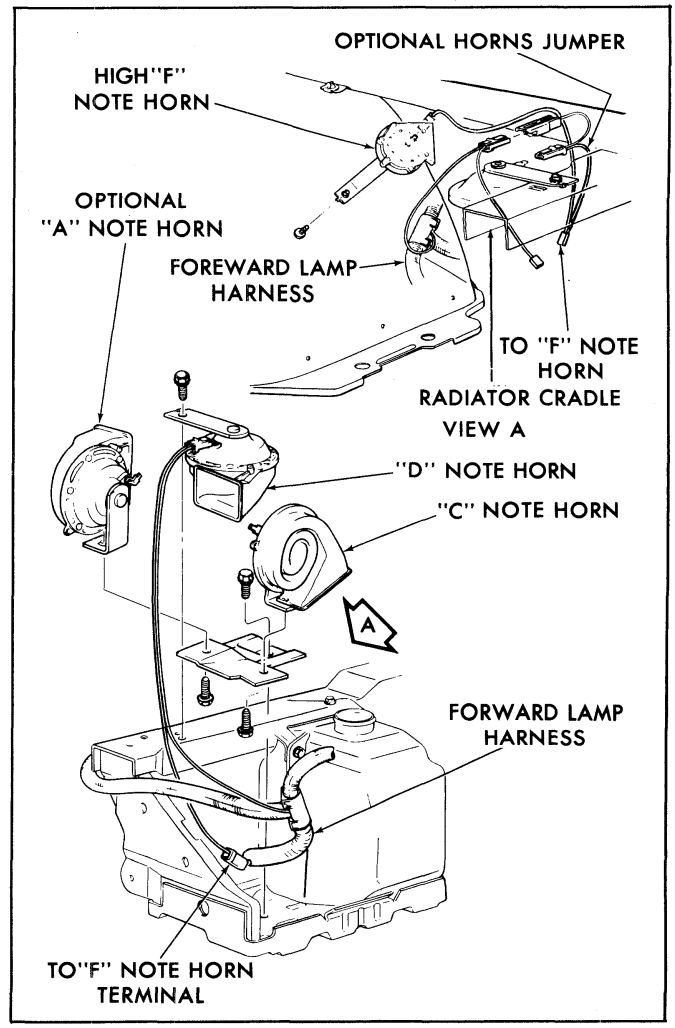


Fig. 8-82 Horns and Mounting Bracket - (Eldorado)

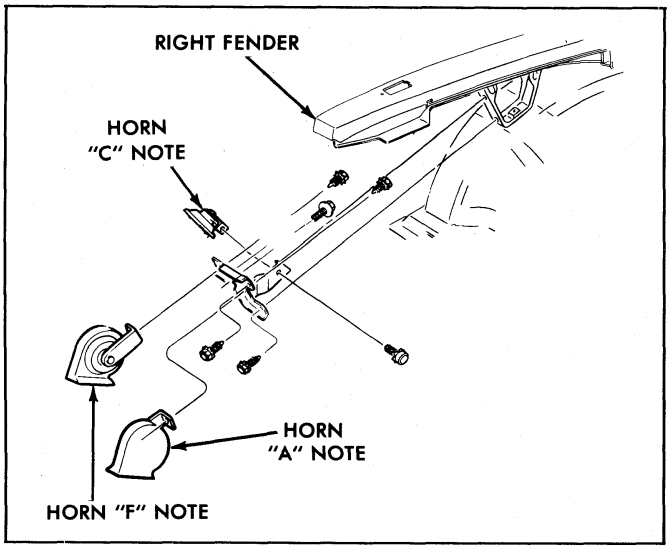


Fig. 8-83 Horn Location and Attachment - (Seville)

ampere limit (each horn) at 12.0 volts. Turn adjusting screw 1/4 turn counterclockwise (90°) to increase draw, Fig. 8-84.

CAUTION: *This adjustment should not be made unless horn fails to blow. A current increase on a properly operating horn can result in complete malfunction of the horn.*

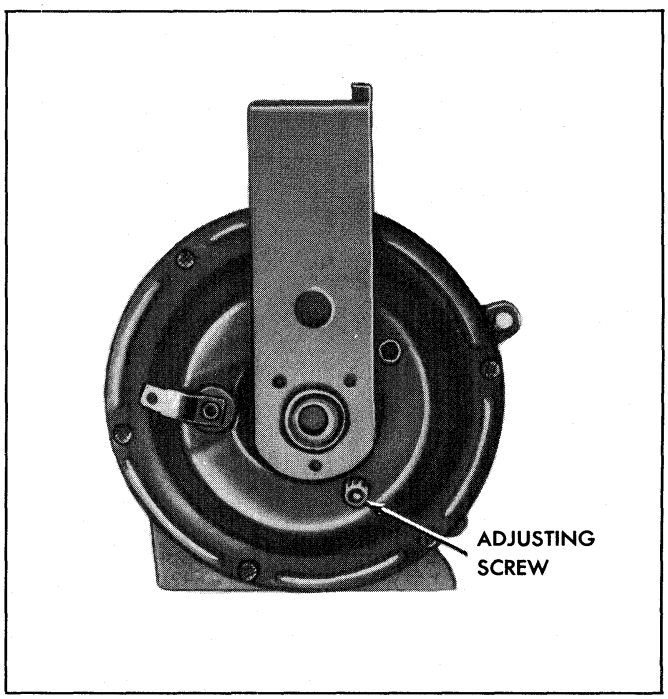


Fig. 8-84 Horn Adjusting Screw

ON-CAR SERVICE

Clock Resetting

The reset knob projects from the upper right hand corner of the clock. To reset, pull reset knob all the way out and turn until desired time is obtained. When resetting, be sure numbers are centered in window. After resetting, push knob all the way in.

If timekeeping characteristics of the clock become erratic, it should be removed and sent to the manufacturer.

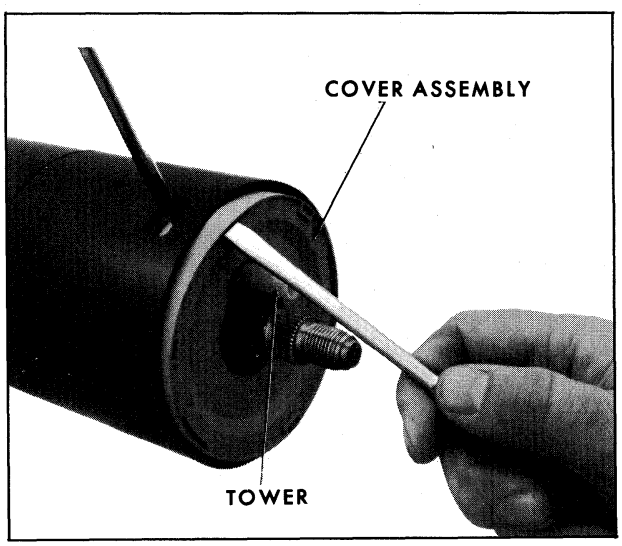


Fig. 8-85 Cover Plate and Mounting Screws

Turn Signal Switch Replacement-Standard Column

1. Disconnect negative battery cable.
2. Remove steering wheel as described in Section 3B, Page 3B-62.
3. Using a thin blade screw driver remove lock plate cover assembly, Fig. 8-85.
4. Install spring compressor J-23131, on steering shaft, Fig. 8-86.
5. Compress lock plate and spring. Remove snap ring and discard, Fig. 8-86.

CAUTION: *Shaft could slide out of bottom of column when snap ring is removed, causing damage to shaft.*

6. Remove lock plate by sliding up and off upper shaft.
7. Slide turn signal cancelling cam, upper bearing preload spring and thrust washer off upper steering shaft.

CAUTION: *Care should be taken at this point as steering shaft is free to move and could slide out of column.*

8. Remove lower steering column cover as described on page 8-41 (exc. Eldorado and Seville) or page 8-21 (Eldorado) or page 8-41 (Seville).
9. Remove screw securing turn signal lever and remove lever from column.
10. Remove two vertical bolts at steering column upper support. Remove shim packs, maintain shims as a unit, for installation.
11. Remove four screws (2 each side) securing column upper mounting bracket to column and remove bracket.
12. Disconnect turn signal harness from car harness and remove wires from plastic protector.

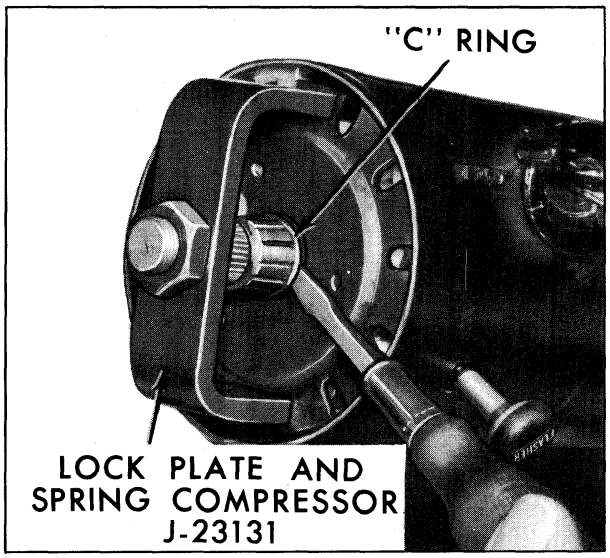


Fig. 8-86 Removing and Installing "C" Ring

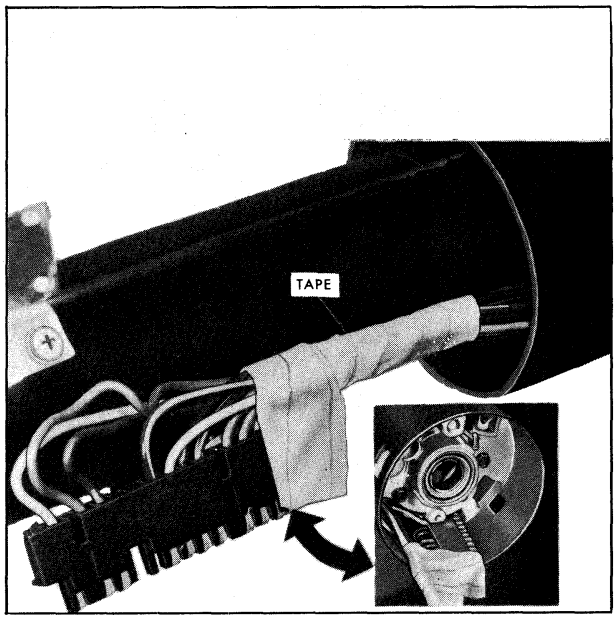


Fig. 8-87 Taping Turn Signal Switch Connector

13. Remove three screws securing turn signal switch to column and pull switch out of position in shift bowl.

14. If switch is known to be bad, cut wires from switch and discard switch. Tape new switch connector to old harness and carefully pull new harness down through column as old harness is removed. Proceed to Step 16.

15. If existing switch is to be reused, wrap a piece of tape around the harness and a length of wire as shown in Fig. 8-87, and carefully pull the harness up through the column.

16. To install switch, tape end of harness to wire as shown in Fig. 8-87 and carefully feed harness down through column.

17. Secure switch to shift bowl with three screws.

18. Install thrust washer, upper bearing preload spring and turn signal cancelling cam on steering shaft.

19. Install lock plate with large flat on plate aligned with flat on steering shaft.

20. Place a **new** snap ring on upper end of steering shaft.

21. Install spring compressor, J-23131, on steering shaft, Fig. 8-86.

22. Compress lock plate and spring and slide **new** snap ring down shaft until ring locks in groove.

23. Remove spring compressor, J-23131.

24. Position cover plate to steering column and secure with three screws.

25. Install steering wheel as described on Page 3B-62.

26. Install turn signal lever and secure with screw.

27. Remove tape from end of harness and connect switch and cruise control (if equipped) to ear harness.

28. Cover both harnesses with plastic protector and position to column. Turn signal connector slides on tabs of column.

29. Position steering column upper bracket over turn signal switch harness plastic protector and install four screws holding bracket to column (2 each side). Tighten screws to 20 foot-pounds.

30. Loosely install two vertical mounting bracket screws. Install shims in same quantity and location as found when bracket was removed.

31. Align steering column as described on Page 3B-64 (Eldorado and Seville). Tighten vertical screws to 20 foot-pounds.

32. Install lower steering column cover as described on Page 8-4 (exc. Eldorado and Seville) or Page 8-21 (Eldorado) or Page 8-41 (Seville).

Turn Signal Switch Replacement-Tilt and Telescope Column

1. Disconnect negative battery cable.

2. Remove steering wheel as described in Section 3B, on Page 3B-62.

3. Slide rubber sleeve bumper from steering shaft.

4. Remove plastic retainer, using small screwdriver to disengage tabs on retainer from C-ring.

5. Install spring compressor J-23063 on steering shaft, Fig. 8-88, threading bolt into steering shaft lock hole.

NOTE: When installing spring compressor, pull upper shaft up 1" from bottomed position then turn ignition to Lock to hold shaft in place.

6. Compress upper steering shaft prload spring and remove C-ring, Fig. 8-88.

7. Remove spring compressor, J-23063, and remove upper steering shaft lock plate, horn contact carrier and upper steering shaft preload spring.

8. Remove lower steering column cover as described on Page 8-4 (exc. Eldorado and Seville) or Page 8-21 (Eldorado) or Page 8-41 (Seville).

9. Remove securing turn signal lever and remove lever from column.

NOTE: On cars equipped with cruise control, perform the following procedure.

a. Disconnect cruise control wire from car harness near bottom of column.

b. Slide harness protector off of cruise control wire.

c. Remove screw securing turn signal lever and gently pull lever out just enough to allow for removal of turn signal switch.

10. Remove two vertical bolts at steering column upper support. Remove shim packs. Maintain shims as a unit, for installation.

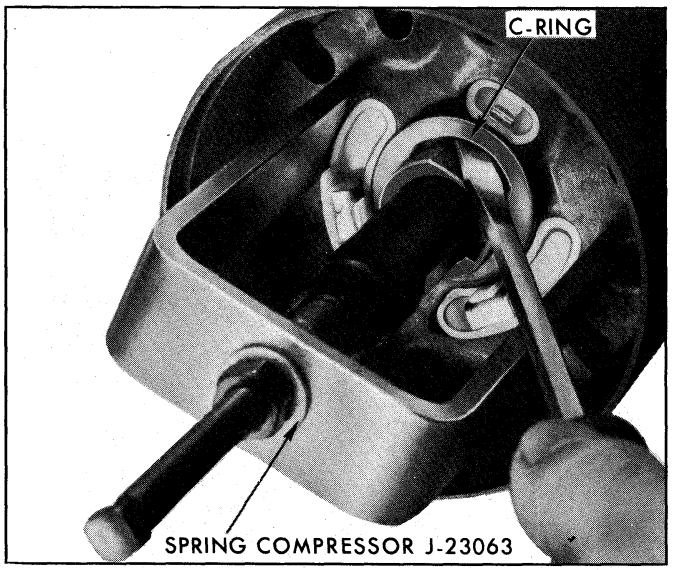


Fig. 8-88 Installing Spring Compressor

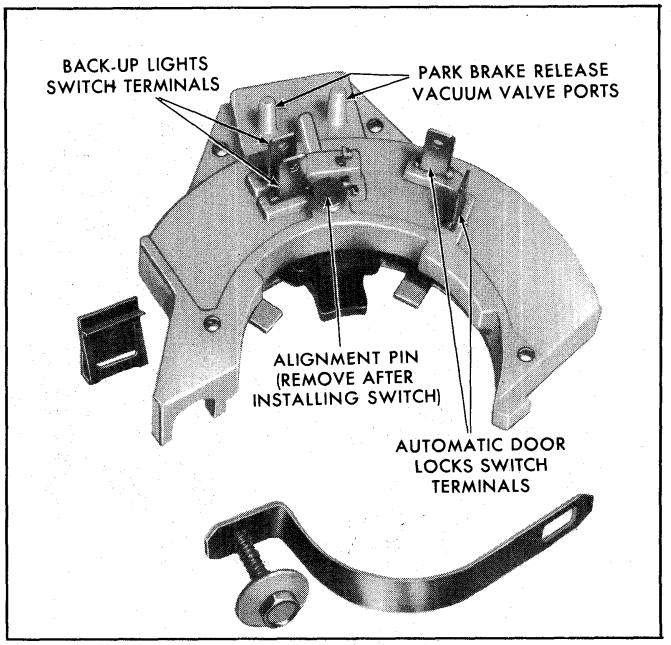


Fig. 8-89 Back Up Light Switch (All Models)

11. Remove four screws (2 each side) securing column upper mounting bracket to column and remove bracket.

12. Disconnect turn signal harness from car harness and remove wires from plastic protector.

13. Remove three screws securing turn signal switch to column and pull switch out of position in shift bowl.

14. If switch is known to be bad, cut wires from switch and discard switch. Tape new switch connector to old harness and carefully pull new harness down through column as old harness is removed. Proceed to Step 16.

15. If existing switch is to be reused, wrap a piece of tape around the harness and a length of wire as shown in Fig. 8-87, and carefully pull the harness up through the column.

16. To install switch, tape end of harness to wire as shown in Fig. 8-87 and carefully feed harness down through column.

17. Secure switch to shift bowl with three screws.

18. Install turn signal lever.

19. Install upper steering shaft preload spring.

20. Install lock plate and carrier assembly.

NOTE: When installing lock plate and carrier assembly, make sure flat on lower end of steering shaft is pointing up and that the small plastic tab on the carrier is up or nearest the top of the shift bowl. Flat surface of lock plate must be installed facing down (against turn signal switch.)

21. Install spring compressor, J-23063. Compress preload spring and lock plate and install C-ring with wide side toward keyway.

22. Remove spring compressor, J-23063.

23. Install plastic retainer on C-ring.

24. Install rubber sleeve bumper over steering shaft.

25. Install steering wheel as described in Section 3B, on Page 3B-62.

NOTE: On cars equipped with cruise control, use the following procedure.

a. Position turn signal lever on switch.

b. Secure lever to switch with retaining screw, installing harness as lever is installed.

26. Remove tape from end of harness and connect switch and cruise control (if equipped) to car harness.

27. Cover both harnesses with plastic protector and position to column. Turn signal connector slides on tabs of column.

28. Position steering column upper bracket over turn signal switch harness plastic protector and install four screws holding bracket to column (2 each side). Tighten screws to 20 foot-pounds.

29. Loosely install two vertical mounting bracket screws. Install shims in same quantity and location as found when bracket was removed.

30. Align steering column as described on Page 3B-64 (Eldorado and Seville). Tighten vertical screws to 20 foot-pounds.

31. Install lower steering column cover as described on Page 8-4 (exc. Eldorado and Seville) or Page 8-21 (Eldorado) or Page 8-41 (Seville).

Back-Up Light Switch (Fig. 8-89)

The back-up light switch, and parking brake vacuum release valve are combined into one unit mounted on the steering column under the instrument panel.

a. Removal

1. Place transmission shift lever in NEUTRAL position.

2. Remove screw in clamp and carefully remove switch and clamp from steering column, being careful not to disturb position of contact carrier.

3. Mark position of contact carrier.

4. Mark top vacuum hose for identification and remove hoses.

5. Disconnect wiring connector(s) from switch.

b. Installation

1. Place transmission shift lever in NEUTRAL detent.

2. Connect wiring connector(s) to switch.

3. Move contact carrier on switch assembly to neutral position as marked during removal. If necessary to install a new switch, the switch will be secured in neutral by an alignment pin. Do not remove pin.

4. Install switch assembly on steering column, aligning contact carrier blade with slot in shift tube. With switch light against column, slide switch down column until bosses on casting rest on bottom edge of slot in outer jacket. Bosses extend below the mounting surface.

5. Place clamp on switch and install screw to tighten clamp, making sure that shift lever is in NEUTRAL detent while this operation is performed.

6. Connect vacuum hoses to switch as marked during removal.

7. Switch should now be properly adjusted. If new switch was installed, it will be necessary to remove the alignment pin.

8. Check to be certain that back-up lights come on in REVERSE and that the park brake will release in drive. If car is equipped with automatic door locks check be certain that doors lock when in DRIVE with driver's seat occupied and ignition "ON".

Horn (Fig. 8-81, Except Eldorado and Seville)

a. Removal

1. Remove front end panel filler attaching screws and remove filler.
2. Disconnect horn wire electrical connector at horn.
3. Remove screw securing horn to radiator support and remove horn.

b. Installation

1. Secure horn assembly to underside of radiator support with attaching screw tightening to (27-34) N·m (20-25 ft.-lbs.).
2. Connect horn wire electrical connector to horn.
3. Install front end panel filler and secure with attachment screws. Tighten to (5-7.5) N·m (45-65 in.-lbs.).

Horn (Fig. 8-82, Eldorado)

Removal and Installation

Two horns are mounted on the left side of the radiator support on a mounting bracket and are secured to the bracket by one screw per horn. Another horn is attached directly to the radiator cradle tie bar by one screw. The remaining horn is mounted on the front side of the left front wheelhouse and is also secured by one screw. All horns may be removed by removing the mounting screw and disconnecting the electrical connector at the horn. Tighten mounting screw to 25-30 ft. lbs. on installation;

Horns (Fig. 8-83, Seville)

a. Removal

1. Remove battery.
2. Disconnect horn wiring jumper harness from forward lamp harness.
3. Remove 2 screws securing horn bracket to right front fender bracket.
4. Remove screws securing horns to mounting bracket.

b. Installation

1. Assemble horns to mounting bracket and secure with screws.
2. Attach horn bracket to right hand fender bracket with 2 screws.
3. Connect horn wiring jumper harness to forward lamp harness.
4. Install battery and tighten battery cable screws to 80 inch pounds.
5. Check horn operation.

LAMP MONITOR SYSTEM

GENERAL DESCRIPTION

The Lamp Monitor system is standard equipment on all cars. It allows the driver to visually check the operation of the exterior lamps without leaving the vehicle. This is accomplished through the use of light conductors. The conductors are used to transfer light from the individual exterior lamp to its respective monitor (Fig. 8-53). The system does not use electrical power in order to operate, nor does it have any moving parts.

Three individual lamp monitors are used. One monitor is mounted on top of each front fender, and one at the center of the headliner, immediately above the rear window.

The front lamp monitor high beam headlamp indicator lens is blue and thus matches the high beam headlamp indicator in the speedometer face. The high beam fiber optic has a blue identification marking near each end.

The front lamp monitor low beam headlamp indicator lens is clear. The fiber optic transmits the light directly from the low beam headlamps and is identified by a white marking near each end.

The park and turn signal lamp monitor lens is, also clear. The fiber optic transmits the amber light from the park and turn signal lamp. There is no marking on the fiber optic.

Each lamp monitored, except headlamps, has a pickup mounted in the housing; the headlamp pickup is located in the connector on the wiring harness and picks up the light from the sealed beam unit nipple.

The rear monitor indicates each tail lamp on the respective side of the vehicle.

Refer to body service manual for servicing rear lamp monitor.

DIAGNOSIS

Monitor Inoperative

1. Check bulb in lamp connected to inoperative monitor.
2. If bulb is burned out, replace bulb. If lamp operates normally, proceed with further checks.
3. Check for proper installation of conductors to sealed beam or lamp housing as required. If correct, proceed to Step 4.
4. Check conductor harness mounting to lamp monitors for proper attachment.
5. Check conductor harness routing for pinched or

severely bent condition.

6. If none of the above checks reveals the inoperative condition, the conductor light fibers have probably been damaged. Replace conductors as required.

ON-CAR SERVICE

Service information pertaining to the Lamp Monitor System may be found on Page 8-68 for all models except Eldorado and Seville. Refer to Page 8-71 for Eldorado and Page 8-76 for Seville.

WINDSHIELD WIPER SYSTEM

GENERAL DESCRIPTION

Service information pertaining to the windshield wiper and washer system not found in this section is covered in the Body Service Manual.

Windshield Wiper Electrical Operation

The wiper switch for Eldorado and Seville is shown in Fig. 8-90. The switch for remaining models is the same except that the control switch lever follows a horizontal path instead of an "L" shape as shown.

LOW SPEED - Moving the control switch lever to the "Lo" speed position, Fig. 8-90, connects the relay control and shunt field circuit directly to ground, Fig. 8-91. This provides the following circuit:

Current feed to the 25 amp windshield wiper fuse in the fuse panel comes from the accessory terminal on the ignition switch. Current flows through the yellow wire to terminal number 2 of the wiper motor. It then flows through the tan wire to one contact point on the relay switch, and on through the relay coil and through the red wire back to terminal No. 1, through the light blue wire and the switch to ground. After passing through the relay points, current flows through the black with double pink tracer wire through the series field and divides; part flowing through the armature and circuit breaker and through the black ground wire, the other part flowing through the shunt field, the solid black wire to terminal number three, and on through the black with double orange tracer wire to ground at the control switch. Current by-passes the 20 ohm resistor ground circuit at terminal No. 3 at this time, because of the lower resistance of the control switch ground circuit.

MEDIUM SPEED - Moving the control switch to the "Medium" speed position, Fig. 8-90, connects a 13 ohm resistor, located in the control switch, in parallel with the 20 ohm resistor connected from the shunt field circuit. These two resistors, connected in parallel, provide slightly less than 8 ohms resistance in the shunt field, allowing less current to flow in the shunt field. This permits correspondingly more current in the armature circuit, resulting in medium speed.

HIGH SPEED - Moving the control switch lever to the "High" speed position, Fig. 8-90, eliminates the path to ground in the control switch, leaving only the 20 ohm resistor in the shunt circuit. This one resistor allows even less current to flow through the shunt field than was possible at either medium or low speeds, which results in high speed operation.

MIST - Moving the control lever to the "Mist" position, Fig. 8-90, and holding there until the wipers move out of the park position before releasing, will allow the wipers to make one complete low speed cycle wipe of the windshield and return to the park position.

Washer Circuit

Depressing the washer button on the control switch, Fig. 8-90, mechanically moves the wiper switch lever to the "Lo" speed position. The washer relay coil is energized by the current flowing from the No. 2 terminal on the wiper unit connector through the yellow wire into the relay coil and from there through the dark blue wire to ground.

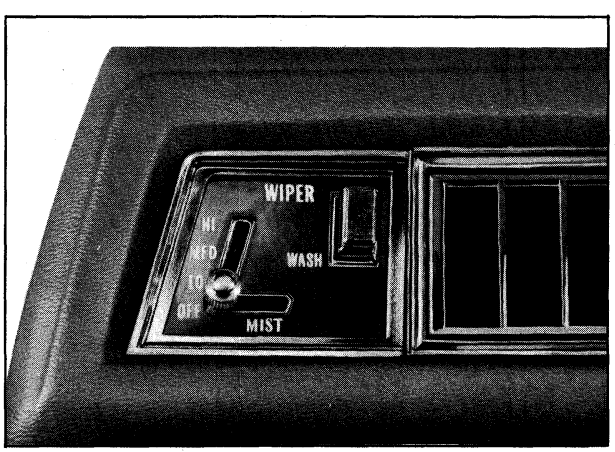


Fig. 8-90 Windshield Wiper Swtich (Eldorado and Seville)

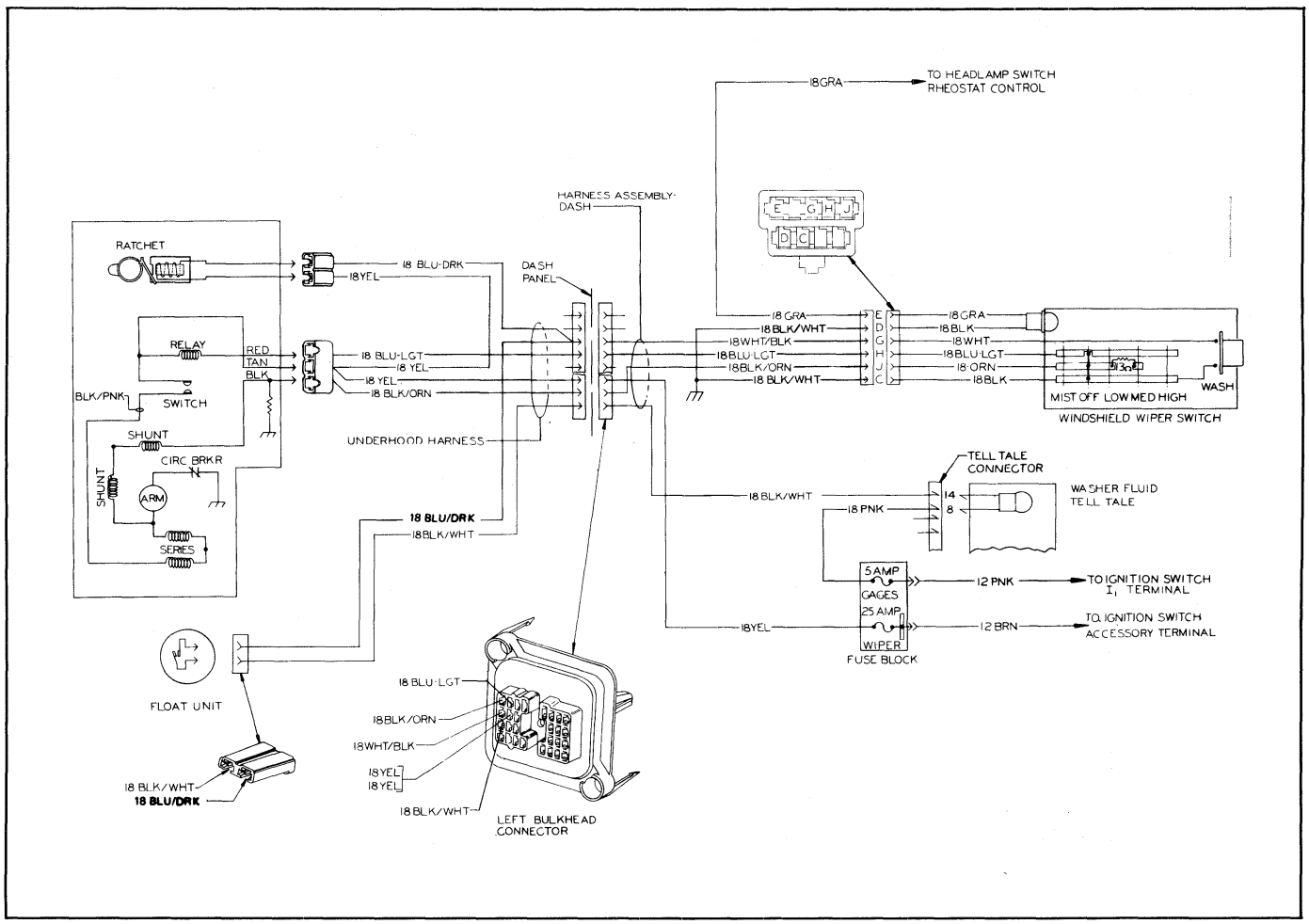


Fig. 8-91 Windshield Wiper Wiring Circuit Diagram (Eldorado)

Wiper Switch

Removal and Installation

Refer to Page 8-8 (except Eldorado and Seville) or Page 8-28 (Eldorado) for this procedure.

Controlled Cycle Wiper System Mechanical Features

The controlled cycle windshield wiper and washer system consists of a wiper unit which contains a 12-volt motor, a gear box section, a relay control, a pulse timing control, and a washer unit.

The wiper and washer assembly is controlled by a switch (driver control) located on the instrument panel.

The dash switch for wiper operation is actually two separate and distinct switches which, due to a cam action within the switch, can be controlled with one lever. The wipers can be operated at three different constant speeds or in a variable delay position.

The washers are activated by depressing the washer button which is integral with the switch. When the washer button is depressed, the wipers operate at low speed, even when in the delay mode. The washer delivers washer fluid to the windshield for eight complete wiper sweeps after the

WIPER SWITCH POSITION			
Lo	Med.	Hi	Delay
Wiper runs and washes in Lo speed	Wiper runs and washes in Medium speed	Wiper runs and washes In Hi speed	Delay operation is overridden. Wiper runs and washes in continuous Lo speed; completes wash cycle plus two drying cycles and then automatically resumes pulse operation.

button is depressed. After washer fluid delivery stops, the blades continue for two additional cycles to dry the glass, and then stop automatically (unless control switch in "ON").

If the dash switch is in any position other than "OFF", the washer system will operate as shown in the following chart.

NOTE: Depressing the dash switch "Wash" button does not mechanically move the wiper switch in the Lo Position. The wiper motor is turned on electrically.

When the wiper switch is positioned in the "Delay" Mode the lever can be moved from the "Min" to "Max" delay positions which will vary the amount of time the wipers will pause at the bottom of the windshield between wipes. The pause can vary from 0 to approximately 12 seconds. "Min" delay provides the equivalent of continuous Lo speed operation.

Complete washer and wiper circuit diagrams are shown in Fig. 8-92 (Eldorado and Seville) or on the fold-out Chassis Wiring Diagram in the back of the manual (except Eldorado and Seville). Washer fluid container attachment and hose routings are shown in Fig. 8-93. Washer fluid delivery height should be between twelve inches above the lower edge of the windshield and the top of the wiper blade sweep area. Fluid heights should be adjusted to these limits as described on Page 8-116. Linkage adjustment may be made as shown in Fig. 8-94.

Complete diagnosis and service procedures can be found in the Body Service Manual.

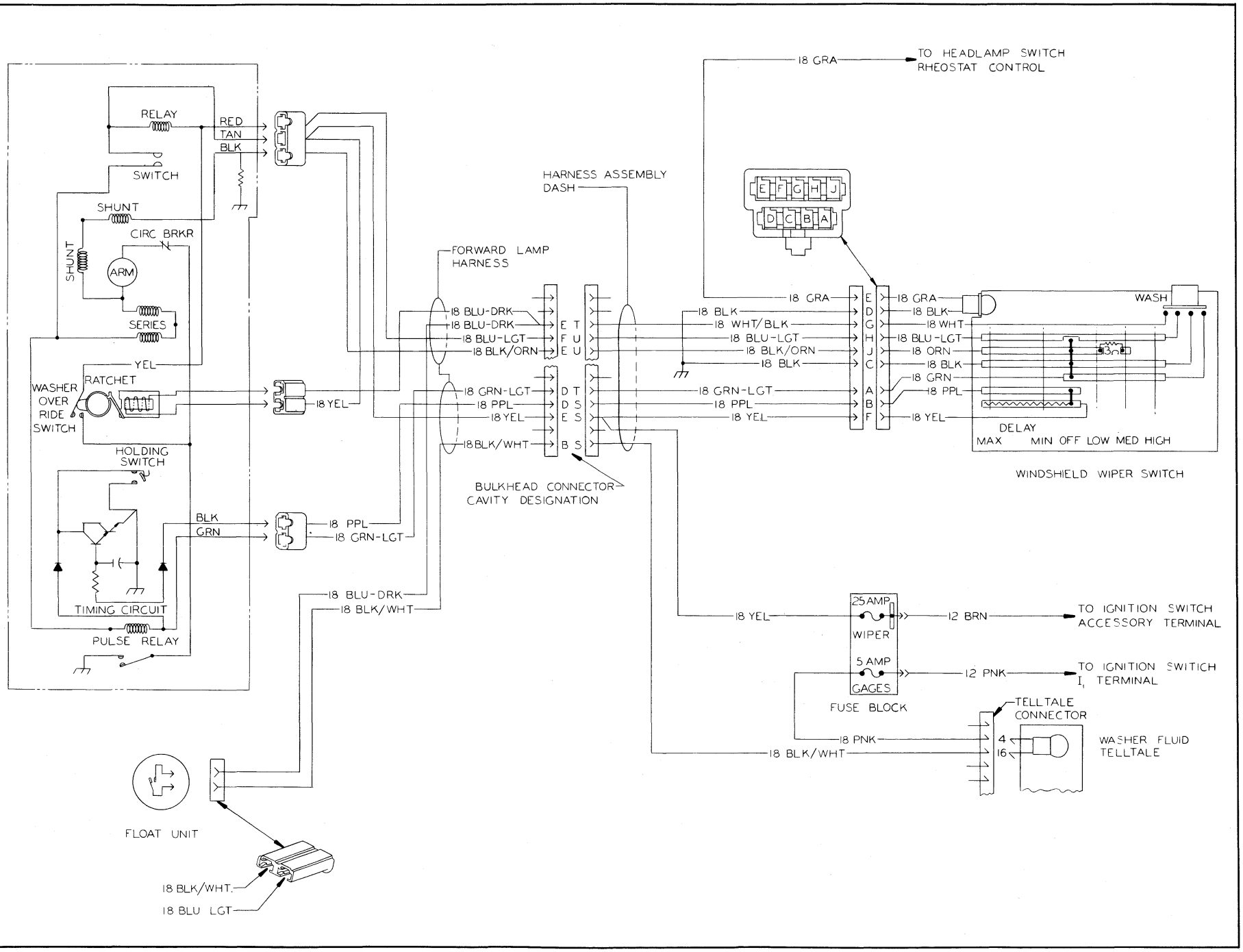


Fig. 8-92 Controlled Cycle Windshield Wiper Circuit Diagram - (Eldorado and Seville)

ON-CAR SERVICE

SEVILLE

Windshield Wiper Switch (Fig. 8-34)

a. Removal

1. Remove left climate control outlet grille as described on Page 8-41.

2. Working through outlet opening, remove screw securing switch to instrument panel.

3. Pull wiper switch and wiring out of panel, unlatch lock tab on connector and disconnect.

NOTE: Instrument panel half of connector is attached to the instrument panel support and should remain in place.

b. Installation

1. Connect switch wiring connector to instrument panel wiring connector.

2. Position switch into instrument panel opening and working through air outlet grille opening, secure with screw.

3. Install left climate control outlet grille as described on Page 8-41.

4. Check wiper and washer operation.

Windshield Wiper Motor (Figs. 8-93 and 8-94)

NOTE: Position windshield wipers in "Park" position for easiest access in removing linkage from wiper motor crank arm.

a. Removal

1. Open hood and disconnect electrical connectors and hoses from wiper and washer.

2. Through access opening below rear edge of hood loosen 2 fasteners securing linkage to wiper motor crankarm, see Fig. 8-94.

3. Remove 3 screws securing wiper to cowl.

b. Installation

1. Position wiper to cowl and secure with 3 screws.

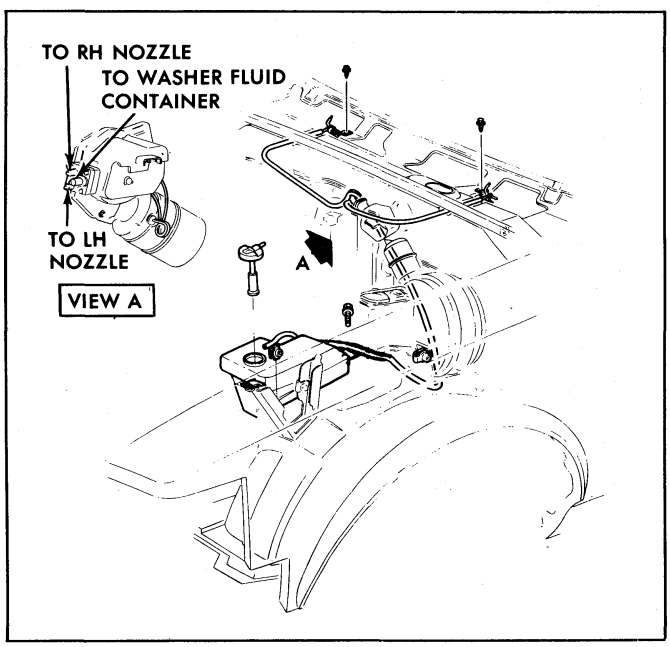


Fig. 8-93 Windshield Washer Installation (Seville)

2. Reaching through access opening, position linkage onto wiper crankarm (making certain that wiper arms are in full "Park" position) and tighten 2 fasteners.

NOTE: Should linkage drop into cowl, a small "J" hook can be used to lift it.

3. Connect electrical connectors and windshield washer hoses.

4. Check wiper and washer operation.

Windshield Washers Height Adjustment

1. Turn ignition key to "Accessory" position and depress "Wash" button.

2. Wipers should operate and washer fluid should squirt for approximately eight complete wiper cycles after button is depressed. Each stream of fluid should hit windshield in an area not lower than 12 inches above the lower reveal molding nor higher than the outer sweep area of the wiper blades.

3. If washers are not within adjustment specifications bend tube at base of each washer nozzle until stream hits within above limits.

Washer Solution Bottle (Fig. 8-93)

a. Removal

1. Disconnect washer fluid hose.

2. Disconnect low washer fluid telltale electrical connector.

3. Working from underside of wheelhouse, remove rear attaching screw.

4. Remove front attaching screw and remove bottle and float unit assembly.

b. Installation

1. Position washer fluid bottle onto left wheelhouse and secure with front screw.

2. Working from underside of wheelhouse secure rear side of washer fluid bottle with attaching screw.

3. Connect washer hose and low washer fluid telltale electrical connector.

4. Check operation of washers and low washer fluid telltale as described on Page 8-119.

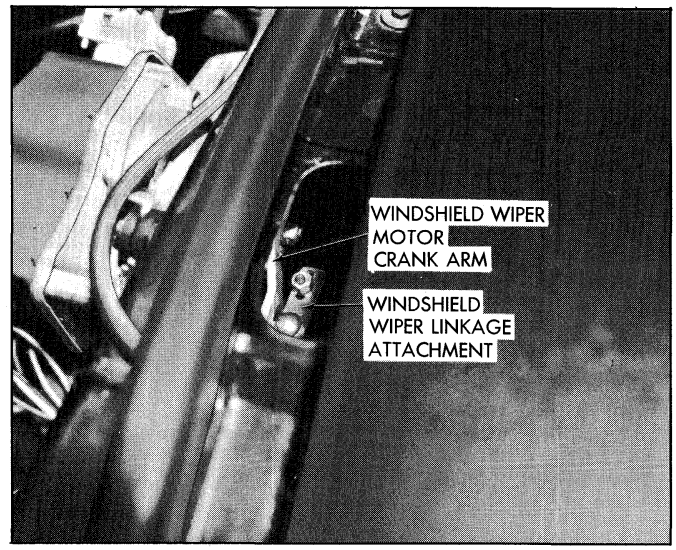


Fig. 8-94 Windshield Wiper Linkage Adjustment - (Seville)

WASHER FLUID LOW LEVEL INDICATOR (Exc. Seville)

GENERAL DESCRIPTION

A washer fluid low level indicator light is provided on all cars as standard equipment. The light is located on the left side of the tell tale housing. It is labeled "WASHER FLUID" and it glows amber when the fluid level in the windshield washer bottle drops below approximately 1/3 full and ignition switch is in "RUN" position. On all cars except Eldorado and Seville, the telltale glows when the wiper system is energized. On Eldorado, however, the telltale glows only when the "WASH" button is depressed.

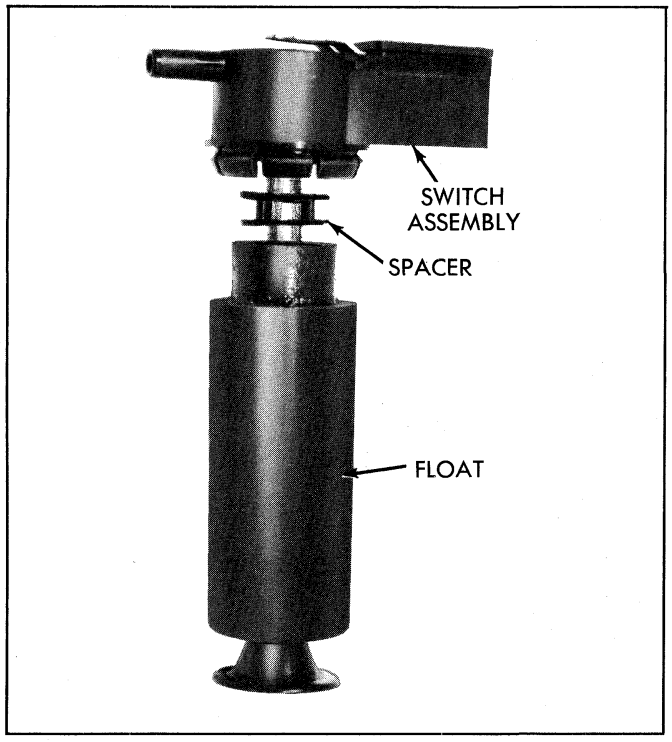


Fig. 8-95 Spring and Lever Type Float Unit

Engaging the wipers allows a small amount of current to flow from the wiper motor terminal through a #18 yellow wire to the washer bottle float unit. Fig. 8-95. When the fluid level in the washer bottle is low, the float drops and the spacer releases pressure from the lever assembly which activates an over center spring contact. This permits the contact points within the cap to close, and allows current to flow to the indicator light.

The indicator system operates in conjunction with the windshield wiper motor. A low fluid level condition will not be indicated to the driver unless the fluid level is below 1/3 full, windshield wipers are running (except Eldorado and Seville) and the washer button is depressed (Eldorado and Seville).

The complete float and cap unit must be replaced if inoperative.

CAUTION: *Use care when handling the float assembly, as the switch can be broken if subjected to a hard impact.*

Refer to body service manual for servicing windshield wiper and washer system.

DIAGNOSIS

Indicator Inoperative

Before proceeding to the diagnostic procedures make certain that the correct operating procedure for the system has been used. In order for the lamp to glow all the following must be followed.

1. Ignition switch in "RUN" position.
2. Fluid level below 1/3 full (or float unit removed from reservoir).
3. "WASH" button depressed.

If the above has been completed and the lamp does not glow proceed as follows:

4. Check for blown "gages" fuse, Fig's. 8-62 and 8-63.
5. Disconnect electrical connector from float unit, Fig. 8-96. Using a jumper wire connect the two wiring terminals to by-pass the float unit.
6. Turn ignition switch to "RUN" position. Depress "WASH" button on windshield wiper switch. "Washer Fluid" telltale should glow. If bulb does not glow, replace bulb.
7. Remove float unit assembly from washer bottle.
8. Connect a self powered test light to float unit terminals. Slide float up and down pick-up tube. Test light should glow when float is lowered and turn off as float is raised. If it does not, replace float unit.
9. If problem exists after float unit has been replaced, check electrical connections at switch, bulkhead connector and windshield wiper switch.

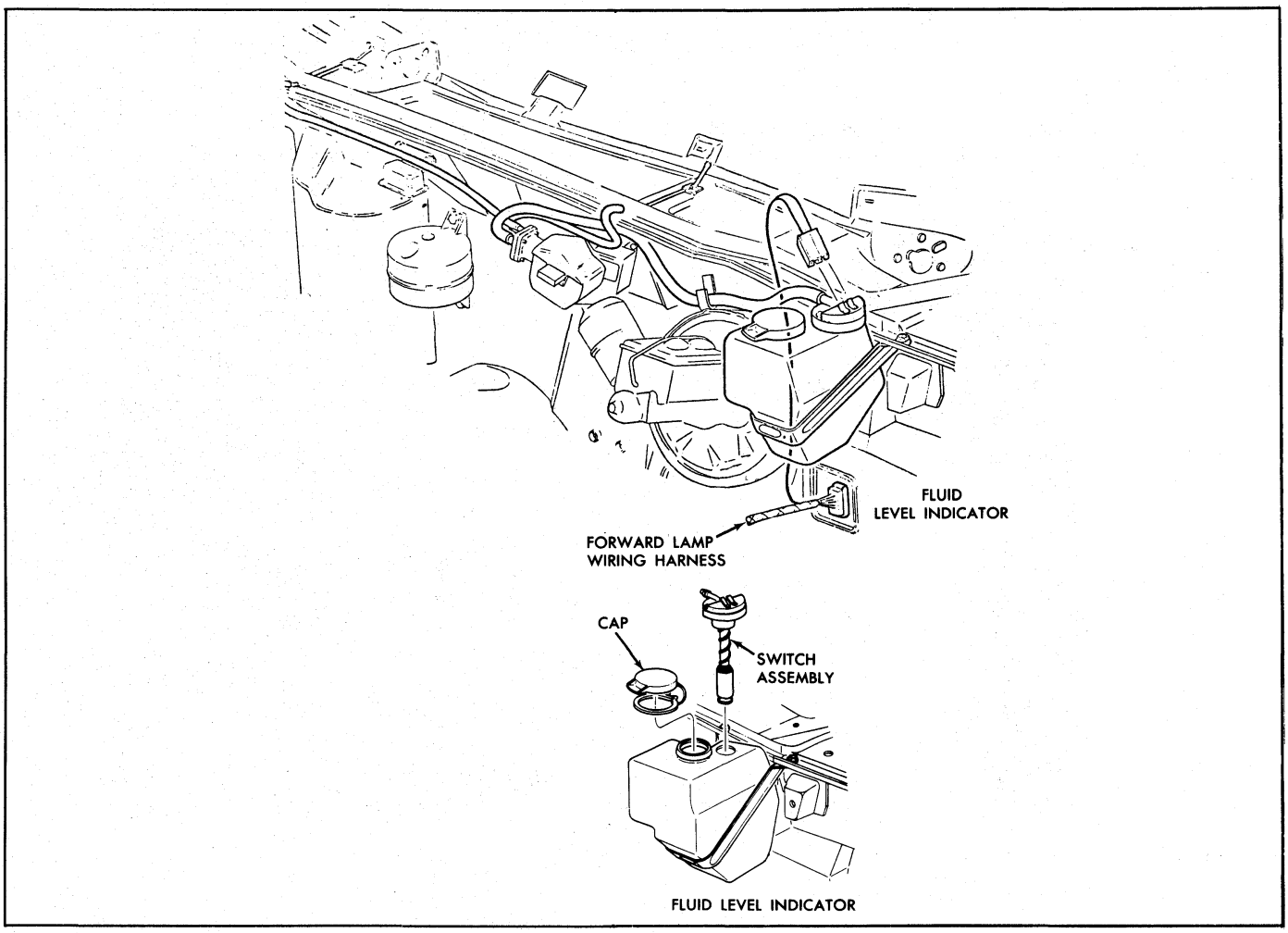


Fig. 8-96 Low Washer Fluid Indicator Installation

WASHER FLUID LOW LEVEL INDICATOR (Seville)

GENERAL DESCRIPTION

A washer fluid low level indicator light is provided as standard equipment on all cars. The light is located on the left side of the telltale housing. It is labeled "WASHER FLUID" and glows amber when the fluid level in the windshield washer bottle drops below approximately 1/3 full and ignition switch is in "RUN" position and the washer button is depressed.

Engaging the washers allows a small amount of current to flow from the wiper motor terminal through a #18 dark blue wire to the washer bottle float unit, Fig. 8-97. When the fluid level in the washer bottle is low, the float drops, allowing the spacer to release pressure from the lever assembly. This permits the lever to activate an over center spring contact which closes the circuit from one terminal to the other and allows current to flow to the indicator light.

The indicator system operates in conjunction with the windshield washers. A low fluid level condition will not be indicated to the driver unless the windshield washer button is depressed.

The complete float unit must be replaced if inoperative. The cap is a separate part.

Refer to body service manual for servicing windshield wiper and washer system.

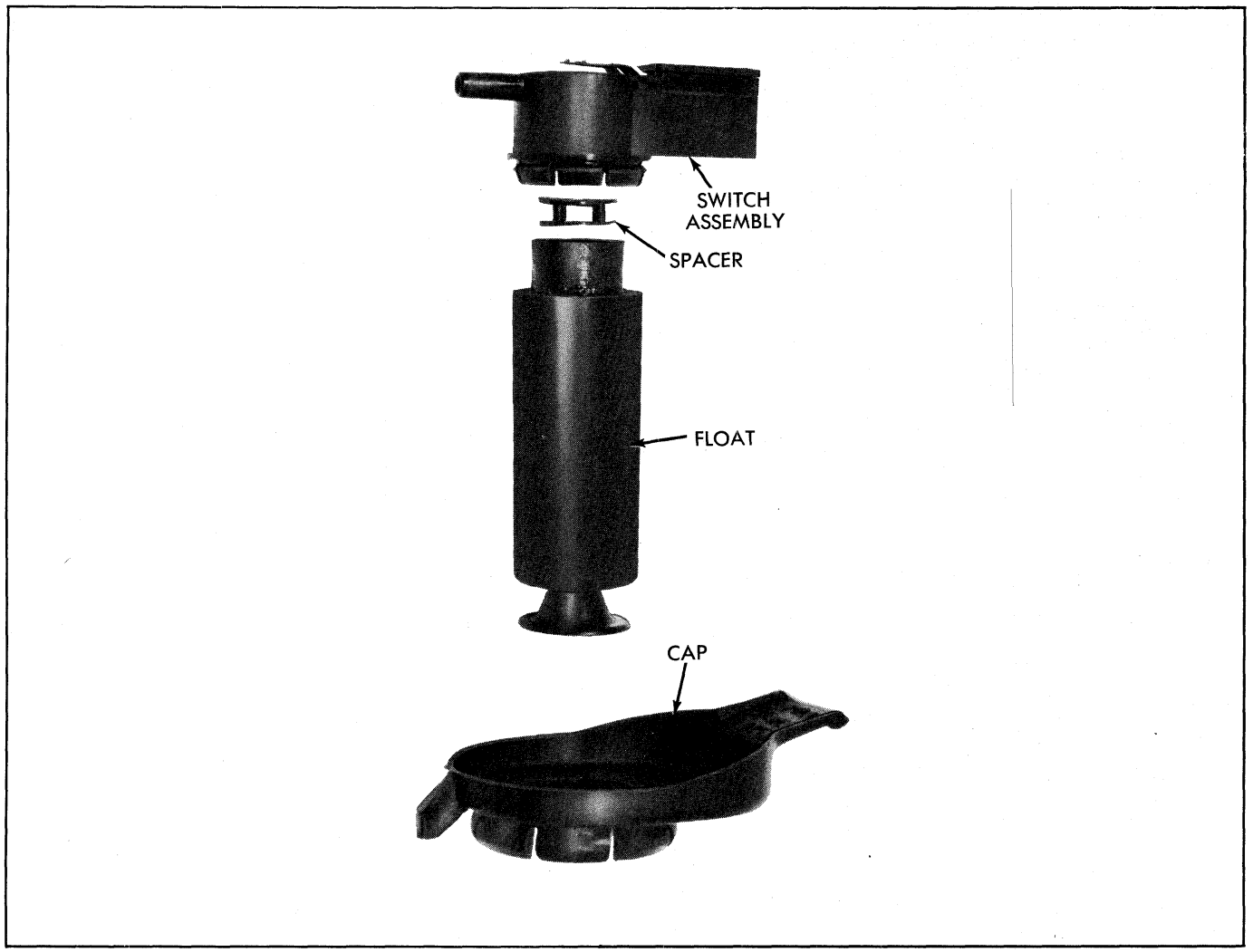


Fig. 8-97 Washer Fluid Level Float Unit (Seville)

DIAGNOSIS

Indicator Inoperative

1. Open hood. Disconnect electrical connector. Using a jumper wire, connect the two terminals to by-pass float unit.

2. Turn ignition switch to "RUN" position. "Washer Fluid" telltale should glow. If bulb does not glow, replace bulb.

3. Remove float unit and cap assembly from washer bottle. Separate cap from float unit.

4. Connect a self powered test light to float unit terminals. Slide float up and down pick-up tube. Test light should glow when float is lowered (approximately 2-1/4 inches fluid in bottle) and turn off as float is raised. If it does not, replace float unit.

5. Examine cap and replace if damaged.

6. Check electrical connections at switch.

ACCESSORIES
TABLE OF CONTENTS

Radio and Antenna
- General Description ... 9-1
- Diagnosis ... 9-12
- On-Car Service ... 9-23
- Unit Repair ... 9-29
- Special Tools ... 9-31

Electronic Cruise Control
- General Description ... 9-32
- Diagnosis ... 9-33
- On-Car Service ... 9-41

Guidematic
- General Description ... 9-45
- Diagnosis ... 9-48
- On-Car Service ... 9-51

Twilight Sentinel
- General Description ... 9-52
- Diagnosis ... 9-54
- On-Car Service ... 9-59

Rear Window Defogger
- General Description ... 9-60
- Diagnosis ... 9-63
- On-Car Service ... 9-64

Theft Deterrent System
- General Description ... 9-65
- Diagnosis ... 9-71
- On-Car Service ... 9-74

Fuel Monitor System
- General Description ... 9-75
- Diagnosis ... 9-76

Fuel Economy Indicator System
- General Description ... 9-77
- Diagnosis ... 9-78

Sunroof
- General Description ... 9-78
- Diagnosis ... 9-80
- On-Car Service ... 9-80

Astroroof
- General Description ... 9-88
- Diagnosis ... 9-88
- On-Car Service ... 9-88

Biarritz Top (Eldorado)
- General Description ... 9-89
- On-Car Service ... 9-89

Automatic Door Locks
- General Description ... 9-90
- Diagnosis ... 9-91
- On-Car Service ... 9-91

RADIO AND ANTENNA
GENERAL DESCRIPTION

RADIO

An AM/FM pushbutton radio is standard on DeVille, Fleetwood Limousine and Formal Limousine. An AM/FM pushbutton stereo signal seeking radio with scan feature is standard on Eldorados, Broughams and Sevilles, Fig. 9-1, and is optional on DeVilles, Fleetwood Limousines and Formal Limousines.

Optional radios include an AM/FM pushbutton stereo radio with integral eight track tape player, Fig. 9-2, an AM/FM stereo twenty-three or forty channel citizens band receiver-transmitter and an AM/FM pushbutton stereo with digital frequency, time and date display. An AM/FM pushbutton stereo signal seeking radio with rear remote control is available on Fleetwood Limousines and Formal Limousines.

The AM/FM pushbutton radio consists of a receiver unit and three separate speaker units. All stereo radios consist of a receiver unit and four separate speaker units. There are two 4 x 6 inch oval front speakers (except Eldorado and Seville) and two 3-1/2 inch round (Eldorado and Seville), one at each end of the instrument panel beneath the top cover. Two 6 inch x 9 inch rear speakers, one at each end of the rear filler panel, are used on all stereo installations except Seville which is 4 inch x 10 inch.

Rotate the control ring behind the tuning knob counterclockwise to increase volume of front speakers and clockwise to increase rear speaker(s) volume. "Balance" is obtained when you hear front and rear speakers equally.

On stereo installations, the left front and right rear speakers are on one channel and the right front and left rear speakers are on the other channel.

All receivers are equipped with an AM/FM band selector bar. Moving the band selector to the left, engages the FM band and all preset FM stations. Conversely, moving the selector bar to the right engages the AM band. Any preset station is mechanically tuned in by depressing the appropriate pushbutton located directly below the band selector bar.

To preset a station on each pushbutton:

a. Select desired band - AM or FM.

b. Manually tune desired station for best reception.

c. Choose the pushbutton you wish to use for that station, pull it straight out, and push it slowly and firmly all the way in.

NOTE: Do not move the AM/FM band selector while any push button is pulled out or damage to the radio could occur.

d. Five AM stations, plus five FM stations, may be preset on the push buttons.

AM/FM AND AM/FM STEREO RADIOS

The frequencies (88-108MHZ) at which FM stations operate create much shorter radio wave length than those produced in AM broadcasting. Unlike frequencies on the AM band, FM frequencies do not bend around the horizon. This limits the distance at which FM signals can be received. The dependable range of FM reception in an automobile is a radius of approximately thirty miles from the transmitting antenna.

When the FM receiver moves out of range of the FM transmitter, it enters what is referred to as the fringe area. In the fringe area, the strength of the FM signal may vary

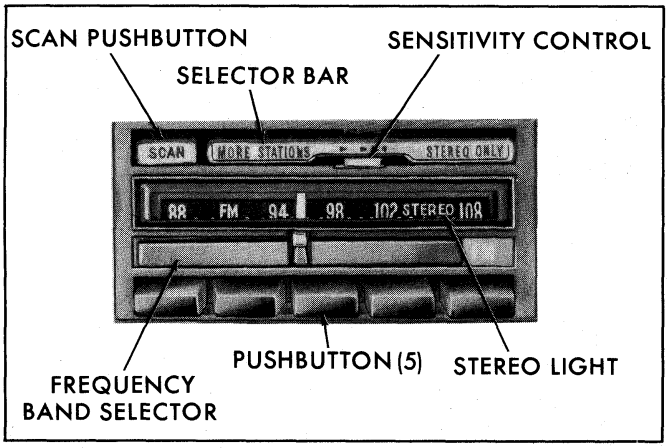


Fig. 9-1 AM/FM Stereo Pushbutton Signal Seeking Radio with Scan

rapidly, causing a flutter or a series of noise bursts as the car moves between high and low level signal points. New circuits incorporated in the 1977 Stereo radio improve fringe area reception by automatically blending from stereo to monaural when the signal level becomes marginal. This reduces the reception band width and reduces apparent noise. Sensitivity has also been improved.

A second effect found in the fringe area is the presence of ignition interference from adjacent vehicles. In both instances, it may be possible to improve reception by carefully retuning; however, it may be necessary to change to a different station if reception still is not good.

Retuning should be necessary only in those few instances when reception becomes slightly noisy while driving through areas such as the center of a large city and a weak signal is being received from a station located away from the center of the city. The interference can be reduced by adjusting the tone control for more bass, and by shifting the speaker fader to favor the rear seat.

While these adjustments will slightly diminish stereo effect on cars so equipped, they will substantially reduce background noise interference.

As soon as reception clears, reset the tone control to the normal detent and again adjust the front and rear speakers for equal output.

The FM section of the AM/FM and AM/FM Stereo radios is equipped with automatic frequency control, which aids tuning to a station. The FM receiver should be tuned directly on station frequency for minimum noise interference; however, the automatic frequency control will tune directly to and lock on station frequency when slight mistuning is encountered.

Another feature of FM tuning is increased signal selectivity. When two FM stations are close in frequency, the FM tuner selects the stronger signal, rejecting the weaker one. This is in contrast to AM performance, where it is not always possible to separate two stations.

The AM/FM radio incorporates an AM receiving circuit and an FM receiving circuit. The audio system is common to both receiving circuits.

The AM/FM Stereo radio incorporates an AM receiving circuit, an FM receiving circuit, an FM stereo detection circuit, and a dual channel audio amplifier in one unit.

The signal seeking feature is provided on the AM/FM Stereo. The AM and FM frequency band selector bar is located below the receiver dial. The scanning feature is provided with all AM/FM stereo signal seeking radios except remote. Upon pressing the scan button the signal seeker seeks upscale stopping at each signal for 5-7 seconds. Pressing the scan button again will stop the scanning action.

All Stereo radios should always be fine tuned to assure maximum signal response and minimize unwanted noise.

To simplify tuning, only the dial for the frequency band selected is visible. The letters "AM" or "FM" on either side of the selector bar show the frequency band selected.

On stereo radios, (except digital and CB which have a small tell-tale light), the letters "STEREO" on the right side of the dial illuminate as shown in Fig. 9-1 when the FM station tuned is capable of transmitting stereo. The illumination of the letters "STEREO", however, does not indicate that the station is transmitting stereo at the particular moment. Stereo programs are broadcast on the FM frequency band only.

THE SCANNING SIGNAL SEEKING TUNER

The scanning signal seeking tuner provided on AM/FM Stereo radios (except remote) is electronically controlled so that the operator may change stations by depressing the selector bar. The signal seeking operation consists of a low to high frequency sweep (left to right) of the AM or FM broadcast band by the tuner.

When the selector bar is depressed and released, the tuner moves to the station of next higher frequency (to the right) and stops automatically at the point where that station is best received. This action takes place each time the selector bar is depressed. When the tuner has reached the point of highest frequency of the broadcast band, it returns to the low frequency (left) side of the broadcast band and begins a new sweep to the right, stopping at the first receivable station. The above procedure is then repeated when the bar is again depressed.

In addition, by depressing the scan button, the operator may scan all or part of the AM or FM broadcast band stopping at each station for 5 to 7 seconds, Fig. 9-1. The scan can be stopped by depressing the scan button a second time.

The stopping sensitivity of the signal seeking tuner may be varied by changing the position of the three-position sensitivity control switch located just below the center of the selector bar, Fig. 9-1:

Left position - tuning selector stops at the strongest stations in your area.

Center position - tuning selector stops at all usable stations.

Right position - when using the FM band, tuning selector stops at FM stereo stations. When using the AM band, selector stops at most local AM stations.

AM/FM STEREO RADIO WITH EIGHT TRACK TAPE PLAYER

With the AM/FM stereo radio with eight-track tape player, Fig. 9-2, the owner may make his own selection of prerecorded music. To operate in the tape player mode, turn the radio on and fully insert a tape cartridge into the opening behind the face of the receiver dial. The dial face will swing up into the receiver when the tape cartridge is inserted. This automatically removes power from the radio and switches control of the speakers to the tape player.

To change tape programs, momentarily depress the volume control knob. Each time the volume control knob is depressed, the tape cartridge will change to the next track.

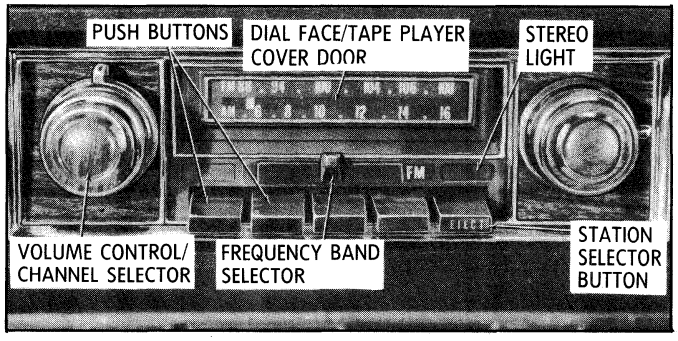


Fig. 9-2 AM/FM Stereo Pushbutton With Integral Eight Track Tape Player

To remove tape cartridge, pull out of the radio face for early models. On later models, push in pushbutton marked "eject", Fig. 9-2. With the tape cartridge removed, power is automatically returned to the radio along with control of the speakers.

Tape cartridges should be handled carefully and should be kept clean. A cartridge should not be left inserted fully in the player. This may cause permanent damage to the cartridge.

Silicone spray lubricants are specifically not recommended for switch plunger or tape head.

AM/FM PUSHBUTTON STEREO DIGITAL FREQUENCY, TIME AND DATE DISPLAY RADIO

This receiver, Fig. 9-3, provides the time of day, elapsed time and radio tuner frequency by means of a yellow, light emitting diode, digital display. By depressing the appropriate pushbutton switch the receiver will automatically recall and display each function for approximately 5 to 7 seconds.

To conserve battery power, the display illuminates only with the ignition turned on. An integral dimmer circuit operates in conjunction with the light dimmer to dim the display as the instrument panel lights are dimmed.

The time of day in hours and minutes, with a colon flashing seconds, is displayed all of the time except when the other functions are called upon by the operator. AM or PM is indicated to the left of the display.

For the radio dial to appear, the radio ON-OFF switch must be on. The radio frequency being received appears for a short time immediately after the ignition is turned on and will reappear if the volume control is momentarily depressed. In addition, the radio dial will appear when the radio is manually or pushbutton tuned.

The month and day of the month are displayed when the "date" button on the receiver is depressed. The colon is steady and separates the day (located on the right of the dial) and the month (located on the left of the dial).

By depressing the "E TIME" pushbutton, the receiver will display elapsed time. This time can be set to zero by depressing the reset pushbutton. This phase of the system is dependant upon the ignition switch. When the switch is in the "Run" position the timer counts. When the switch is in the "Off" position the timer discontinues the count, but stores the time elapsed.

Two recess setup buttons are provided for setting the correct hour; one at the right and left end of the digital display panel marked "HOUR" and "MIN" respectively. A small nonbreakable blunt object may be used during the setup procedure. Do not use a lead pencil or other object that might break and jam the setup buttons. The buttons should be depressed and held until the proper digit appears.

Radio stations frequently provide the exact time of day by referencing to: "At the sound of the tone the exact time is _____". You can set your digital radio to the minute by simultaneously depressing the hour and min buttons when the tone is heard and then setting the display to correspond to the time provided.

PROCEDURE FOR SETTING DATE AND TIME

1. The ignition must be in the "RUN" or "ACC" position during setup.

2. Be sure the Time of Day is displayed prior to beginning setup of any other functions.

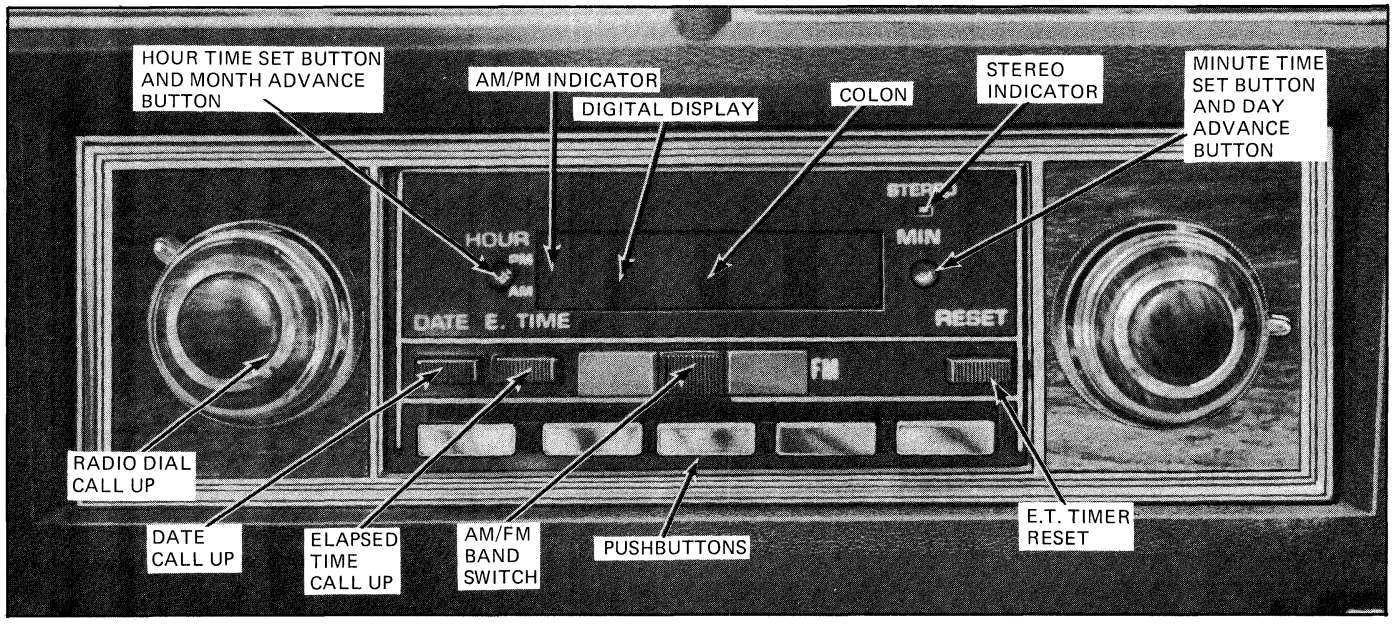


Fig. 9-3 AM/FM Stereo Pushbutton Digital Display Clock-Radio

BUTTONS				Depress and Hold Until Proper Digit Appears
FUNCTION	DATE	HOUR	MIN.	
HOUR		*		Advances AM/PM indicator @ 12 check AM/PM
AM/PM		*		Automatically advances @ 12
MINUTE			*	
MONTH	*1st.	*2nd.		Push and hold in sequence shown.
DAY	*1st.		*2nd.	Push and hold in sequence shown.
Feb. 29	*1st.	*2nd.	*2nd.	Push Date button and then *immediately* depress the HOUR and MIN. button simultaneously.
*Always wait until the Time of Day is displayed before setting up any function.				

3. All functions are independent during setup; minutes do not automatically advance hours, hours do not automatically advance days, and days do not automatically advance months.

4. Hours advanced beyond 12 o'clock will advance the AM/PM indicator. Always check the AM/PM indicator after advancing hours.

5. In setting the month and day, the DATE and HOUR and DATE and MIN respectively must both be pressed. Always depress the DATE button before depressing either the HOUR or MIN. button.

AM/FM STEREO 23 or 40 CHANNEL CITIZENS BAND RECEIVER-TRANSMITTER

The CB radio transceiver, Fig. 9-4, is integrated with an AM/FM stereo unit by means of a jumper harness (Figs. 9-22 thru 9-24). The speaker system used for the radio is also used for the CB transceiver. A three position switch in the upper right hand corner of the radio face determines the operation mode.

Placing the mode switch in the "Radio" position allows only the AM/FM stereo portion of the radio to function. In this mode the unit operates as a standard radio.

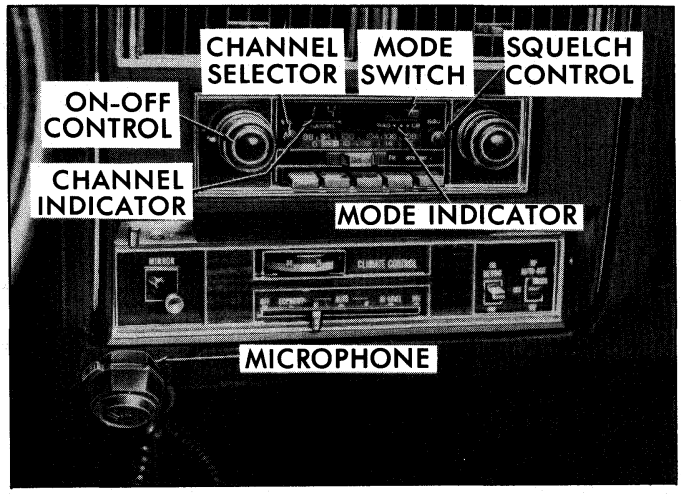


Fig. 9-4 AM/FM Stereo Pushbutton Radio With 23 or 40 Channel Citizens Band Transceiver

Placing the mode switch in the "CB" position allows only the CB portion of the unit to function. The CB channel selector is on the left side of the unit face and allows for the selection of any of the CB channels. A channel read-out in the upper left corner shows the channel selection. In addition, there is a squelch control located on the right side of the transceiver face. Turning the control clockwise allows only strong CB stations to be received and eliminates background noise. Turning the control counterclockwise increases background noise but allows weaker CB stations to be received.

NOTE: Turning the squelch control too far counterclockwise prohibits reception of the signal.

Placing the mode switch in the center or "override" position engages both functions of the radio. The entertainment portion is received until a CB signal of pre-determined strength (determined by squelch control setting) interrupts the radio signal. The CB Signal overrides the radio signal until the message is completed, then the receiver reverts to the entertainment mode.

Included with the unit is a microphone. Depressing and holding the push-to-talk-button permits transmission of a signal. Releasing the button allows for reception of incoming messages.

CAUTION: *The antenna must be fully extended to achieve maximum receive and transmit efficiency of the "CB" portion of the radio.*

There is no over-voltage protection for the "CB" unit. It should be switched off when jump starting the car to avoid damage to any of the electronic circuits.

CB TRANSCEIVER LOCATION (Fig. 9-22 thru 24)

All (except Eldorado and Seville) carbureted cars will have the CB transceiver located in the E.C.U. mounting brackets behind the glove box liner. All (exc. Eldorado and Seville) cars with E.F.I. will have the transceiver mounted below the instrument panel just above the transmission tunnel.

The CB transceiver on Seville is attached to the back of the glove box liner. On Eldorado the unit is located below and to the left of the E.C.U. mounting position behind the glove box liner.

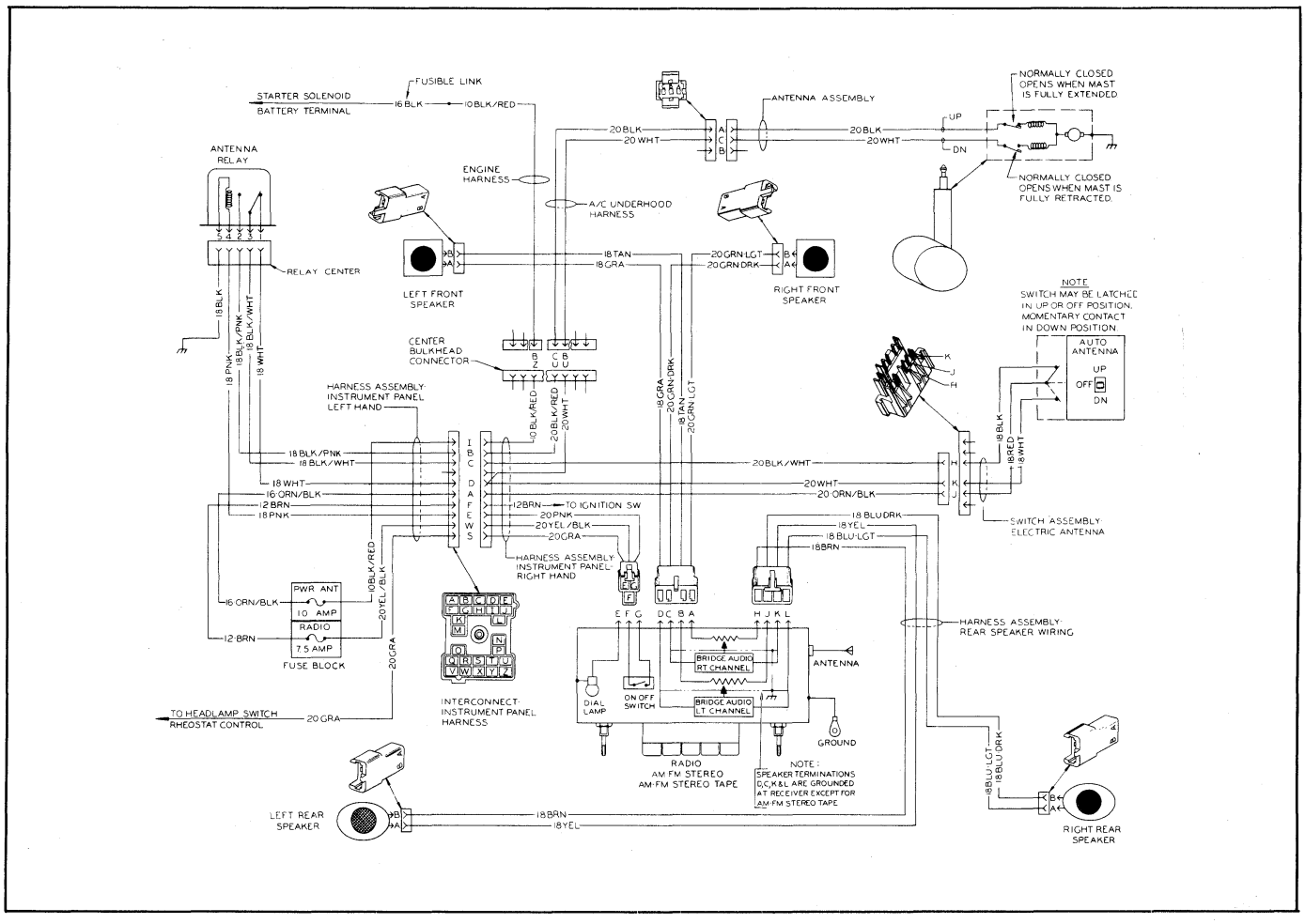


Fig. 9-5 Radio Wiring Circuit Diagram (All Exc. Eldorado & Seville)

Radio Controls, Operation

a. Frequency Band Selector Bar

The frequency band selector bar is located below the frequency dial. Sliding the bar to the right engages the AM band and changes the dial to the AM frequency. Sliding the selector bar to the left engages the FM band and changes the dial to the "FM" frequency. Stereo broadcasts can be received on the FM band only. When an FM stereo station is tuned the letters "Stereo" illuminate on the right side of the dial, except digital and "CB" which have a small tell-tale light.

On the stereo radio with the tape player, the "Stereo" light is located to the right of the band selector.

b. Rear Seat Remote Control (Fleetwood Limousine Styles Only)

Rear seat remote radio control is available as an option for installation in Fleetwood Limousine style cars equipped with the AM/FM stereo signal seeking radio. The remote controls consist of an ON-OFF volume control knob, a sensitivity control, and a selector button located behind the sliding access door in the right rear quarter panel trim.

Once the appropriate AM or FM band is selected at the radio, the rear seat remote control overrides the front radio control when it is turned on and off, and controls the volume in both channels simultaneously. The three position sensitivity control is located beneath the ON-OFF volume control knob. Rotating the control clockwise when the receiver is on the AM band allows the tuner to stop only on most powerful stations, slightly lower power stations and all possible stations respectively. Rotating the control clockwise when the receiver is on the FM band allows the turner to stop only on the most powerful stations, all possible stations, and stereo-only stations respectively.

c. Switch Volume and Tone Controls

The left knob turns the radio on and off, and controls the volume. On the stereo radio, the knob controls the volume in both channels simultaneously. The tone control ring around the left knob is turned counterclockwise for bass tones and clockwise for treble tones. When indexed at the detent, it provides a balanced normal tone. On the stereo radio, this control varies the tone in both channels simultaneously. On the radio with stereo eight-track tape player combination, momentarily depressing the volume control knob changes tape programs, with a cartridge fully inserted.

For best stereo reception, neutralize the cone control by turning it to the center detent position, then adjust the front and rear speaker control as outlined in Part d so that the sound is balanced to your ears. Centering the tone control permits normal response from the speakers, and balanced speaker output is desirable for greatest stereo effect.

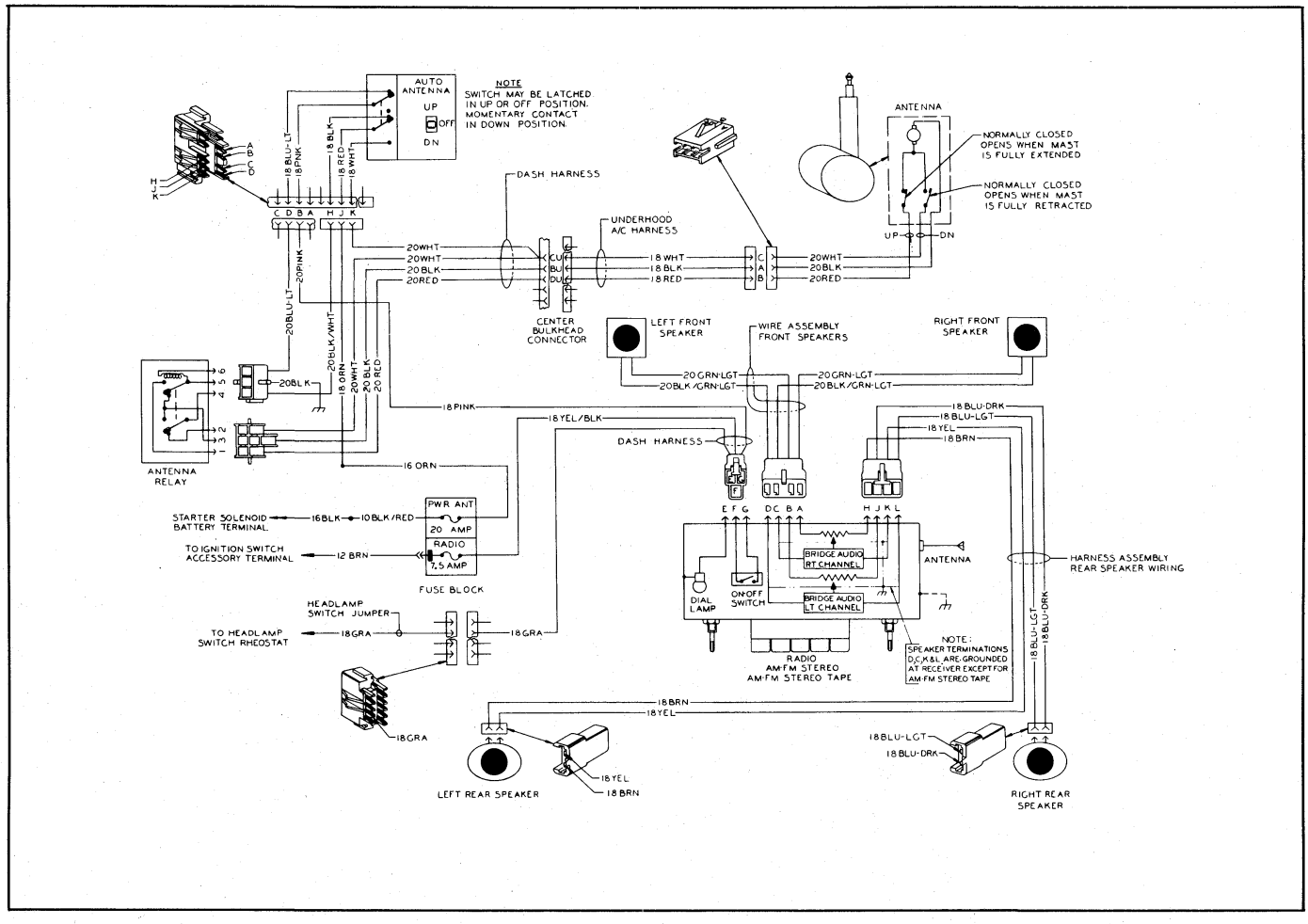


Fig. 9-6 Radio Wiring Circuit Diagram (Eldorado)

d. Manual Station Selector and Speaker Control

The right knob is used to tune stations manually. The ring around the knob is the speaker control. When the ring is turned all the way counterclockwise on the monaural, about 90% of the volume will be shifted to the front speakers. Turning the ring progressively clockwise will shift the speaker favor to the rear. Turning the ring to the full clockwise position shifts about 90% of the speaker volume to the rear speaker or speakers. This control has no effect on the balance of stereo channels.

e. Push Button Tuning (AM/FM, AM/FM Stereo)

Each one of the five push buttons may be preset to a favorite AM station when on the AM band. Each one of these same five push buttons may be set to a favorite FM or stereo station when on the FM band. This makes a total of ten pre-set favorite stations. To preset push buttons on AM stations, proceed as follows:

Slide frequency band selector bar to the right to engage the AM band. Manually fine tune to favorite AM station. Pull push button straight out to unlatch then push in all the way to relatch. Push button is now set to desired station. Whenever this push button is depressed, the preset station will be selected. Set additional push buttons to AM stations as desired.

To preset push buttons to FM and FM stereo stations, proceed as follows:

Slide frequency band selector bar to the left to engage the FM band. Manually fine tune to favorite FM or stereo station. Pull push button straight out to unlatch. Then push in all the way to relatch. Push button is now set to desired FM or Stereo station. Whenever this push button is depressed, the preset station will be selected. Set additional push buttons to FM or stereo stations as desired.

CAUTION: *Do not move the AM-FM slide bar band selector while any push button is pulled out. Damage to tuner mechanism may result.*

f. Automatic Tuning (Signal Seeking Radios Only)

To use automatic tuning, depress the selector bar above the dial momentarily. Any station within range of the receiver and determined by the sensitivity control switch setting, can be obtained by holding the bar depressed until the dial pointer approaches the desired frequency, and then releasing the bar. The automatic tuner will seek immediately when the selector bar is depressed.

g. Sensitivity Control (Signal Seeking Radios Only)

A three-position sensitivity control switch for automatic tuning is located below the center of the selector bar. On the AM band, moving the switch to the left allows the tuner to stop only on most powerful stations. In the middle position, stations of slightly lower power will be received in addition

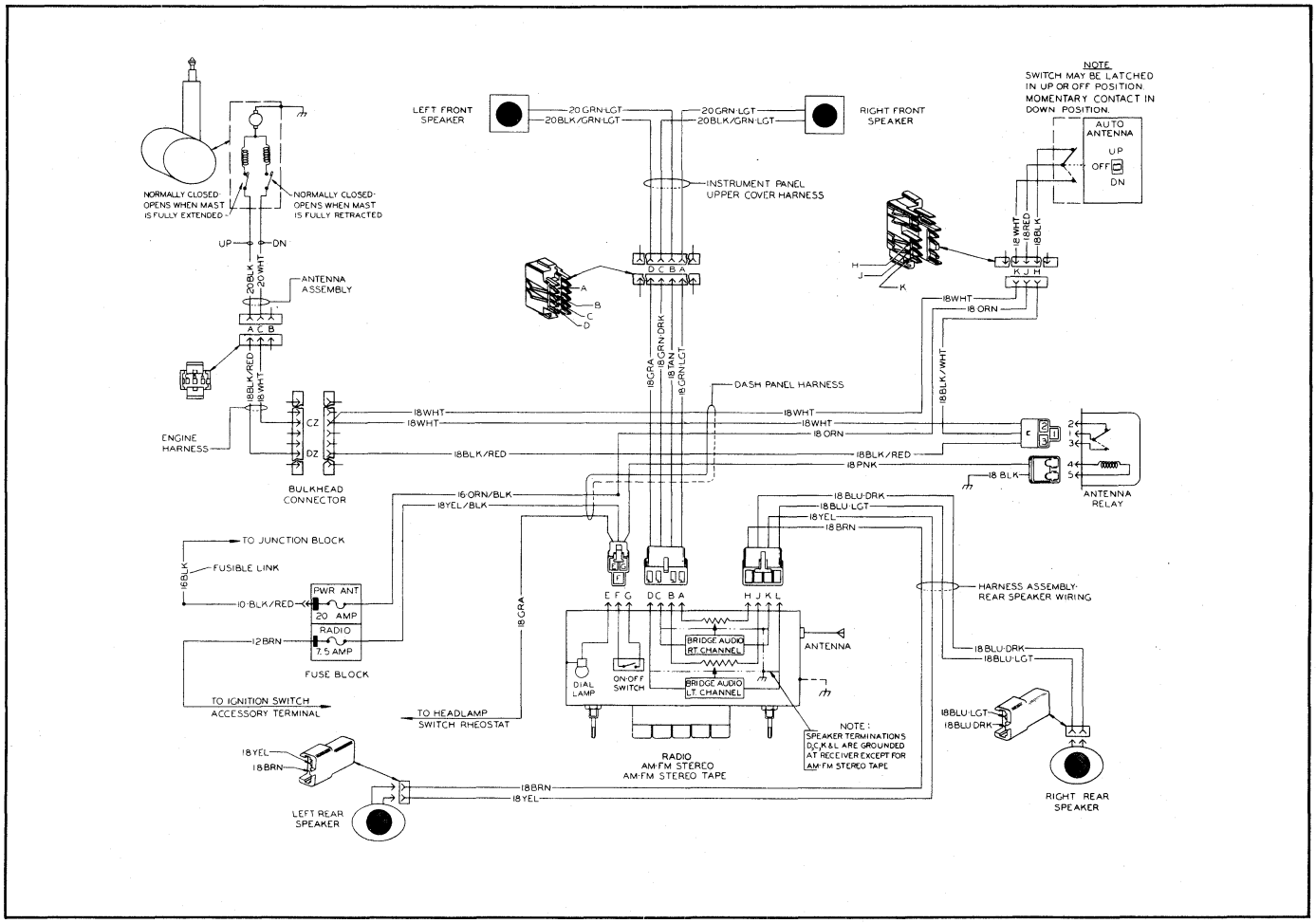


Fig. 9-7 Radio Circuit Diagram (Seville)

to stronger stations. To obtain maximum sensitivity, and bring in all possible stations, move switch to the right.

On the FM band, the left and center switch positions allow the tuner to stop only on most powerful stations and all possible stations respectively.

When the switch is in the right hand position, the tuner will stop only on FM stereo stations.

On Fleetwood Limousine series cars, when the rear seat remote radio controls are on, the red selector button is illuminated. Depressing this button performs the same function as pressing the selector bar. With the rear seat radio control ON, the driver may reduce or increase the volume of the front speakers with the ring behind the right control knob, tune the radio manually or with the push buttons, and change the frequency bands. With the ring around the left control knob, he may vary the tone in both channels simultaneously. With remote control turned OFF, all front controls will operate normally.

Radio Noise Suppressors

a. Ignition Suppressors

Various types of ignition suppressors are used to prevent ignition noise from interfering with radio reception. Failure of any of these parts to function properly is accompanied by a popping noise. The noise increases as the engine is accelerated, and varies with engine speed. If this interference is present, check the following suppressors:

1. Ignition noise is suppressed by use of resistance core ignition cables. Check for high resistance in cables. The resistance of these cables is 2,000 to 6,000 ohms per foot.

2. Make certain resistance spark plugs are being used to minimize ignition noise.

3. On Eldorados, check ground cable between transmission housing and cowl.

4. It is particularly important that the terminals in the ignition secondary cables make good mechanical contact with the spark plug terminals and HEI cap terminals. A loose connection at these points will result in excessive ignition noise, seriously reducing FM performance.

5. A capacitor mounted on the inside of the HEI unit may be checked by running engine at medium speed and then quickly turning ignition switch to the Accessory position. If the noise is eliminated, while the engine is coasting to a stop, replace capacitor. This check applies to FM reception only.

b. Antenna Motor Electrical Noise

Excessive antenna motor electrical noise is often caused by the antenna lead-in cable ferrule at the antenna mast not being properly installed. This condition can be corrected by removing, cleaning if necessary, and then reconnecting the antenna lead-in cable, and tightening retaining nut.

c. Generator Capacitor

A 1.5 mtd. capacitor is mounted inside the generator to suppress generator whine. Turn Climate Control off and if radio whine is speed sensitive, replace capacitor.

POWER ANTENNA

An electrically operated, telescoping rod-type antenna, Fig. 9-8 thru 10, is installed with all radios. This antenna is designed for improved AM/FM fringe area, and FM metropolitan area performance. It is mounted in the right front fender assembly on all models except Seville which have the antenna mounted on the left front fender.

A three position switch located in the accessory switch panel to the right of the steering column is used to control the antenna. With the switch in the "Up" position, the antenna automatically raises to full height when the radio and ignition are turned on and fully retracts when the radio or ignition switch is turned off.

The "Dn" position is a momentary position by which the antenna can be lowered. The center or manual "OFF" position allows the antenna to be left at any height without it being retracted automatically.

The antenna is operated by a reversible electric motor. The motor drives a gear and pulley assembly that extends or retracts a drive cable fastened to the smallest of the three antenna sections. The action of the drive cable, as it is extended, forces the antenna rod upward.

In lowering the antenna, the drive cable is retracted. This pulls the three sections of the antenna rod downward.

CAUTION: *Do not raise or lower the antenna by hand. This may damage the operating mechanism.*

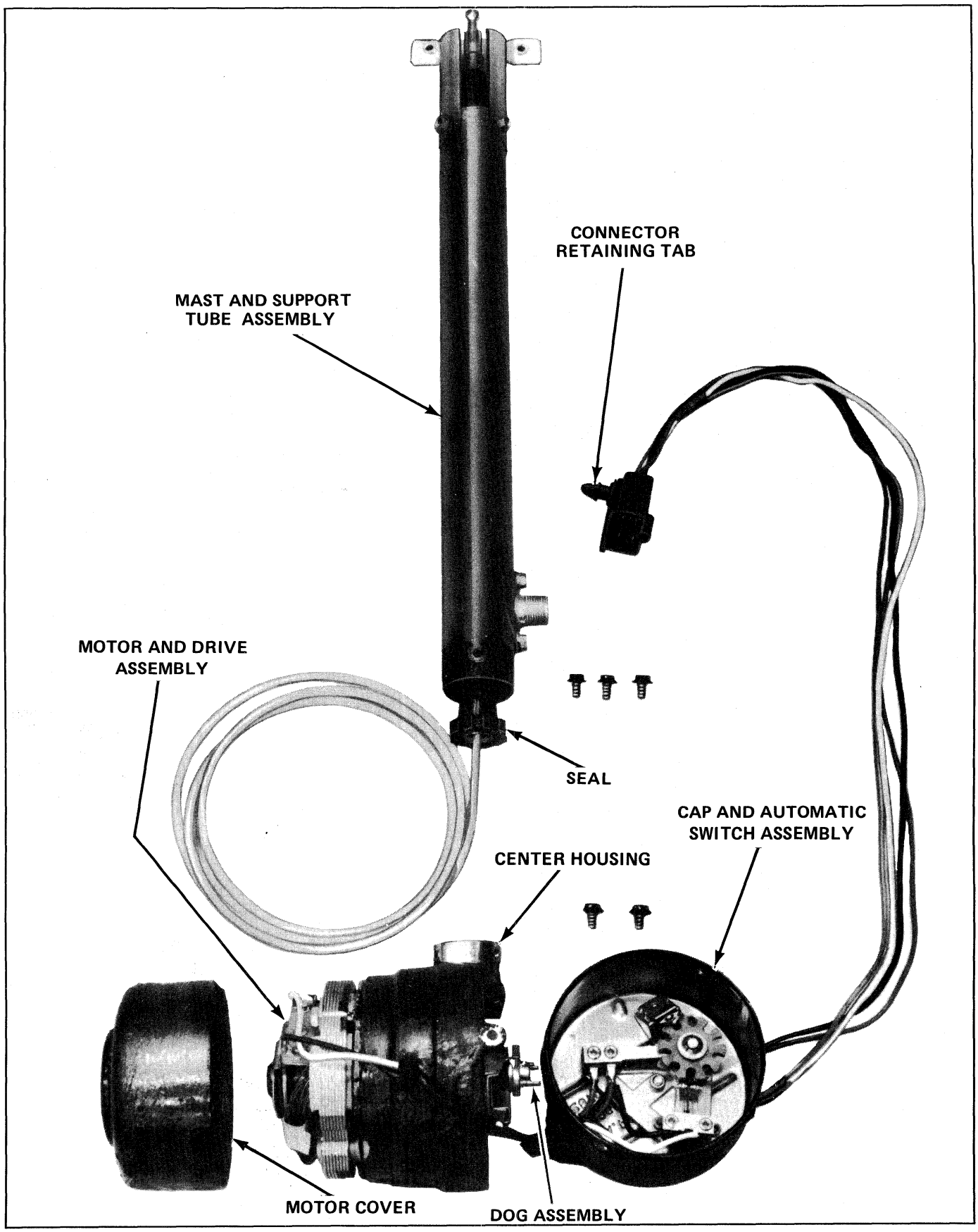


Fig. 9-8 Electric Antenna Disassembled (Except Eldorado and Seville)

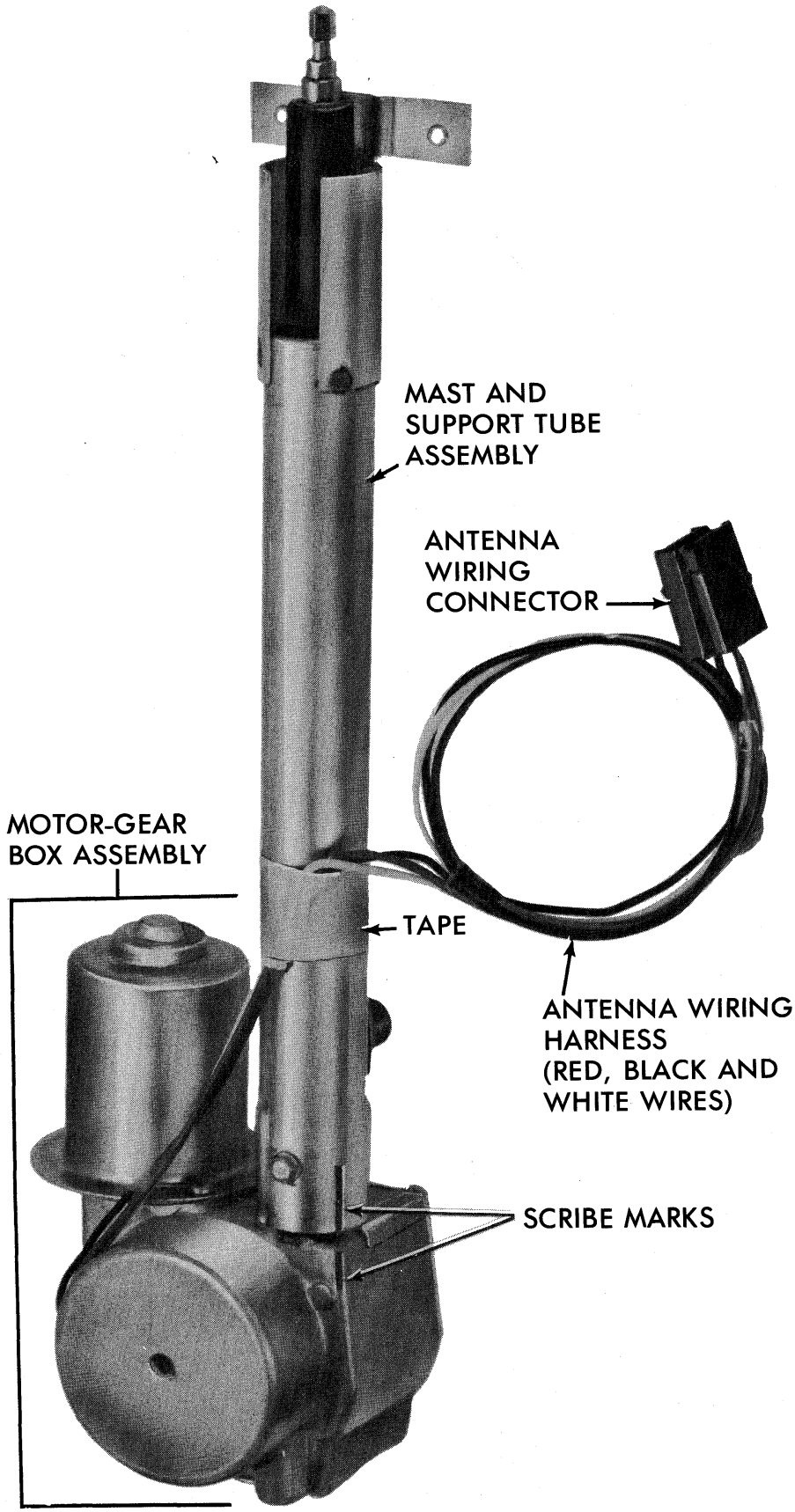


Fig. 9-9 Power Antenna Assembly (Eldorado)

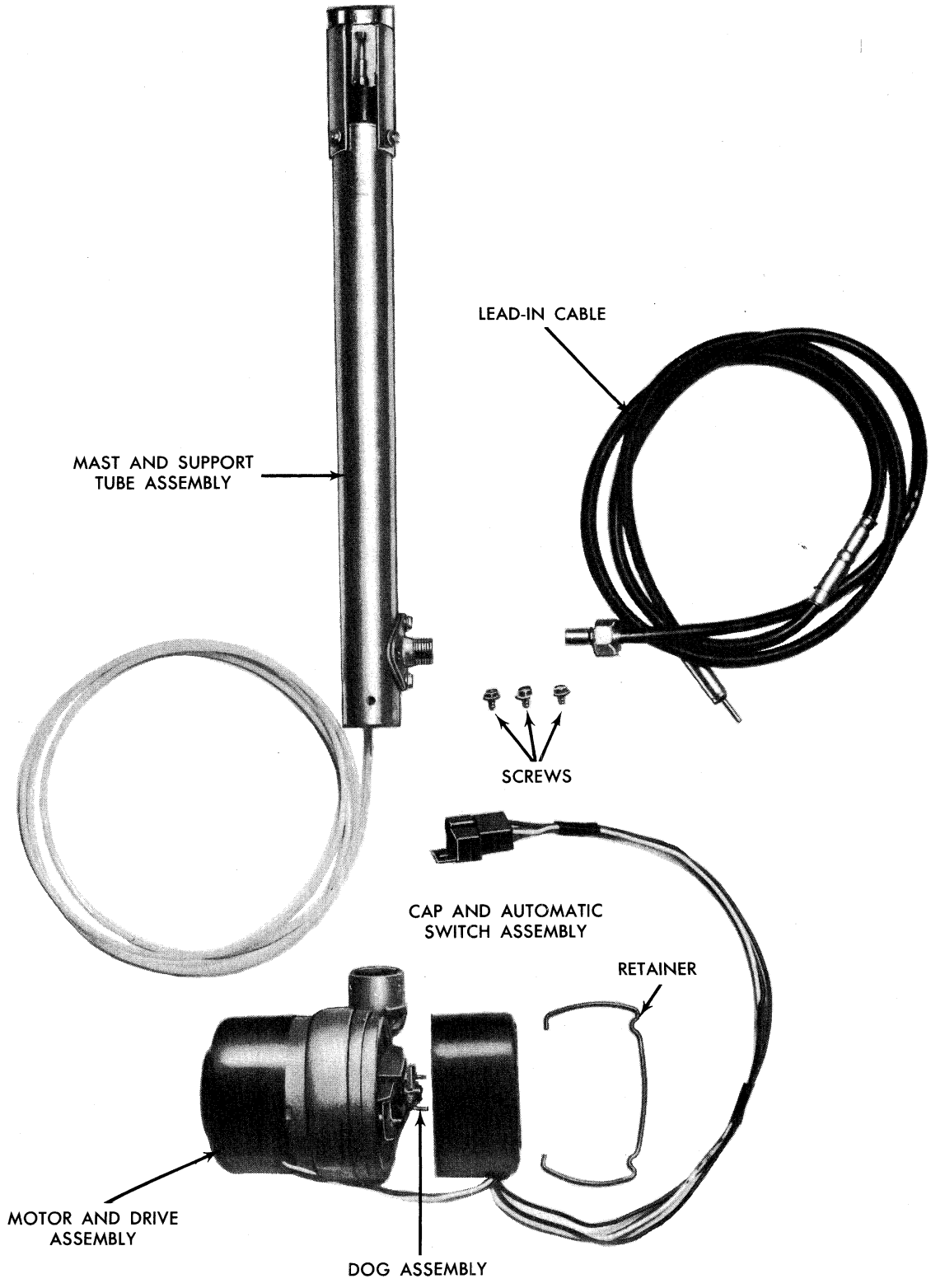


Fig. 9-10 Electric Antenna Disassembled (Seville)

DIAGNOSIS

Many conditions that affect radio operation may be corrected without removing set from car. Check condition and using diagnosis chart on page 9-16 perform the operation or operations necessary to correct the condition. If these minor repairs are not effective, radio should be removed from car and repaired at an authorized radio service station.

CAUTION: *Do not turn on radio with any speaker disconnected, as an audio fusistor may be damaged.*

a. Fuse

For signal seeking and AM/FM receivers, a thump should be heard from the speakers when the radio is turned on. If thump is not heard, check 7.5 amp. fuse and replace with one of the same amperage. If fuse blows the second time on non-signal seeking receiver or signal seeking, the radio should be sent out for repairs.

b. Battery

Check battery and make sure that it is fully charged. If attempting to diagnose problems with the engine off, batteries supplying less than 9 volts will cause erroneous diagnosis of AM and FM problems.

c. Speaker Connections

Check speaker leads for possible open circuit or ground. There are four speakers with stereo installations, three with monaural radios. All 1977 speakers are ungrounded and both speaker terminals are wired to the radio.

d. Electric Antenna

Use a test antenna and lead-in plugged into the set with test antenna held outside car. If radio works satisfactorily with this test assembly, car antenna should be checked for a short or ground, and lead-in should be checked for continuity. Test antenna mast for shorts to ground while wiggling antenna.

If a ground is indicated in this test, disassemble antenna and check for poor insulators or presence of water or moisture in body tube. Test with volt-ohm meter from end of either lead-in tip to ground. If lead-in test shows a ground, replace lead-in.

The conditions mentioned above will cause a weak or intermittent signal and will cause signal seeker if so equipped, to sweep back and forth across the dial when tuning bar is depressed while car is in an unusually weak signal area, such as in a building or under a viaduct.

Do not remove the set to correct this condition until all previous checks on the antenna have been made with the car in a fairly strong signal area.

e. Antenna Will Not Raise or Lower

This condition can be due to an open fuse, loose electrical connections at the switch on the receiver unit or at the antenna motor, a bent antenna mast, or a malfunctioning relay. If a check of these causes fails to correct the condition, disassemble the antenna and replace any inoperative parts.

f. Antenna Switch Test

1. Remove accessory switch panel as described on page 8-8 (Exc. Eldorado and Seville) or, page 8-31 (Eldorado) or page 8-47 (Seville).

2. Disconnect electrical feed wires from wiring harness.

3. Touch one lead of self-powered test light to red wire and other lead to black wire. Test light should light when switch is held in "up" position, Fig. 9-11.

4. Remove test light lead from black wire and touch to white wire. Test light should not light when switch is held in "down" position, Fig. 9-11.

5. If switch performs as above, remove test light and reinstall switch. If not, replace antenna switch.

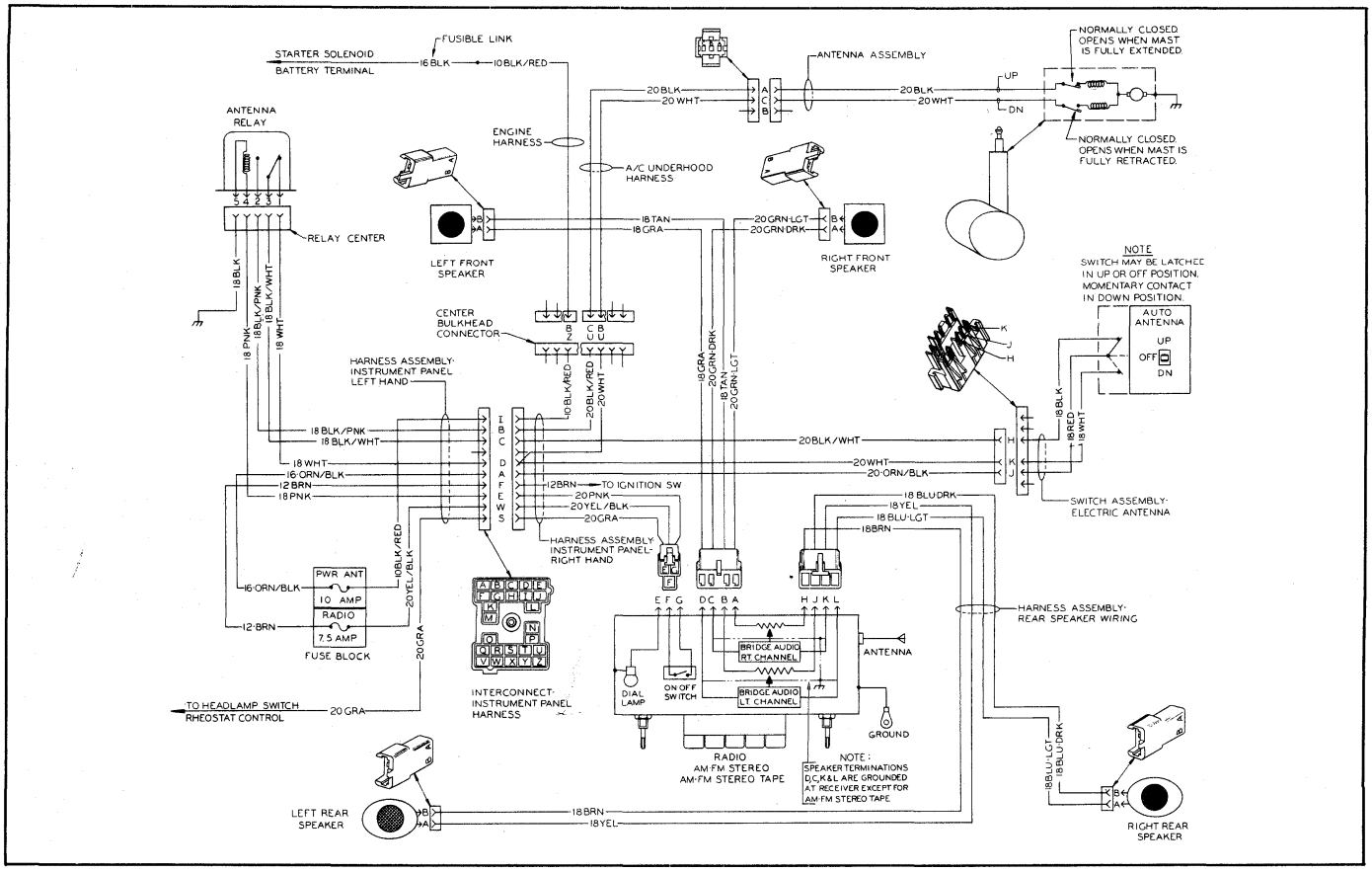


Fig. 9-11 Electric Antenna Wiring Circuit Diagram (Except Eldorado and Seville)

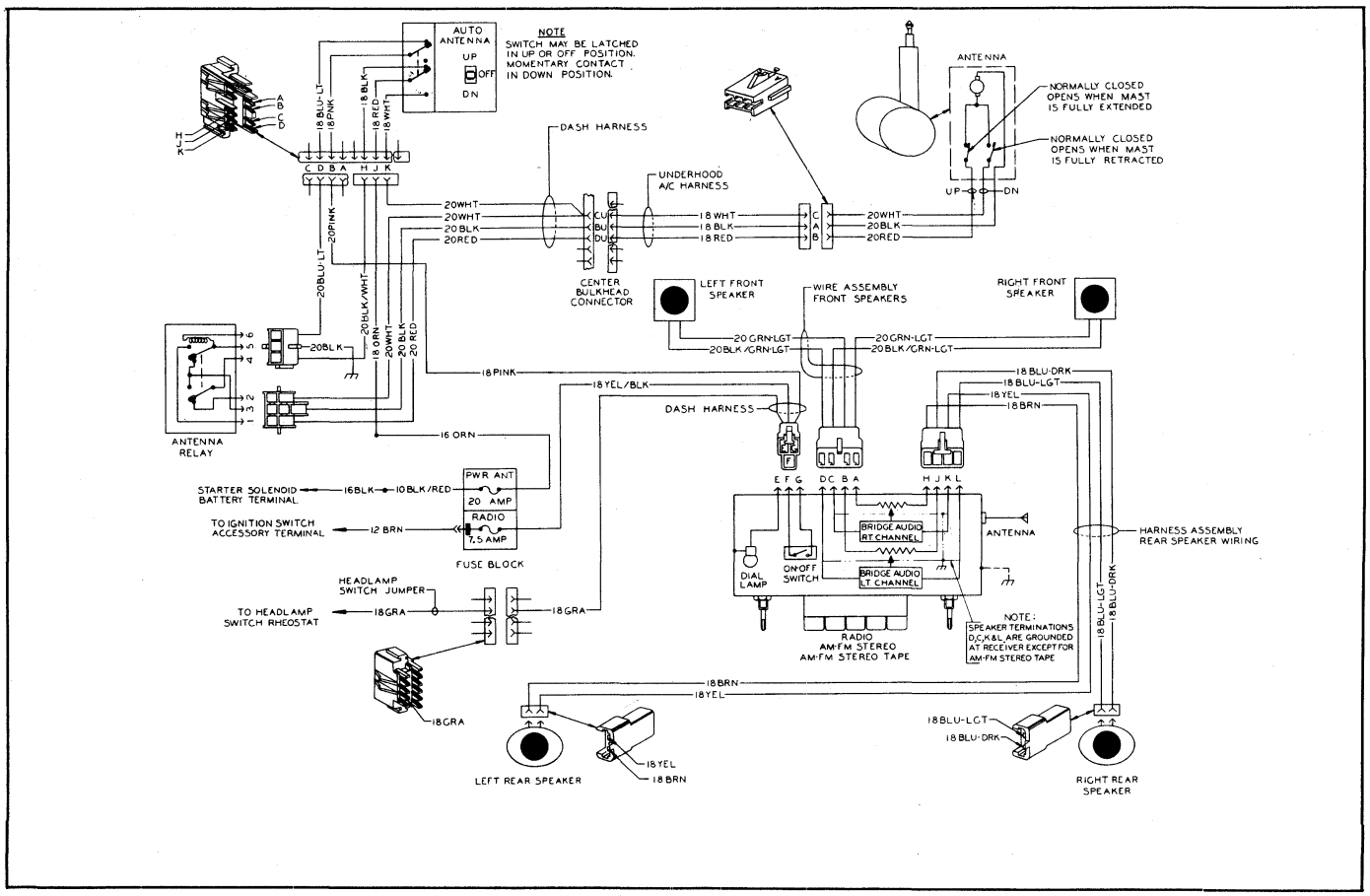


Fig. 9-12 Electric Antenna Wiring Circuit Diagram (Eldorado)

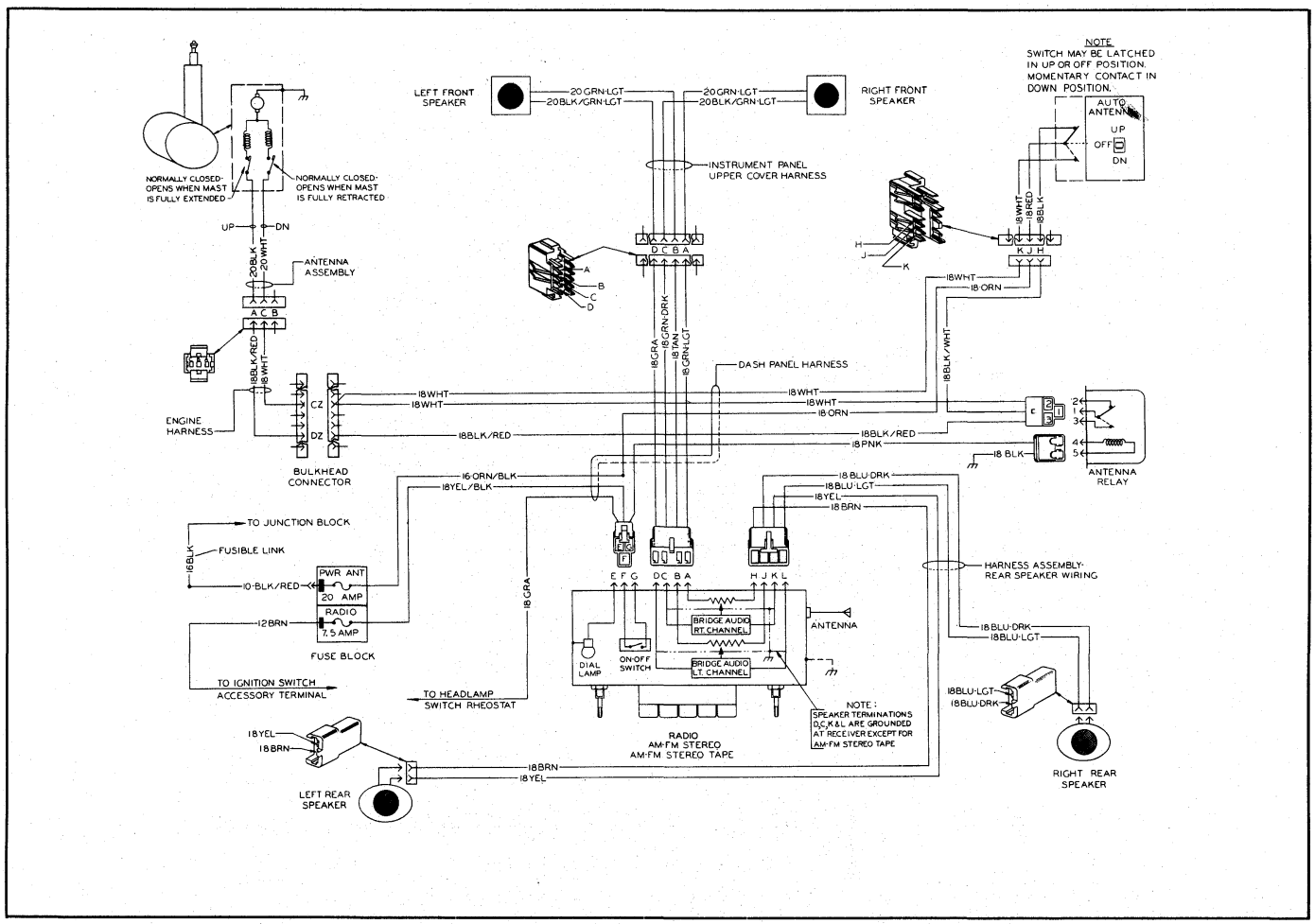
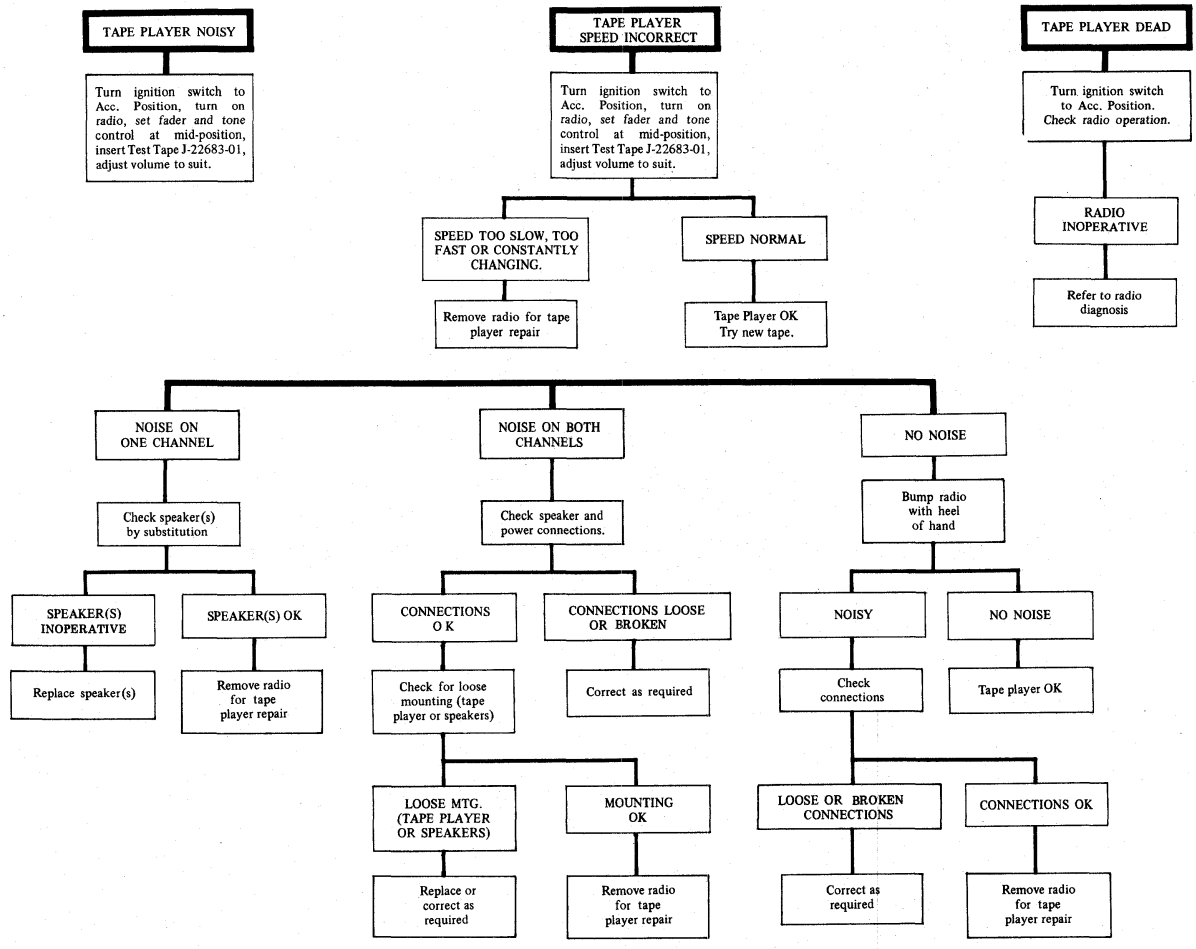
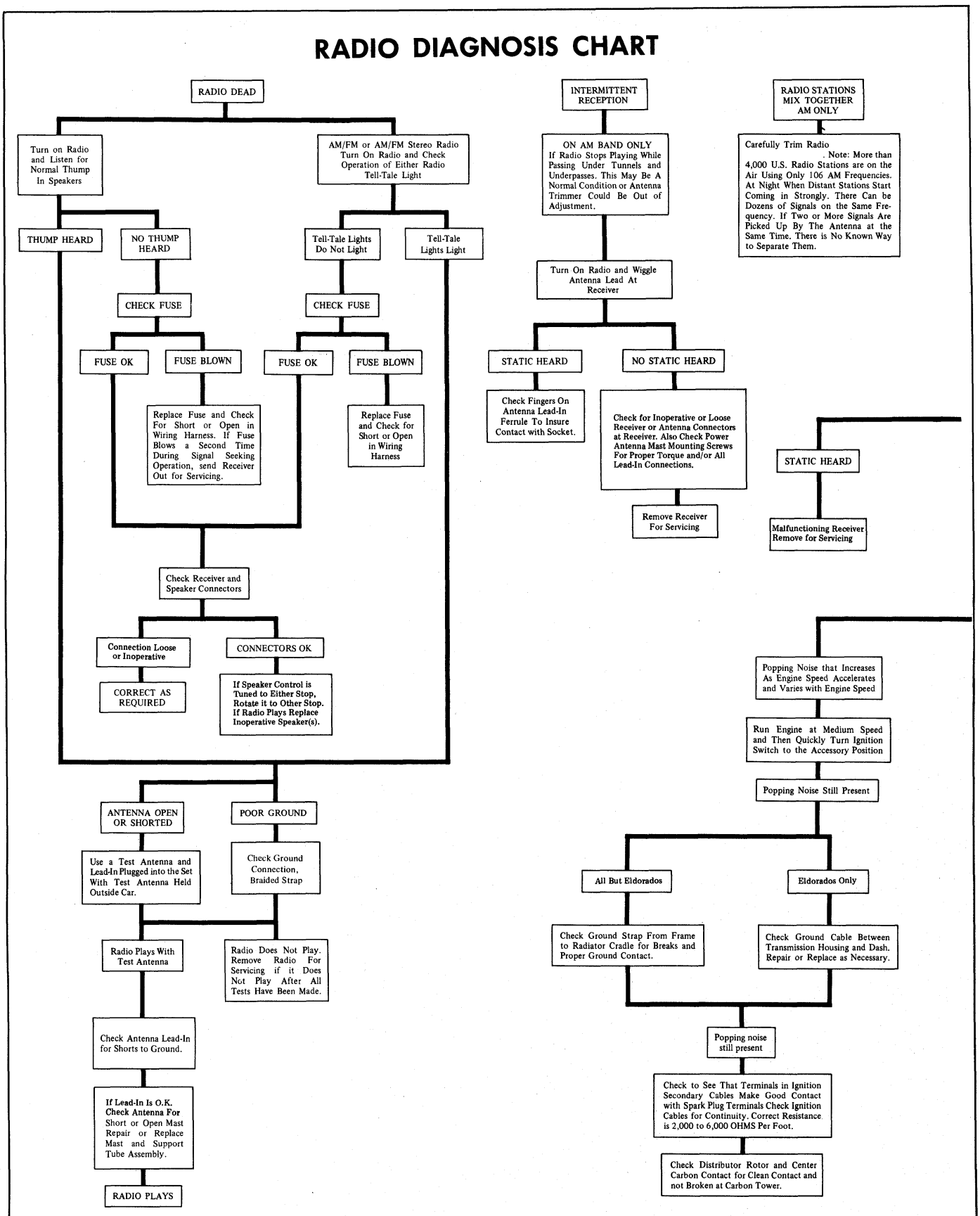


Fig. 9-13 Electric Antenna Circuit Diagram (Seville)

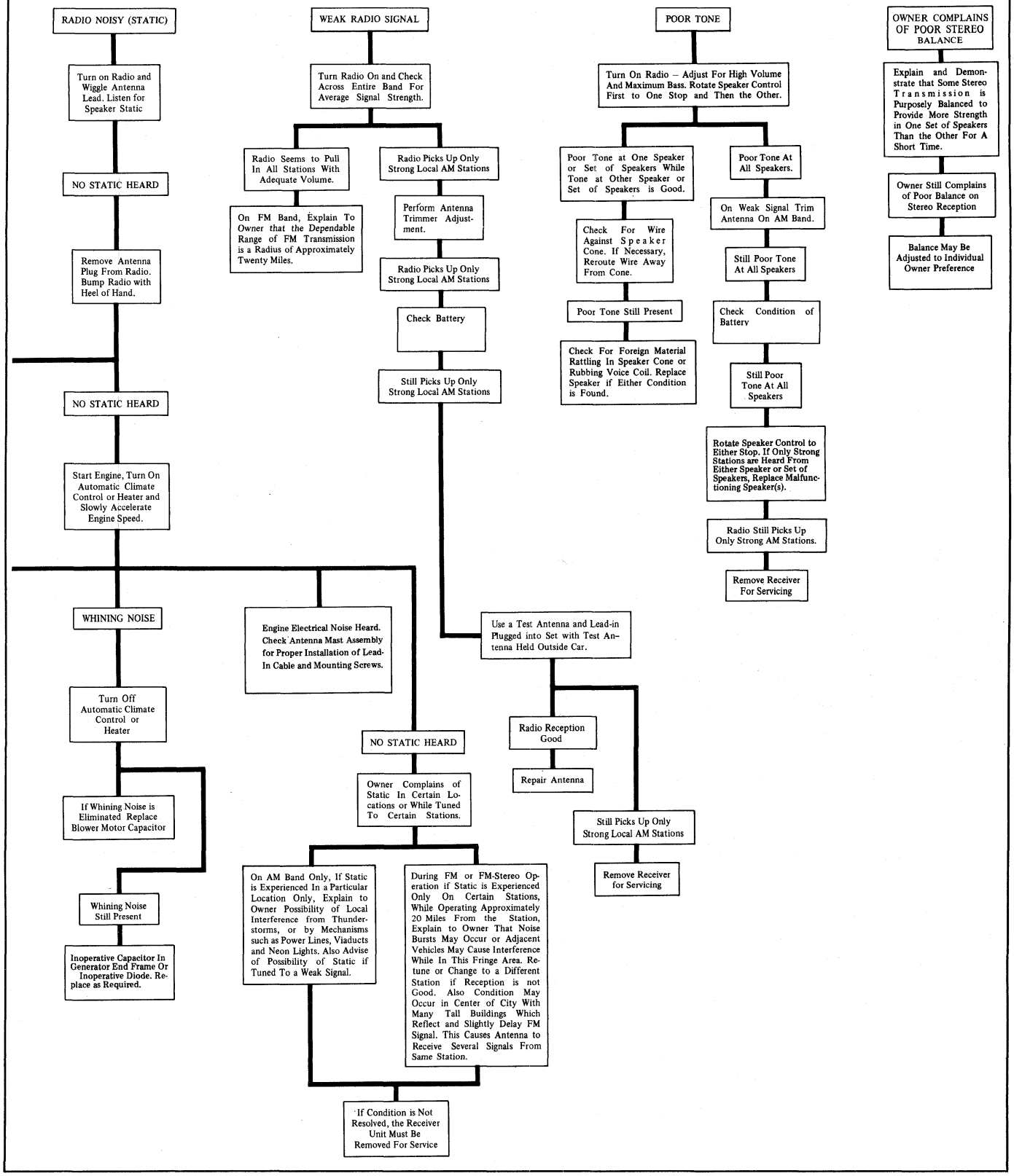
INTEGRAL STEREO EIGHT TRACK TAPE PLAYER DIAGNOSIS



RADIO DIAGNOSIS CHART



RADIO DIAGNOSIS CHART



POWER ANTENNA DIAGNOSIS (Exc. Eldorado)

CONDITION	CAUSE	CORRECTION
Antenna does not operate when ignition is "ON" and radio switch is turned "ON", and antenna switch is not in "OFF" position.	Open 7-1/2 amp Radio fuse	Replace 7-1/2 amp Radio fuse in fuse block
	Open 20 amp (Seville)/10 amp (Exc. Eldorado and Seville) Antenna fuse	Replace Antenna fuse in fuse block
	Antenna relay disconnected	Connect wiring connectors to relay (Seville). Plug in relay to relay center (exc. Seville).
	Antenna wiring connector (3 way) disconnected	Connect 3 way antenna wiring connector to harness connector
	Antenna not grounded (open) at fender mount.	Remount antenna to fender to secure proper ground
	Radio power connector disconnected	Connect power connector to radio receiver
	Relay power wire (pink wire) disconnected at harness	Connect relay (pink wire) to harness connector
	Relay inoperative (click should be audible when radio switch is turned "OFF" with antenna switch in "UP" position.	Replace relay
	By-passed up/down limit switch.	Replace cap and automatic switch assembly (on antenna)
	Antenna motor inoperative	Replace motor and drive assembly
Antenna operates both up and down automatically and up manually to full height, but cannot be operated downward by manual switch.	Manual antenna switch white wire open	Repair white wire as necessary
	Manual antenna switch does not make contact in "DOWN" position	Check for loose connection. If secure, replace antenna switch assembly
Motor runs but antenna does not move; or only moves a short distance up or down.	Drive cable slippage at engagement point inside motor housing	Replace motor and drive assembly
	Drive disconnected from mast	Replace mast and support tube assembly
	Stripped drive gears inside motor housing	Replace motor and drive assembly
	Slipping clutch inside motor housing	Replace motor and drive assembly
Motor continues to run without stopping after antenna is extended to its full height, or it continues to run with ignition switch turned "OFF" and mast secured into fender (On C and K bodies, one to five clutch clicks are normal after antenna has lowered into fender before motor stops)	Inoperative or bypassed "UP" limit switch	Replace cap and automatic switch assembly (on antenna)
	Inoperative or by-passed "DOWN" limit switch	Replace cap and automatic switch assembly (on antenna)

POWER ANTENNA DIAGNOSIS — ELDORADO

PROBLEM	PROCEDURE	RESULTS
Antenna Inoperative; motor will not run	Step 1 — Check Radio and Antenna fuses	Radio fuse blown — Go to Step 2 Antenna fuse blown — Go to Step 3 Fuses OK — Go to Step 6
	Step 2 — Replace Radio fuse and recheck antenna operation	Antenna inoperative — recheck Radio fuse. If blown, locate and repair shorted or grounded condition in circuit between fuse block and antenna relay terminal No. 6, Fig. 9-14. Antenna operative — End of test
	Step 3 — Replace Antenna fuse and recheck antenna operation	Antenna inoperative — recheck antenna fuse, if blown go to Step 4 Antenna operative — End of test
	Step 4 — 1. Disconnect electrical connector at antenna unit and replace fuse 2. Turn ignition switch ON 3. Place antenna dash switch in AUTO position 4. Turn radio switch ON and OFF several times, then check fuse	Antenna fuse blown — locate and repair shorted or grounded condition in circuit from fuse block to relay terminal No. 4 or from terminal No. 2 and No. 3 to antenna, Fig. 9-14. Antenna fuse OK — Go to Step 5
	Step 5 — Reconnect electrical connector at antenna unit and check antenna operation	Antenna inoperative — Recheck fuse, if blown, check antenna unit wires for shorted or grounded condition. If no wiring defect is found, replace antenna unit Antenna operative — End of test
	Step 6 — Disconnect electrical connect at antenna unit and make two voltage checks; Voltage Check No. 1 1. Radio and ignition switches ON, dash switch in AUTO position 2. Connect test light to ground and probe wire terminal (blk.) that connects to black wire terminal, Fig. 9-14. Voltage Check No. 2 1. Ignition switch OFF, dash switch in AUTO position 2. Connect test light to ground and probe white wire that connects to antenna white wire terminal, Fig. 9-14	Test light ON in both checks — Reconnect electrical connector and go to Step 7 Test light OFF in both checks — Recheck antenna fuse, if OK, go to Steps 8 and 9 Test light OFF at voltage check No. 1 — Go to Step 8 Test light OFF at voltage check No. 2 — Go to Step 9
	Step 7 — Try operating antenna as described below: To Extend Antenna — 1. Ignition and radio switches ON. dash switch in AUTO position	Antenna extends and retracts Antenna unit OK, problem is in underhood wiring harness, dash harness, or antenna relay. Go to Step 10 Antenna motor runs but mast will not

POWER ANTENNA DIAGNOSIS — ELDORADO (Cont'd.)

CONDITION	CAUSE	CORRECTION
Antenna Inoperative (Cont'd.)	2. Connect jumper wire from antenna connector red wire to ground, Fig. 9-14. To Retract Antenna — 1. Ignition switch OFF, dash switch in AUTO position 2. Connect jumper wire from antenna connector black wire to ground, Fig. 9-14.	move — Refer to diagnosis procedure under problem description: "Antenna will not move up and down full travel or antenna motor runs but mast will not move" Antenna inoperative; motor will not run — Replace antenna unit
	Step 8 — 1. Ignition and radio switches ON, dash switch in AUTO position 2. Connect test light to ground and probe instrument panel wiring harness terminals 3, 4 and 6 at relay, Fig. 9-14.	Test light ON at terminals 3, 4 and 6 — Locate and repair open in wire from No. 3 terminal to antenna black wire terminal Test light ON at terminal 4 and 6, OFF at 3 — Check relay ground from terminal No. 5. If OK, relay is defective Test light OFF at Terminal 4 — Recheck antenna fuse. If OK, locate and repair open in circuit from fuse block to relay terminal No. 4 Test light OFF at terminal 6 — Recheck radio fuse. If OK, locate and repair open in circuit from radio fuse to relay terminal No. 6
	Step 9 — 1. Turn ignition OFF and place dash switch in AUTO position 2. Check test light to ground and probe car wiring terminal at relay terminal No. 2, Fig. 9-14. Step 10 — 1. Disconnect antenna wiring harness from underhood wiring harness 2. Turn ignition switch OFF and place dash switch in AUTO position 3. Connect test light to battery (+) positive source and probe wire terminal that attaches to antenna black wire, Fig. 9-14.	Test light ON — Locate and repair open in wire from relay terminal No. 2 to antenna white wire terminal Test light OFF — Replace relay Test light ON — Go to Step 11 Test light OFF — Replace relay
	Step 11 — 1. Ignition and radio switches ON, dash switch in AUTO position 2. Connect test light to battery (+) positive source and probe wire terminal that connects to antenna red wire, Fig. 9-14.	Test light ON — Car wiring and relay OK, recheck antenna operation (Step 7) Test light OFF — Go to Step 12
	Step 12 — Same set-up as Step 11, probe wire terminal connected to relay terminal No. 1, Fig. 9-14.	Test light ON — Locate and repair open in wire between antenna red wire terminal and relay terminal No. 1 Test light OFF — Check relay ground circuit. If OK, replace relay.

POWER ANTENNA DIAGNOSIS — ELDORADO (Cont'd.)

PROBLEM	PROCEDURE	RESULTS
Antenna will not move up and down full travel or antenna motor runs but mast will not move	1. Remove antenna unit from vehicle 2. Disassemble mast and support tube assembly from motor gear box assembly 3. Check that drive cable is attached to mast, manually extend and retract the mast sections and note whether or not they move freely	Antenna will not extend/retract — Replace mast and support tube assembly Antenna sections operate normally — If drive cable does not appear to be worn or damaged replace antenna assembly
Antenna operates normally in AUTO mode but will not retract manually	Check for open condition in wire between antenna dash switch and relay terminal No. 2	Wire open — Repair condition No open condition — Replace dash switch

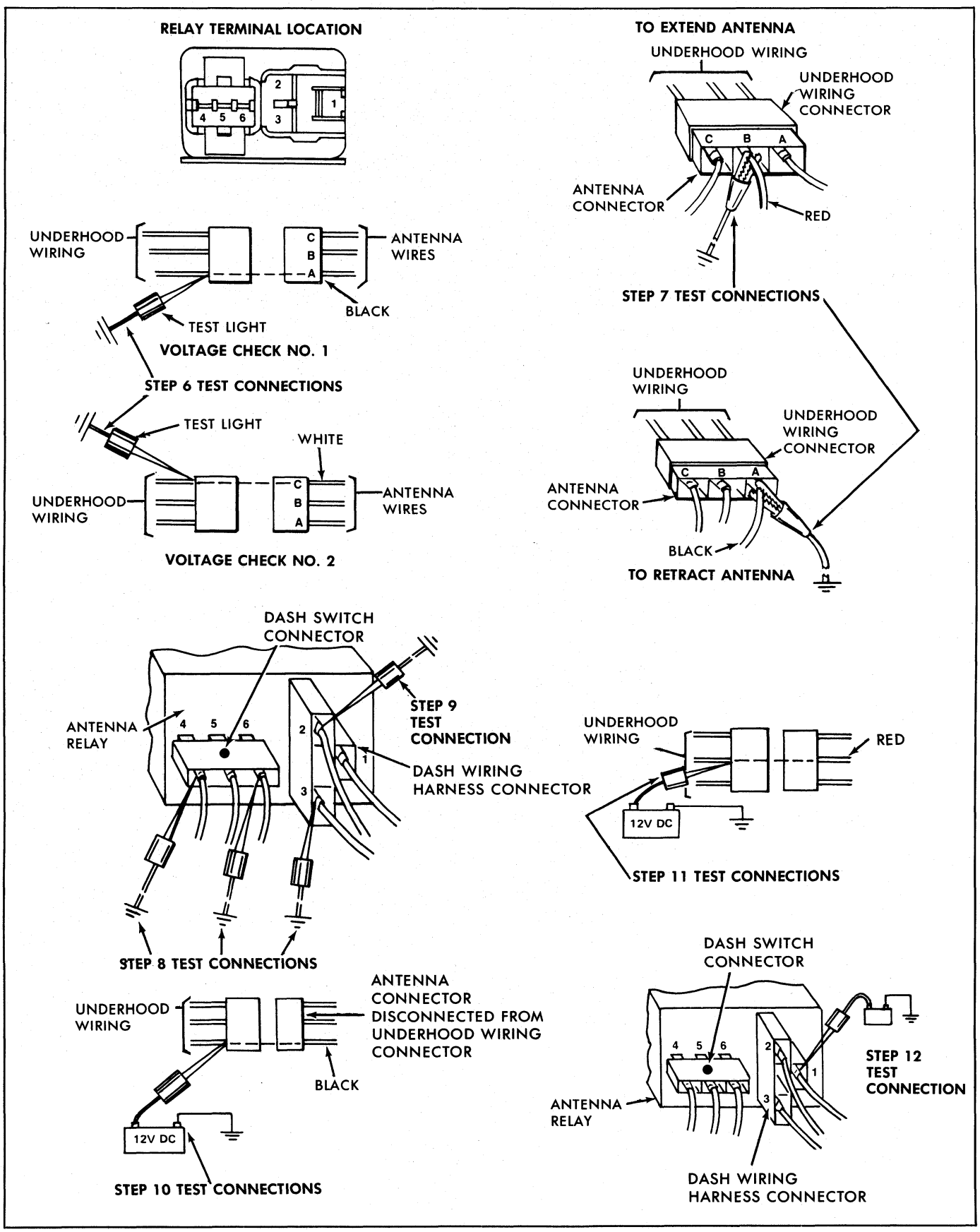


Fig. 9-14 Power Antenna Diagnosis Test Connections (Eldorado)

ON-CAR SERVICE

Minor Adjustments

a. Antenna Trimmer Adjustment (Fig. 9-15)

NOTE: If antenna is not trimmed, the set will have weak and fading AM reception. Antenna trimming should always be performed after any radio or antenna repair work, or antenna replacement is completed).

1. Turn radio on. Switch to AM band.

2. Use manual antenna switch and extend mast to full up position.

3. Tune in a weak station at approximately 1400 Kilohertz on the AM band and turn volume control to maximum.

4. Adjust antenna trimmer, located behind right control knob ring, for maximum volume. Access to antenna trimmer is gained by removing right control knob, spring and ring use a standard 1/8" screwdriver to adjust the screw, Fig. 9-15.

NOTE: If during adjustment, the station becomes strong so that a change in volume cannot be heard with further screw rotating, tune to a weaker station and continue the adjustment).

b. Balance Adjustment, Fig. 9-16, (AM/FM Stereo Models Only)

If the sound appears to be louder on one side of the car than the other, an adjustment to the audio balance may be made.

NOTE: On some stereo programming, it is normal for one side to be louder than the other for a short time. This is done purposely for stereo effect. The only positive method to tell if the balance control needs adjustment is to tune in a non-stereo program and make a critical evaluation.

If the adjustment is needed proceed as follows:

1. Turn radio on. Switch to AM band.

2. Remove left knob, spring and control ring to gain access to stereo balance screw.

3. With fader control turned fully clockwise, insert screwdriver into balance screw, Fig. 9-16.

4. Rotate balance control adjustment clockwise or counterclockwise until the sound in the left and right speakers appear to have equal volume.

5. Install left control ring, spring and knob.

Stereo Tape

The only required maintenance on tape players is periodic cleaning of the tape player head. This service should be performed approximately every 100 hours of operation. The head cleaning is done by swabbing the head (unit still installed in car) with a cotton swab that has been dipped in rubbing alcohol.

No lubricants should be used since they will cause the player to operate improperly, especially at extreme temperature.

Do not bring any magnetized tools near the tape head. If the head becomes magnetized, every cartridge played in the player will be degraded.

A test tape cartridge, Fig. 9-34 is available for diagnosing problems in tape players. The "Stereo 8" test tape cartridge is part #J-22683-01. Test tape cartridges should always be stored in a container to keep the tape clean.

RADIO UNIT (Exc. Eldorado and Seville, Fig. 9-17)

a. Removal

1. Remove center instrument panel insert as described on page 8-8.

2. Remove 4 screws securing radio to lower instrument panel.

3. Disconnect 3 electrical connectors and antenna lead-in at radio unit and remove radio.

b. Installation

1. Connect 4 electrical connectors and antenna lead-in at radio unit.

2. Secure radio unit to lower instrument panel with 3 screws.

3. Re-install center instrument panel insert as described on page 8-8.

4. Check radio operation.

RADIO SPEAKER (Exc. Eldorado and Seville)

a. Remove

1. Remove instrument panel top cover as described on page 8-2.

2. Remove 2 fasteners securing each speaker to upper instrument panel.

3. Disconnect electrical connections at speakers.

4. Remove speaker.

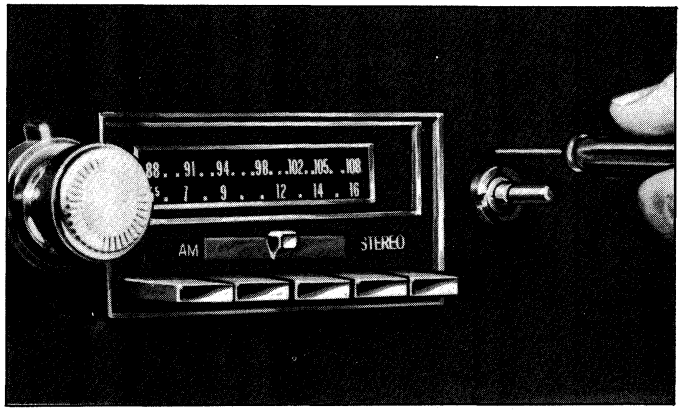


Fig. 9-15 Antenna Trimming Adjustment

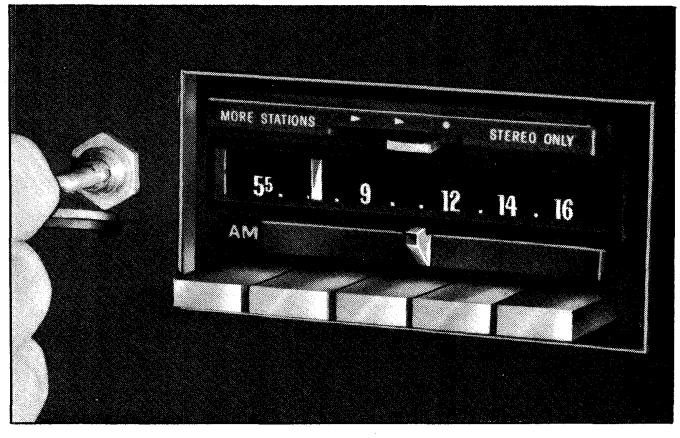


Fig. 9-16 Stereo Speaker Balance Adjustment

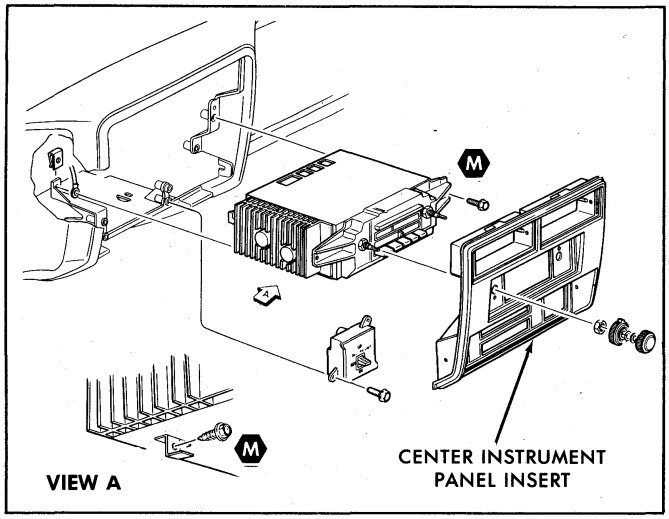


Fig. 9-17 Radio (Exc. Eldorado and Seville)

b. Installation

1. Connect electrical connector at speaker.
2. Position each speaker and secure to upper instrument panel with 2 fasteners.
3. Check speaker operation.
4. Re-install instrument panel top cover as described on page 8-2.

Radio Rear Seat Speaker (Exc. Seville)

a. Removal

NOTE: Access to rear speaker is gained through trunk compartment.

1. Remove 3 retainers which secure speaker baffle.
2. Disconnect speaker lead from connector at rear of speaker. This is a brown wire on the AM/FMStereo left rear speaker and a dark blue wire on all right rear speakers.
3. Remove four nuts securing speaker to rear filler panel and remove speaker.

b. Installation

1. Install speaker to rear filler panel and tighten four attaching nuts evenly to a maximum of 12 inch-pounds to prevent speaker distortion.
2. Connect speaker lead to connector at rear of speaker. This is a brown wire on the AM/FM Stereo left rear speaker and a dark blue wire on all right rear speakers.
3. Install speaker baffle and secure with 3 retainers.

Rear Seat Remote Control Unit (Fleetwood Limousine Styles Only)

a. Removal

1. Remove rear seat cushion by pushing rearward and lifting forward edge of cushion, then pull forward.
2. Remove rear seat back by removing two screws along lower edge of back and lifting assembly off mounting hooks.
3. Remove five screws securing right quarter window garnish molding and remove molding.
4. Remove six screws retaining right arm rest assembly.
5. Remove right front and rear door sill plates.
6. Remove right front kickpad.
7. Peel back carpet to gain access to remote cable along right sill, and remove securing tape.
8. Remove instrument panel top cover as described on page 8-2.
9. Disconnect cable assemblies at rear of radio.
10. Remove one screw and bend two clips out of way and remove cable from shroud vent duct and hinge pillar areas.
11. Thread cable through harness conduit in rear partition.
12. Loosen set screw in knob assembly and remove knob assembly, felt washers, and sensitivity ring.
13. While holding control and cable assembly in one hand, remove jamb nut securing assembly to escutcheon.
14. Route cable out of right rear quarter trim panel assembly.

b. Installation

1. Thread plug end of cable forward through hole in line with harness conduit in rear partition.
2. Route cable to radio through hinge pillar area and along shroud vent duct.
3. Connect cable assemblies at left rear corner of radio.
4. Route cable along instrument panel and install in wiring conduit. Secure with one screw and two clips.
5. Secure control and cable assembly to escutcheon with jamb nut.
6. Install sensitivity ring, felt washer, and knob assembly and tighten set screw in knob assembly.
7. Turn on radio and test for operation. Extend antenna fully and peak antenna trimmer on weak station at approximately 1400 Kilohertz on AM band, as described on page 9-23.
8. Install right front kickpad.
9. Install carpet and right front and rear door sill plates.
10. Install instrument panel top cover as described on page 8-2.
11. Install right armrest assembly with six attaching screws.
12. Install right quarter window garnish molding and secure with five screws.
13. Install rear seat back on mounting hooks and secure with two attaching screws.
14. Install rear seat cushion.

Radio Receiver Unit (Eldorado, Fig. 9-18)

a. Removal

1. Remove ash tray as described on page 8-28.
2. Remove radio knobs, anti-rattle springs, control rings and hex nuts.
3. Remove radio to lower instrument panel support brace nut at rear of radio.
4. Loosen brace to support screw and rotate brace to the right.
5. Slide radio from instrument panel and disconnect antenna cable, speaker connector and power connector.
6. Rotate dial side downward and lower the left hand side of the radio. Remove through ash tray opening.

b. Installation

1. Position radio into instrument panel, connect antenna cable, speaker connector and power connector.
2. Install brace onto radio and tighten support screws.
3. Install radio to brace nut.
4. Install hex nuts, anti-rattle springs, and radio knobs.
5. Install ash tray as described on page 8-28.

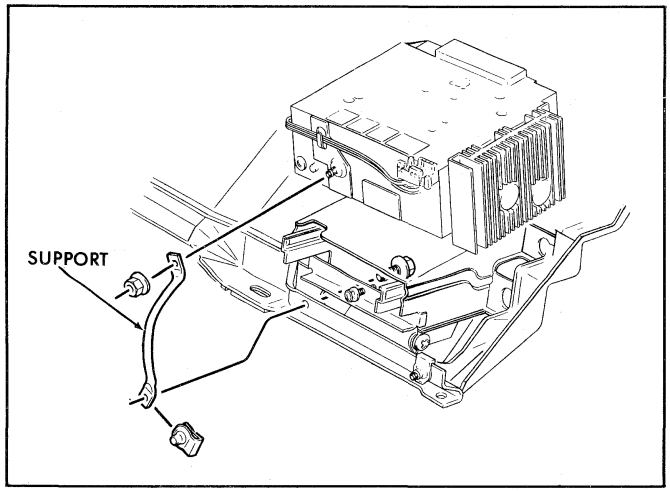


Fig. 9-18 Radio (Eldorado)

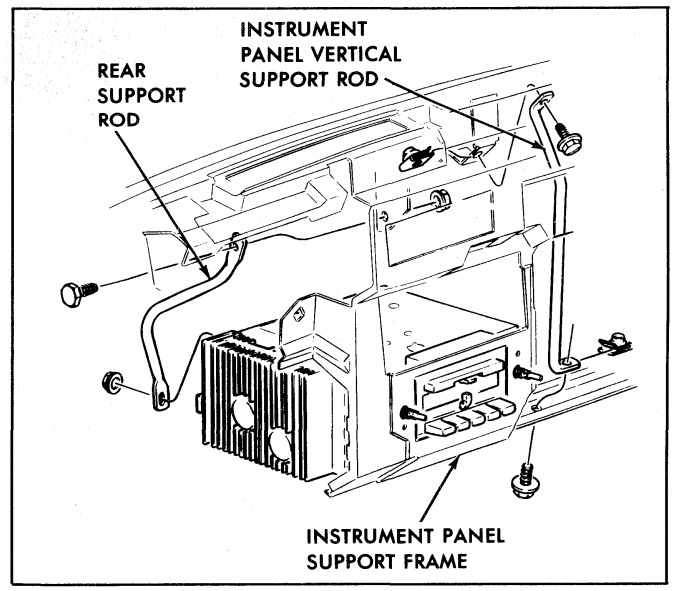


Fig. 9-20 Radio (Seville)

Radio Front Speakers (Eldorado Fig. 9-19)

a. Removal

1. Left Speaker-Remove instrument panel pad as described on page 8-21. Remove screw, disconnect air duct and push forward. Right speaker may be removed by working through access area in top of glove box.

2. Depress spring retainer, and remove speaker.

3. If speaker is malfunctioning cut wires and remove.

b. Installation

1. Position speaker in top cover and secure with retaining spring.

2. Cut wires to proper length and splice into new speaker leads. Solder or crimp with solderless connector.

3. Left Speaker - Install air duct and secure with screw. Install instrument panel pad as described on page 8-21.

Radio Front Speaker Grilles (Eldorado, Fig. 9-19)

a. Removal

1. Remove instrument panel top cover as described on page 8-22.

2. Remove speaker by releasing spring retainer.

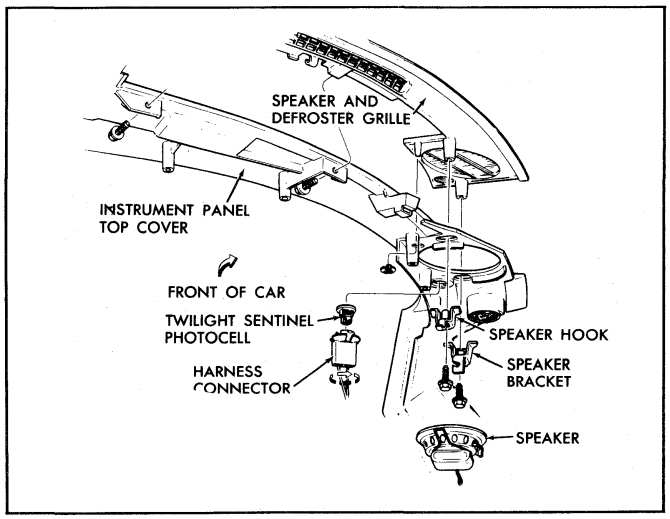


Fig. 9-19 Radio Speaker and Speaker/Defroster Grille (Eldorado)

3. Remove 2 screws securing speaker mounting brackets to top cover and remove brackets.

NOTE: Left grille:

a. Remove 2 screws securing tell tale extension to top cover.

b. Remove 8 screws securing tell tale base top cover. Remove tell tale side clock mounting screw only.

c. Carefully pivot tell tale assembly to gain access to speaker mounting screw.

4. Remove 2 screws securing speaker grille to top cover and remove grille.

b. Installation

1. Position speaker grille on top cover and secure with two screws.

NOTE: Left grille-install tell tale base and extension to top cover.

2. Install speaker mounting brackets and secure each with 2 screws.

3. Install speaker with retaining spring.

4. Install instrument panel top cover as described on page 8-22.

5. Install instrument panel pad as described on page 8-21.

Radio Receiver (Fig. 9-20, Seville)

a. Removal

1. Remove Electronic Fuel Injection (EFI) Electronic Control Unit (ECU) as described on page 8-52.

2. Remove screw securing climate control outlet extension to heater case.

3. Disconnect antenna.

4. Remove nut securing radio rear support rod to receiver and pivot rod out of way.

5. Remove control knobs, anti-rattle springs, control rings and **both** hex nuts.

NOTE: Both control knobs on radios with integral 8-track tape players are retained with 5/64 inch allen head set screws.

6. Slide radio forward and pivot back of radio down to gain access to electrical connectors.

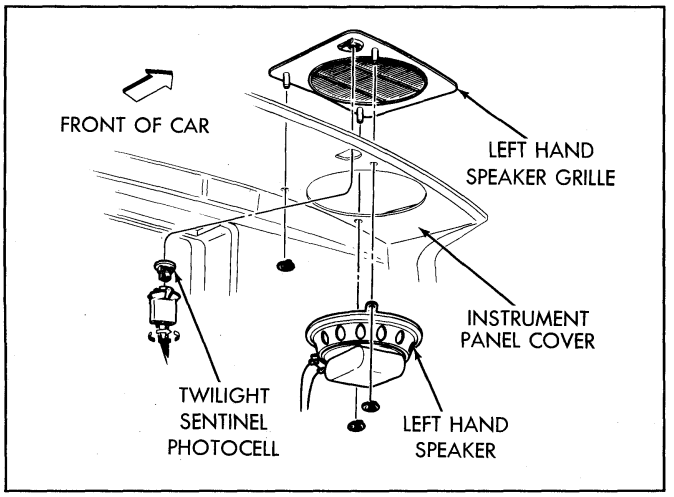


Fig. 9-21 Radio Speakers and Grilles (Seville)

7. Disconnect electrical connectors and remove radio.

b. Installation

1. Position radio under instrument panel and connect electrical connectors.
2. Slide radio into instrument panel opening, pivot rear support rod over radio stud and secure with nut.
3. Connect antenna lead.
4. Install hex nuts, control rings, anti-rattle springs and control knobs.
5. Tighten control knob 5/64 inch allen head set screws.
6. Install climate control outlet extension and secure with screw.
7. Install fuel injection electronic control unit as described on page 8-52.

Radio Front Speakers and Grilles (Fig. 9-21, Seville)

a. Removal

1. Remove top cover as described on page 8-44.
2. Left speaker only–remove telltale housing assembly as described on page 8-46.
3. Remove 2 fasteners securing speaker to top cover.
4. Remove third fastener to remove speaker grille.

NOTE: When removing or installing speakers note speaker wire routing through clips on top of climate control outlet ducts.

b. Installation

1. Position speaker grille and secure with fastener at inboard location.
2. Position speaker onto studs and secure with 2 fasteners.
3. Left speaker only - install telltale housing with 4 screws.
4. Install top cover as described on page 8-44.

Radio Rear Seat Speakers (Seville)

a. Removal

NOTE: Access to rear speaker is gained through trunk compartment.

1. Remove speaker baffle by removing 3 retainers.
2. Disconnect speaker lead from connector at rear of speaker.
3. Remove speaker retainer bracket.

b. Installation

1. Install speaker to rear filler panel with retainer bracket.
2. Connect speaker lead to connector at rear of speaker.
3. Install speaker baffle.

CB TRANSCEIVER (Figs. 9-22 Thru 24) REMOVAL AND INSTALLATION

a. Removal–All Exc. Eldorado with Carburetion

1. Remove glove box liner as described on page 8-11 (except Eldorado and Seville) or page 8-49 (Seville).
2. Remove electrical connector microphone jack and antenna lead-in at transceiver.
3. Remove 4 screws, 2 upper and 2 lower, securing transceiver to E.C.U. mounting brackets.
4. Remove transceiver from under instrument panel.

b. Installation

1. Position unit to E.C.U. mounting brackets and secure with 4 screws.
2. Reconnect electrical connector, microphone jack and antenna lead-in at transceiver.
3. Re-install glove box liner as described on page 8-11 (except Eldorado and Seville) or page 8-49 (Seville).

c. Removal–All Exc. Eldorado and Seville with E.F.I.

1. Remove 2 screws, one right and one left, securing transceiver to mounting brackets.
2. Disconnect electrical connector microphone jack and antenna lead-in at transceiver.
3. Remove transceiver.

d. Installation

1. Connect CB Antenna lead-in, microphone jack and electrical connector at transceiver.
2. Position unit to mounting brackets and secure with 2 screws.

e. Removal–Eldorado

1. Remove glove box liner as described on page 8-32.
2. Disconnect electrical connector, antenna lead-in and microphone jack at unit.
3. Remove 2 screws, one at left and one behind, securing transceiver to support brackets.
4. Remove transceiver through glove box opening.

f. Installation

1. Position unit to support brackets and secure with 2 screws.
2. Connect electrical connector, antenna lead-in and microphone jack to transceiver.
3. Reinstall glove box liner as described on page 8-32.

g. Removal–Seville

1. Remove glove box liner as described on page 8-49.
2. Disconnect 3 connections at transceiver.
3. Remove 2 screws securing unit to mounting brackets.

h. Installation

1. Position transceiver to mounting brackets and secure with 2 screws.
2. Connect electrical connector, CB antenna lead-in and microphone jack at transceiver.
3. Reinstall glove box liner as described on page 8-49.

CB Microphone (Fig. 9-4)

The CB microphone is serviced as an assembly consisting of the microphone, electrical cord and microphone jack. It can be removed by unhooking it from the holding bracket and disconnecting the jack at the transceiver.

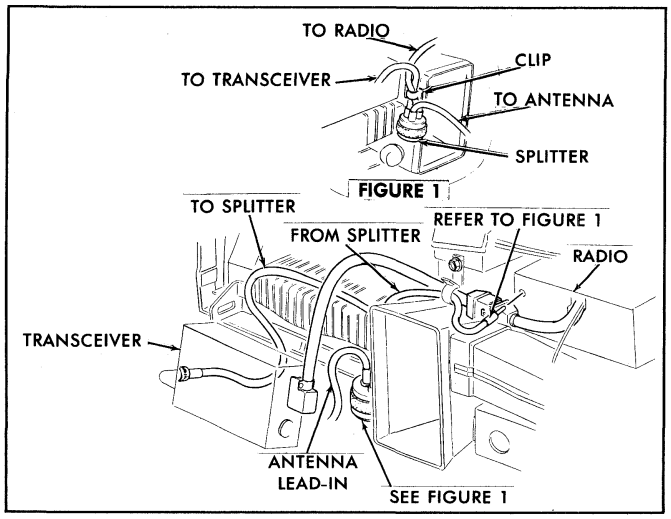


Fig. 9-22 CB Transceiver (Except Eldorado and Seville)

Electric Antenna Unit

Many antenna troubles can be prevented by cleaning and lightly oiling the antenna rod at periodic intervals. Cleaning is easily performed at oil change intervals, or when a car is being washed, by wiping the rod with a soft cloth.

NOTE: If car has been undercoated, check to make sure that drain holes have not been plugged.

If the antenna has been disassembled for service reseal all areas at which the sealer was disturbed to prevent the entry of moisture.

Moisture in Cylinder

Weak reception or fading may be caused by moisture in the support tube, due to condensation or leakage through the insulation bushings. If trouble has been traced to moisture in the tube, the antenna must be removed, disassembled and the drive housing should be cleaned or replaced. Always reseal motor, drive and lower mast after servicing antenna. The splash shield is important in preventing road splash from entering the lower drain holes. Before installing antenna, check drain holes in motor lower housing and below support tube mounting point to be sure they are not obstructed.

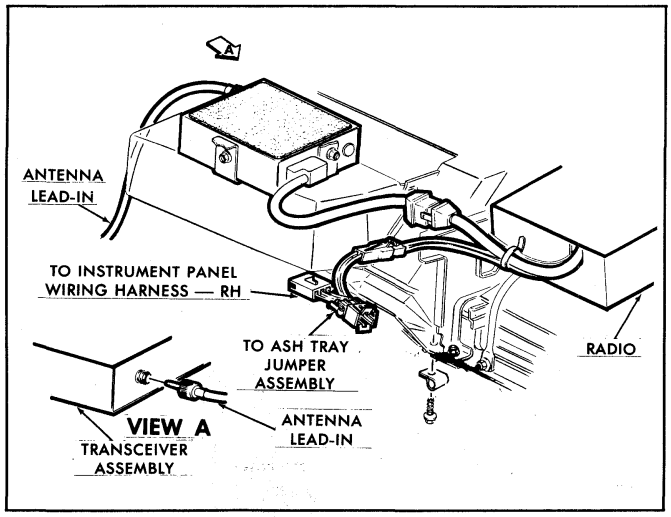


Fig. 9-23 CB Transceiver (Eldorado)

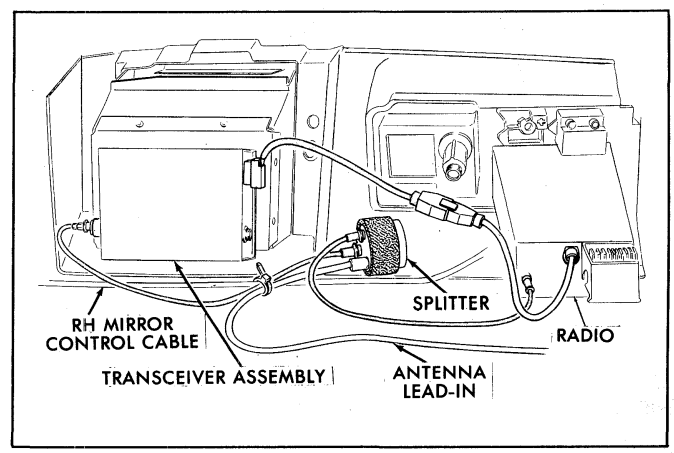


Fig. 9-24 CB Transceiver (Seville)

CITIZENS BAND ANTENNA

In its fully lowered position, the Seville "CB" antenna will remain approximately 3-3/4" above the fender. This is a normal condition and no attempt to lower the antenna further should be made.

POWER ANTENNA UNIT (Except Eldorado and Seville Fig. 9-25)

a. Removal

1. Lower antenna.
2. Disconnect negative battery cable at battery.
3. Disconnect electrical connector. Raise right front end of car and disconnect antenna lead-in cable from support tube.
4. Remove two screws which secure upper antenna mounting bracket to fender.
5. Remove bolt and washers securing antenna to right

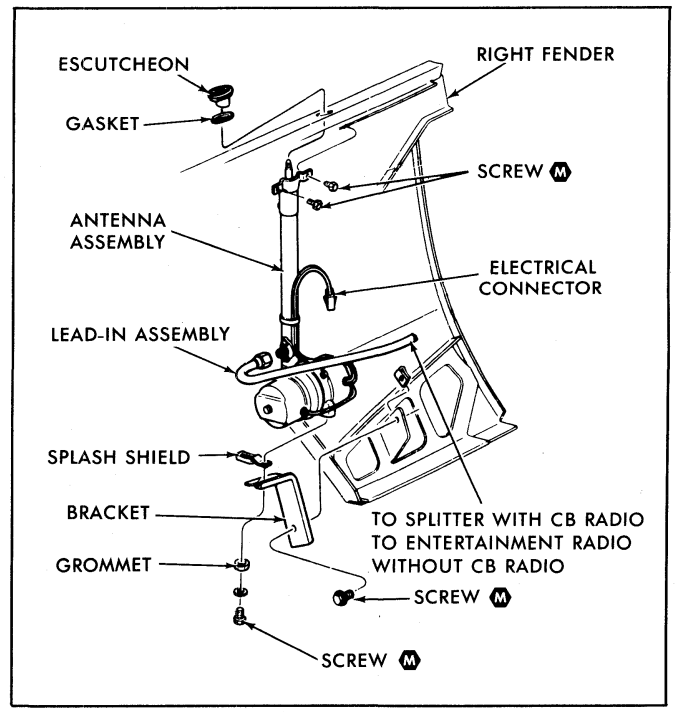


Fig. 9-25 Antenna Location and Attachment (Except Eldorado and Seville)

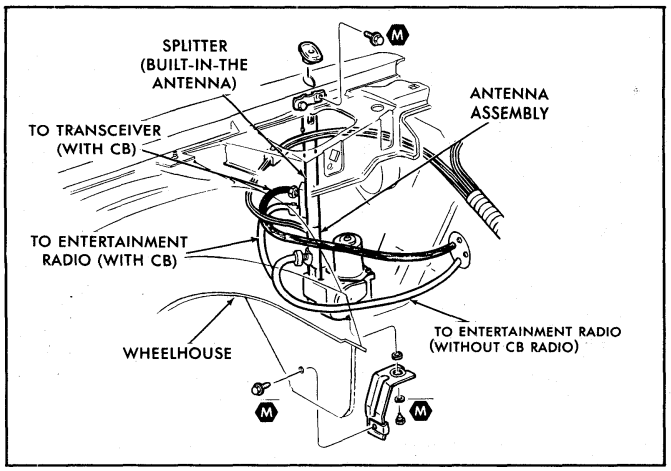


Fig. 9-26 Antenna Location (Eldorado)

fender antenna mounting bracket and grommet.

6. Remove 3 screws securing wheelhouse to fender.

7. Flex wheelhouse and remove antenna through opening.

8. Escutcheon may be removed by depressing lock tabs and pushing escutcheon out through top of fender.

b. Installation

1. Install escutcheon.

2. Flex wheelhouse and position antenna to fender through opening.

3. Install 3 screws securing wheelhouse to fender.

4. Install splash shield, bolt and washers securing antenna assembly to right fender antenna mounting bracket.

5. Install two screws securing upper antenna mounting bracket to fender.

6. Connect lead-in cable to support tube and lower car.

7. Connect electrical connector.

8. Connect negative battery cable and tighten to 70 inch pounds.

9. Check operation of antenna.

POWER ANTENNA UNIT (Eldorado, Fig. 9-26)

a. Removal

1. Lower antenna.

2. Disconnect negative battery cable at battery.

3. Disconnect electrical connector and antenna lead-in cable from support tube.

4. Remove two screws securing antenna support tube to upper fender.

5. Remove 1 screw securing antenna support bracket to wheelhouse.

6. Remove antenna and support bracket.

b. Installation

1. Place antenna in position to install.

2. Secure antenna support bracket to wheelhouse with screw.

3. Using 2 screws secure support tube to upper fender.

4. Connect electrical connector and antenna lead-in at antenna.

5. Connect negative battery cable at battery and tighten to 70 inch pounds.

6. Check antenna operation.

POWER ANTENNA OVERHAUL PROCEDURE–ELDORADO–(Mast and Support Tube Assembly Replacement Fig. 9-9)

a. Removal

1. Scribe a reference mark on the mast support tube and motor-gear box.

2. Remove tape attaching antenna wiring harness to support tube.

3. Remove 2 screws securing support tube to gear box and separate tube and gear box.

4. Clamp the gear box in a vise.

CAUTION: *Do not clamp gear box too tight or damage to unit may occur.*

5. Connect 12 volt power source to antenna to extend mast and run the drive cable out of the gear box. Continue until drive cable is completely out of gear box.

NOTE: If mast will not extend and/or drive cable does not move out of gear box, manually assist mast or cable while motor is running.

b. Installation

1. Start cable in the gear housing with cable looped in direction shown (grease cable lightly with lithium grease prior to installation).

2. Push cable into housing until it bottoms, then apply pressure to force an additional 3/4 inch of cable into gear box. This will engage the cable with the drive pulley.

3. Connect 12 volt power source to antenna to retract cable into gear box.

4. Assemble support tube to gear box using scribe marks as a positioning guide.

5. Use 2 screws to secure mast assembly to gear box. Torque the screws 20 inch pounds.

6. Reattach antenna wiring harness to support tube with tape.

7. Re-install unit in car as described above and check operation.

8. If mast does not fully extend, operate system to retract the mast. Continue running motor until motor-gear box limit switch shuts motor off. Then check complete operation (If mast does not fully retract reverse above procedure).

Electric Antenna (Seville, Fig. 9-27)

a. Removal

1. Remove 3 retainers which secure access plate to left hand wheelhouse.

2. Disconnect antenna lead and wiring harness connectors.

3. Using Tool J-25655 antenna nut wrench remove antenna escutcheon from top of fender.

4. Loosen screw securing antenna to wheelhouse mounting bracket.

5. Slide antenna and grommet from mounting bracket and remove through wheelhouse access port.

b. Installation

NOTE: Before installing antenna make certain the 2 drain holes in the bottom of the antenna housing and 2 drain holes at the base of the mast are open.

1. Position antenna inside fender, slide grommet onto mounting bracket and tighten screw to 65 inch pounds.

2. Install escutcheon nut using Tool J-25655 antenna nut wrench and tighten to 80 inch pounds maximum torque.

3. Connect antenna lead and wiring harness.

4. Position access plate and secure with 3 retainers.

5. Check antenna operation.

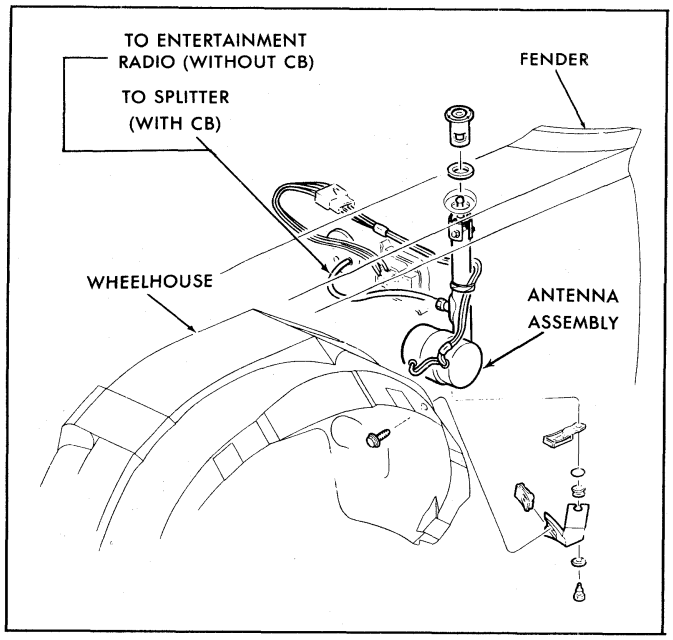


Fig. 9-27 Electric Antenna Installation (Seville)

Antenna Switch

The procedure of removing and installing the accessory switch panel is described on page 8-8 (Exc. Eldorado and Seville), page 8-31 (Eldorado) and page 8-47 (Seville).

UNIT REPAIR

Antenna Dog Assembly Replacement (Except Eldorado and Seville, Figs. 9-28 Thru 31)

a. Disassembly

1. Clamp antenna lower mounting boss in vise.
2. Remove 2 screws which secure automatic switch and cover assembly to drive housing. Cut sealer at housing-to-cover joint.
3. Separate switch and cover assembly from drive housing. Pry with screwdriver as shown in Fig. 9-28 to avoid cracking center housing ears.
4. Rock dog assembly gently with pliers as shown in Fig. 9-29 to loosen pin.
5. Remove pin securing dog assembly in position to shaft, Fig. 9-30.
6. Using open end wrench, remove dog assembly from shaft by turning dog counterclockwise.

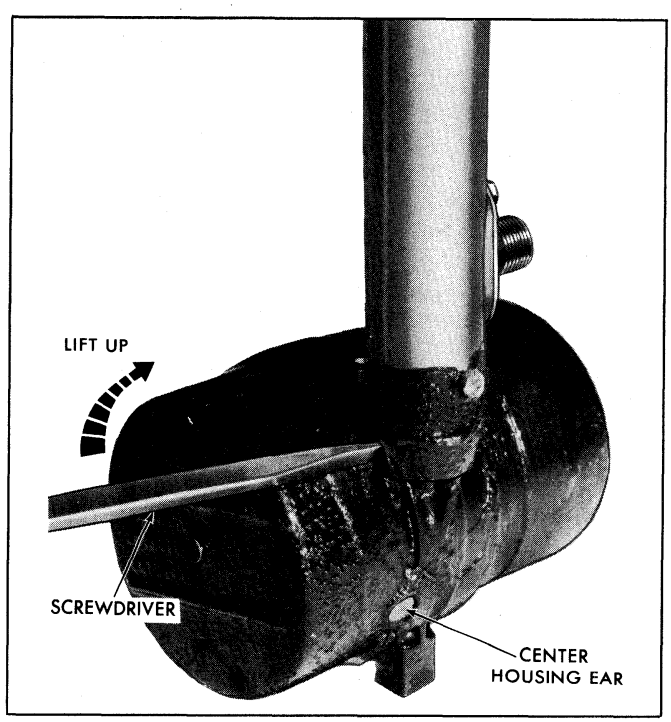


Fig. 9-28 Separating Cap From Antenna Housing (Except Eldorado and Seville)

b. Assembly

1. Loosely install dog assembly on shaft by turning in clockwise direction.
2. Using template provided, measure distance between top of pin on dog to case of drive housing, Fig. 9-31. Adjust as necessary.
3. Final position of dog assembly MUST be parallel with beam as shown in Fig. 9-31. If in final gaging dog is not parallel with beam, turn dog counterclockwise until it is.

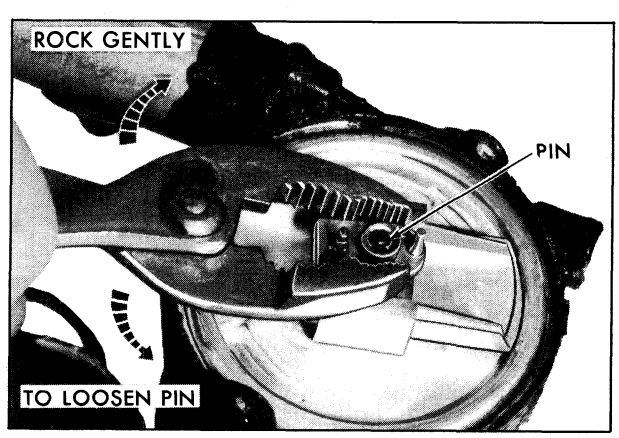


Fig. 9-29 Loosening Antenna Dog Pin (Except Eldorado and Seville)

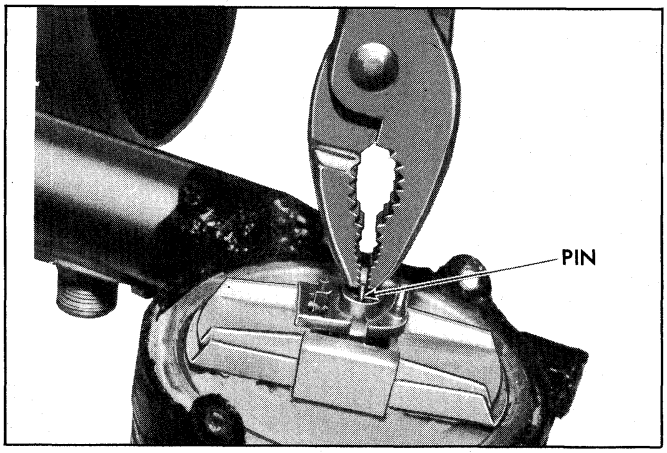


Fig. 9-30 Removing Antenna Dog Pin (Except Eldorado and Seville)

4. Install pin which secures dog to shaft Fig. 9-30.

5. Position automatic switch and cover assembly to driv housing and secure with 2 screws.

6. Remove antenna assembly from vise and reseal joint using care to be certain drain holes remain open.

Antenna Dog Assembly Replacement (Fig. 9-32, Seville)

a. Disassembly

1. Clamp antenna lower mounting boss in vise.

2. Remove 2 screws securing automatic switch assembly to drive housing and remove switch assembly.

3. Using open end wrench, remove dog assembly from shaft by turning dog counterclockwise.

b. Assembly

1. Loosely install dog assembly on shaft by turning in clockwise direction.

2. Using template provided, measure distance between top of longest pin on dog to base of drive housing, Fig. 9-32. Adjust as necessary.

3. Position automatic switch assembly to drive housing and secure with 2 screws.

4. Remove antenna assembly from vise.

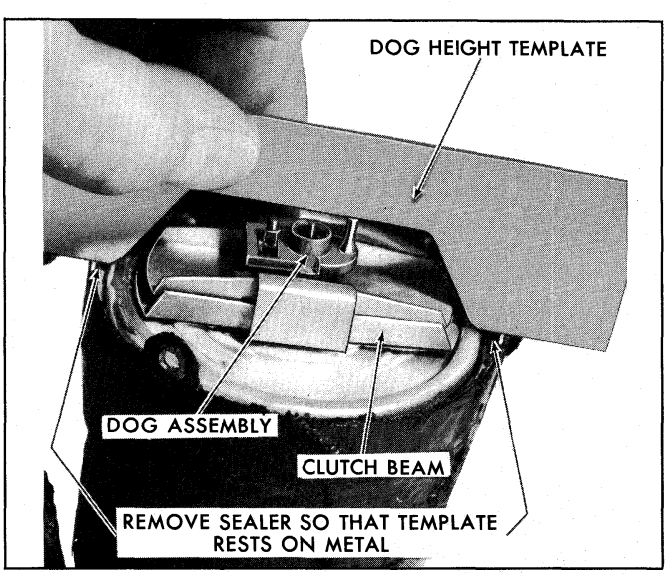


Fig. 9-31 Adjusting Dog Height and Position (Except Eldorado and Seville)

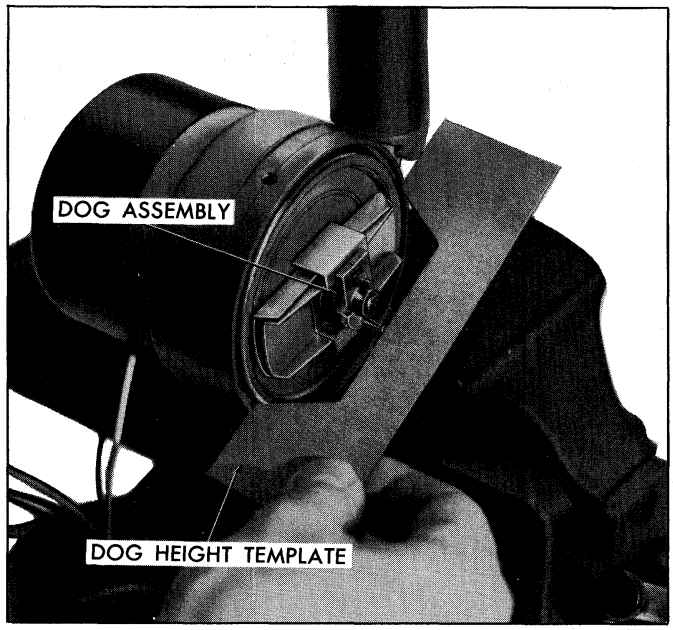


Fig. 9-32 Measuring Dog Height (Seville)

Antenna Cap and Automatic Switch Assembly Replacement (Fig. 9-28, Except Eldorado)

a. Disassembly

1. Clamp antenna lower mounting boss is vise.

2. Untape antenna wiring harness from support tube.

3. Remove 2 screws which secure automatic switch and cover assembly to drive housing. Cut sealer at housing-to-cover joint.

4. Separate switch and cover assembly from drive housing, Fig. 9-28.

5. Stagger cut black and white wires midway between motor and switch assembly and discard switch.

b. Assembly

1. Strip approximately 3/16" of insulation off black and white wires from both motor and switch leads.

2. Join leads together (black to black and white to white) and solder securely.

3. Tape solder joints with electrical tape.

4. Position automatic switch and cover assembly to drive housing and secure with 2 screws.

5. Tape antenna wiring harness to support tube.

6. Remove antenna assembly from vise and reseal joint using care to be certain drain holes remain open.

Antenna Motor and Drive Assembly Replacement (Fig. 9-33 Except Eldorado)

a. Disassembly

1. Remove dog assembly from shaft as described on page 9-29.

2. Stagger cut black and white wires midway between motor and switch assembly.

3. Remove three screws securing support tube assembly to drive housing and pull support tube and drive cable completely out of drive housing.

4. Remove motor and drive assembly from vise.

5. Cut sealer and use a thin bladed screw driver to remove motor cap, Fig. 9-33.

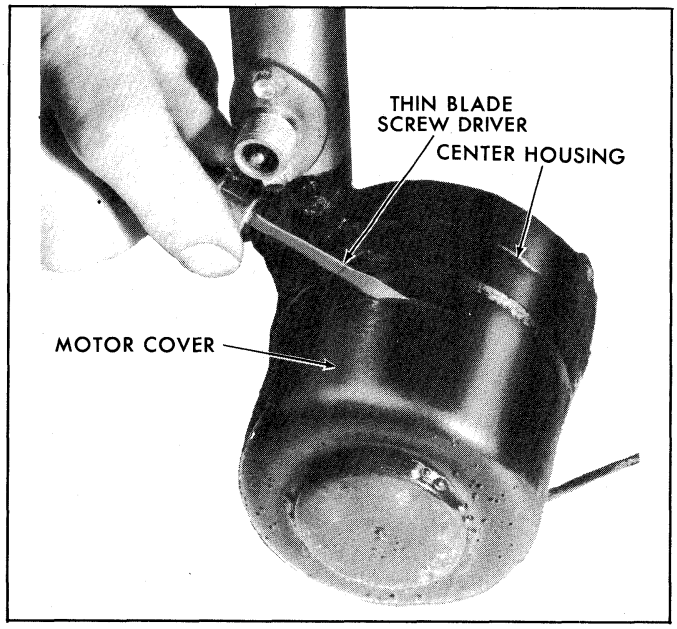


Fig. 9-33 Removing Antenna Motor Cap (Except Eldorado)

b. Assembly

1. Clamp new motor and drive unit mounting boss in vise.

2. Using template provided, measure distance between top of longest pin on dog to case of drive housing. Adjust as necessary. Final adjustment must place dog parallel with beam as shown in Fig. 9-31. If dog is not parallel turn dog counterclockwise until it is.

3. Install pin which prevents dog from turning on shaft.

4. Strip approximately 3/16" of insulation off black and white wires from both motor and switch leads.

5. Join leads together (black to black and white to white) and solder securely.

6. Tape solder joints with electrical tape.

7. Position automatic switch and cover assembly to drive housing and secure with 2 screws.

8. Apply 12 volts to black wire in four way connector while grounding antenna and run antenna to full up position.

9. Add small amount of lithium grease to cable and insert end of drive cable into drive housing and push in as far as possible to start cable.

10. With antenna grounded, apply 12 volts to white wire in four way connector and run antenna all the way down, guiding cable and mast while retracting.

11. Position support tube assembly to drive housing and secure with three screws.

12. To adjust cable for height, run antenna up until it stops; then down as outlined in Steps 7 and 9.

13. Reseal open joints using care to be certain drain holes remain open.

Antenna Mast and Support Tube Assembly Replacement (Except Eldorado)

a. Disassembly

1. Clamp antenna lower mounting boss in vise.

2. Untape antenna wiring harness from support tube.

3. Apply 12 volts to black wire in four way connector while grounding antenna and run antenna to full up position.

4. Remove three screws securing support tube assembly to drive housing and pull support tube and drive cable completely out of drive housing.

NOTE: If cable cannot be pulled out by hand remove antenna dog as outlined above.

b. Assembly

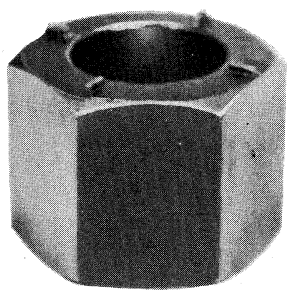
1. Add small amount of lithium grease to cable and insert end of drive cable into drive housing and push in as far as possible to start cable.

2. With antenna grounded, apply 12 volts to white wire in four way connector and run antenna all the way down, guiding cable and mast while retracting.

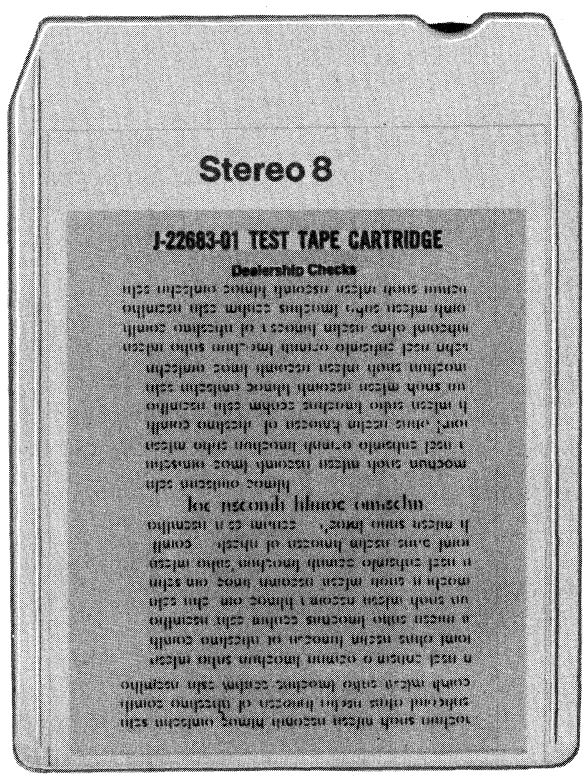
3. Position support tube assembly to drive housing and secure with three screws.

4. To adjust cable for height, run antenna up until it stops; then down as outlined in Disassembly Step 3 and Assembly Step 2.

5. Reseal open joint using care to be certain drain holes remain open.



J-22655
ANTENNA NUT WRENCH



J-22683-01
TEST TAPE CARTRIDGE

Fig. 9-34 Special Tools - Radio

ELECTRONIC CRUISE CONTROL
GENERAL DESCRIPTION

Cruise Control is a speed control system that uses engine manifold vacuum to actuate the throttle power unit, Fig. 9-37. The power unit moves the throttle when its diaphragm is subjected to varying amounts of vacuum. The amount of vacuum to the power unit is controlled by a power unit solenoid valve attached to the power unit in line with a vacuum control valve. The power unit solenoid valve constantly modulates vacuum to the power unit in response to commands from the electronic controller. The controller receives signals from the engagement and instrument panel switches, electric brake release switch and speed sensor. The speed sensor consists of a light emitting diode and photo transistor. The photo transistor generates an electrical signal to the electronic controller when exposed to light from the light emitting diode. Power is supplied to the diode when the cruise control system is on.

Signals representative of the speed of the car are sensed by the photo transistor which is activated by reflected light from each passing bar of the rotating speedometer speed cup drive magnet. The surface of the drive magnet is highly reflective to enhance the reflection of light to the photo transistor. The speed cup has a dull black finish which inhibits the reflection of light thus preventing erroneous signals from being sent to the electronic controller. The light from the light emitting diode is in the infra red area of the spectrum, which is not visible to the human eye. Both the light emitting diode and photo transistor are enclosed in one connector which attaches to the back of the speedometer cluster adjacent to the speedometer cable (Fig. 9-37). A wire harness connects the speed sensor to the electronic controller.

Input signals received from the sensor by the electronic controller are used to control the power unit solenoid valve which regulates the amount of vacuum that must be supplied to the power unit in order to control the speed of the car.

A three position (on-off-auto) switch, located on the instrument panel, and an engagement switch, located at the end of the turn signal lever, control the operation of the system.

Two systems for brake release are provided:

1. An electric switch mounted on the brake pedal support cancels the controller signal and shuts off the system by venting the power unit.

2. A vacuum release valve is also mounted on the brake pedal bracket which vents the system vacuum to the atmosphere as a second disengagement system.

ELECTRONIC CONTROLLER

The electronic controller receives signals from the cruise engagement switch, instrument panel switch, electric brake release switch and speed sensor. It processes this information and transmits voltage commands to the vacuum control valve and power unit solenoid valve on the power unit.

VACUUM CONTROL VALVE

The vacuum control valve opens when the system is engaged and the green light on the instrument panel switch is illuminated. The valve operates in response to commands from the electronic controller acting through a relay. A diode is used to divert voltage surges produced by operation of the relay coil away from the electronic controller. When the vacuum control valve is open, vacuum is available at the power unit solenoid valve for control of the power unit as described below. The vacuum control valve is closed when the system is off.

POWER UNIT SOLENOID VALVE

The solenoid valve constantly modulates vacuum to the power unit in response to commands from the electronic controller so that the throttle is always in the proper position for the desired cruise speed.

POWER UNIT

The Power Unit is a vacuum actuated variable position diaphragm assembly that positions the throttle when the system is in operation. It is powered by controlled vacuum from the power unit solenoid valve mounted on the power unit and operates the throttle linkage via a throttle cable (except Eldorado and Seville) or bead chain (Eldorado and Seville). The power unit has a port on the sealed side of the diaphragm housing. When controlled vacuum is applied to this port, atmospheric pressure moves the diaphragm inward and pulls on the throttle cable or bead chain thus opening the throttle.

BRAKE RELEASE SWITCHES

One electrical brake release switch and one vacuum release valve are employed in the Cruise Control system.

When the brake pedal is depressed, the electric release switch cuts off the voltage supplied thru the engagement switch to the electronic controller. Engagement switch operation is required to return the electronic controller to operation. The vacuum release valve operates after the electric release switch whenever the brake pedal is depressed. This switch serves as a backup release system and opens a port to atmospheric pressure that vents the power unit if the electrical switch did not release thereby returning the throttle to the idle position.

INSTRUMENT PANEL SWITCH (Fig. 9-35)

This switch is located on the instrument panel to the left of the steering column adjacent to the headlamp switch. The three position toggle switch controls the electrical power to the cruise control system. When the switch is in the "OFF" position the system cannot be engaged. When the switch is

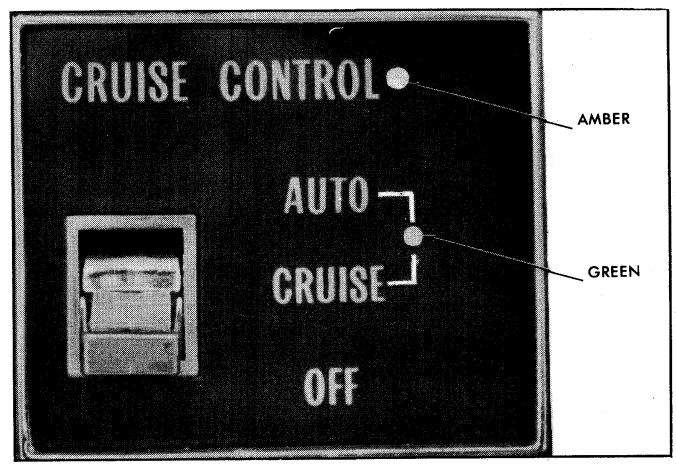


Fig. 9-35 Cruise Control Instrument Panel Switch

in either "CRUISE" or "AUTO", the amber light to the right of the words "CRUISE CONTROL" is lit and the system may be engaged with the switch located in the turn signal lever at any speed above approximately 25 mph. When the system is engaged, a green light is illuminated adjacent to the words "AUTO" and "CRUISE" as shown in the figure.

ENGAGEMENT SWITCH

The engagement switch, located within the turn signal lever, has various modes of operation and is dependent upon the position of the instrument panel switch.

With the instrument panel switch in the "OFF" position, the system will not operate.

With the instrument panel switch in the "CRUISE" position, the engagement switch operates as follows:

a. Switch in fully released position:

1. System not engaged: No function of the system will occur.

2. System has been previously engaged: Control voltage is being supplied to the power unit solenoid valve from the electronic controller. The power unit solenoid valve regulates vacuum to the power unit which maintains throttle position for desired speed.

b. Switch Partially Depressed (Detent Position)

The electronic controller is activated and a control voltage is supplied to the power unit solenoid valve. In turn, the power unit solenoid valve regulates the vacuum supplied to the servo to initially set or reset the speed.

c. Fully Depressed

The electronic controller signals the power unit solenoid valve to vent the power unit to atmosphere. This position is used by the driver when a decrease in speed is desired.

The driver may fully press the button with no pressure on the accelerator pedal. In this case, the throttle returns to idle and the car slows. When the button is released, the vehicle will cruise at the new lower speed.

With the instrument panel switch in the "AUTO" position, the engagement switch operates as follows:

a. Switch in Fully Released Position

Operation is the same as when the instrument panel switch is in the "CRUISE" position.

b. Switch Partially Depressed (Detent Position)

This position allows the driver to engage the system at a given speed, resume that speed after braking and accelerate from a previously set speed. After obtaining the desired speed using the accelerator pedal the driver can partially depress the engagement switch and the electronic controller will provide a control voltage to the power unit solenoid valve and regulate the required vacuum to the power unit to maintain the set speed. If the driver momentarily applies the brakes and wishes to resume the previously set speed, partially depressing and releasing the engagement switch (above approx. 25 mph), will accelerate the car at a controlled rate until the previously set speed is reached. If the driver wishes to advance the speed of the car from an initial set speed, partially depressing and holding the engagement switch will accelerate the car at a controlled rate until the push button is released. The car will now cruise at the new speed.

c. Fully Depressed

Operation is the same as when the instrument panel switch is in the "CRUISE" position.

DIAGNOSIS

ROAD TEST

1. Put dash switch in "OFF" position. Drive car to 50 mph. Push engagement switch button on turn signal lever into the detent position and release. System should remain inoperative.

2. Put dash switch in "CRUISE" (center) position. Amber light should come on.

3. Engage system by momentarily pushing the turn signal engagement switch button in to the detent position and releasing at 50 mph; remove foot from accelerator. Green light should come on when button is released and system is engaged. Vehicle should maintain speed of 50 mph. Note amount, if any, by which car speed differs from the 50 mph speed when engaged. This is called "lock-in" error and can be corrected by the adjustment procedure on page 9-44.

4. Put dash switch in "AUTO" position. Vehicle speed should not change.

5. Push engagement switch button in to the detent position and hold. Vehicle should accelerate at a controlled rate. Release button to engage system at cruise speed of approximately 55 mph. System should now be set a new speed and vehicle should maintain that speed.

6. Depress brake pedal an estimated 1/2 inch; green light should go out confirming action of electric brake release switch and vehicle should start to slow down. Allow vehicle to slow to approximately 45 mph using brakes if desired.

7. Momentarily depress engagement switch button to detent position and release. Vehicle should accelerate at a controlled rate and resume previously set speed of 55 mph and maintain that speed. Green light should come on when button is released.

8. Push engagement switch button all the way in and hold. Green light should go out. Coast to 50 mph.

9. Release button to engage system at 50 mph; green light should come on and vehicle should maintain that speed.

PRELIMINARY INSPECTION (Refer to Figs. 9-36 thru 39)

NOTE: Make sure all test equipment such as test lights and voltmeters are in good working order prior to using them.

Electrical and Vacuum Inspection

Fuse

Inspect Cruise Control fuse and replace as necessary.

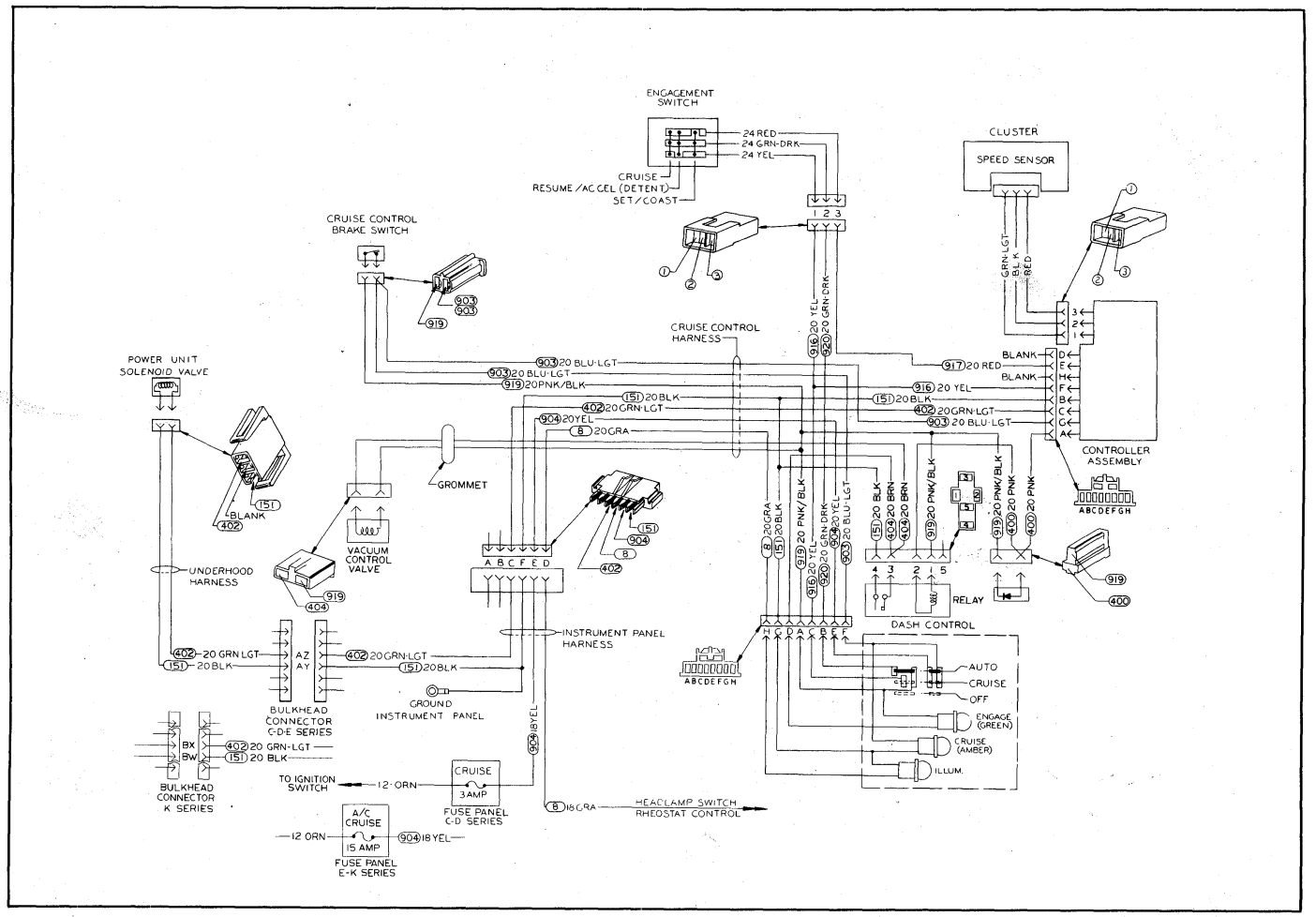


Fig. 9-36 Cruise Control Circuit Diagram

Electric Brake Release Switch (Engine Off)

On Car Check:

1. Turn ignition ON and instrument panel switch to either "CRUISE" or "AUTO".
2. Connect test light (or voltmeter) to ground.
3. Probe blue wires at connector. Lamp should light (12 volts on meter) indicating feed from dash switch.
4. Probe pink/black wire at connector. Lamp should light (12 volts on meter) indicating switch continuity.
5. Check switch adjustment with probe still at pink/black wire depressing brake pedal - (1/8"-1/2") should turn out light (no voltage on meter).
6. Adjust or replace switch as necessary.

Off Car Check:

1. Use ohmmeter or self-powered test light.
2. With switch plunger extended, meter should read infinity (open circuit). Test light OFF.
3. With switch plunger fully depressed, meter should indicate continuity. Test light ON.

Instrument Panel Switch and Harness

On Car Check-Switch (Engine Off)

1. Turn ignition ON.
2. Connect test light on voltmeter to ground.
3. Disconnect the 3 wires from the turn signal lever engage switch from the cruise harness connector.
4. Probe the three terminals in this cruise harness connector, first with the instrument panel switch in "OFF", then "CRUISE', and finally in the "AUTO" position. In either "Cruise" or "Auto" switch positions, the amber indicator should light. The checks should indicate the following:

INSTRUMENT PANEL SWITCH ON CAR TEST			
	Indication at Terminal		
Instrument Panel Switch Position	#1 (Yellow)	#2 (Green)	#3 (Red)
AUTO	OFF	ON	OFF
CRUISE	ON	OFF	OFF
OFF	OFF	OFF	OFF

Instrument Panel Switch (Off Car)

1. Refer to the following pages for removal and installation of the switch: except Eldorado and Seville, page 8-8, Eldorado, page 8-30 and Seville, page 8-51. Use ohmeter or self powered test light.
2. Identify printed circuit terminals from letters A thru

H on harness connector. Letters read from bottom to top A thru H on switch assembly.

3. The checks should indicate this following.

INSTRUMENT PANEL SWITCH OFF CAR TEST			
Instrument Panel Switch Position	Indication Between Terminals		
	A to B	A to C	E to F
AUTO	CLOSED	OPEN	CLOSED
CRUISE	OPEN	CLOSED	CLOSED
OFF	OPEN	OPEN	OPEN

Engage Switch and Harness (On or Off Car)

The engage switch can be checked after disconnecting it from the harness and performing the following tests with an ohmmeter:

ENGAGE SWITCH ON OR OFF CAR TEST			
Engage Switch Position	Indication Between Terminals		
	1 to 2 (Yellow-Green)	1 to 3 (Yellow-Red)	2 to 3 (Green-Red)
RELEASED	CLOSED	CLOSED	CLOSED
PARTIALLY DEPRESSED	OPEN	OPEN	CLOSED
FULLY DEPRESSED	CLOSED	OPEN	OPEN

If incorrect indications occur, replace engagement switch and harness.

WIRE COLORS	
TERMINAL	COLOR
1	Yellow
2	Green
3	Red

With one lead of ohmmeter connected to steering column mounting bracket, check each terminal. All should show open. If any indicate continuity, a short exists and lever and harness must be replaced.

VACUUM CONTROL AND POWER UNIT SOLENOID VALVES

a. Resistance Test (Engine Off)

1. Disconnect electrical connector at solenoid valve being tested.

2. Connect ohmmeter to solenoid valve terminals.

3. Measure resistance, it should be between 55 and 70 ohms on power unit valve and between 23.5 and 27.5 ohms on vacuum control valve.

4. If reading is outside of limits replace applicable valve.

b. Functional Test (Engine Off)

1. Disconnect electrical connector at valve being tested.

2. Connect a jumper wire from the positive terminal of the battery to one terminal of the valve being tested.

3. Connect another jumper wire to ground.

4. Brush the other end of the grounded jumper wire across the remaining terminal of the valve. You must hear the vacuum control valve or power unit solenoid valve open and close as you make and break contact with the terminal. Both valves will click twice indicating that each respective valve is functioning properly.

c. Functional Test (Engine Operational)

1. Prior to starting the engine, disconnect the bead chain or cable at the power unit.

2. Disconnect the electrical connectors at the vacuum control and power unit valves.

3. Start engine and let idle.

4. Touch a jumper wire from the battery positive terminal to one terminal of the vacuum control valve while the other terminal of the valve is grounded with a second jumper wire. The diaphragm should not move proving that no vacuum is reaching it. If it does move, the power unit solenoid valve is leaking and must be replaced.

5. Remove wires from vacuum control valve and repeat step (4) with jumpers connected to the power unit solenoid valve. Diaphragm should not move. If it does move the vacuum control valve is leaking and must be replaced.

Controller Current Leakage Test at Power Unit Solenoid Valve Connector (Engine Operational)

1. Disconnect electrical connector at valve.

2. With car running at idle, check D.C. voltage between connector terminals. Must be less than 1.0 volt D.C.

3. Momentarily increase idle speed for several seconds. Voltmeter must indicate less than 1.0 volt D.C.

4. Any indications above 1.0 volt D.C., replace controller.

Instrument Panel Switch (Amber "ON" Lamp Inoperative or Malfunctioning)—Engine OFF

1. Turn ignition switch ON.

2. Place instrument panel switch in CRUISE position and then AUTO.

3. If amber "ON" lamp is not illuminated in both positions check for burned-out lamp, open ground wire, open connector, inoperative switch or printed circuit.

4. Place instrument panel switch in "OFF" position.

5. If, amber "ON" lamp is illuminated check for shorted leads or inoperative switch, or blown fuse.

Instrument Panel Switch (Green "Cruise" Lamp Circuit)

1. If road test shows system controls speed and "green" indicator light is inoperative, check for burned out lamp or open in wiring between switch connector and controller connector (pink wire).

2. If green indicator remains "on" when system is not controlling speed, check for short in harness between switch and relay, malfunctioning relay, or short in harness between relay and controller connector (pink wire). if OK, replace controller.

Controller

There should be no attempt made to repair the electronic cruise controller. Check to make sure connectors are fully seated - Red (8) way and black (3) way speed sensor. If all other components have been checked and found to be functioning properly - then replace the controller.

Speed Sensor Check (Figs. 9-37, 38) On Car-Engine Off

1. Turn ignition on and Cruise dash switch to "AUTO" or "CRUISE" position.

2. Refer to the following pages for partial removal of the speedometer cluster for access to the speed sensor 3-way connector located on the electronic controller; page 8-6 (except Eldorado and Seville), page 8-23 (Eldorado) and page 8-42 (Seville). Connect voltmeter between ground and No. 2 (black) terminal. Note and record this voltage reading. Should read voltage greater than 10 volts. This is less than full battery voltage because of the internal circuitry of the electronic controller.

3. Connect voltmeter between ground and No. 3 (red) terminal. Voltage should be (1 to 2) volts less than value in terminal No. 2. This is the voltage drop through the light emitting diode.

4. Connect voltmeter between ground and No. 1 terminal (green wire). Roll car forward while checking voltage. Voltage should fluctuate. Also, two peaks should occur within six feet of car travel. This is output of photo transistor.

VACUUM CONTROL VALVE CIRCUIT FUNCTIONAL TEST (Engine Operational)

1. Prior to starting the engine, disconnect the bead chain or cable at the power unit.

2. Disconnect vacuum hose that links vacuum control valve to power unit solenoid valve at power unit valve.

3. Connect jumper wire from ground to cavity "A" on rear of large electronic controller wiring connector, Fig. 9-36.

4. Start engine and let idle. Amber light should be on to confirm power supply. Checks should indicate conditions listed below in chart at bottom of page in column one. Refer to adjacent cause-correction information if they do not.

If the above conditions are met, the vacuum control system is functioning properly and the diagnosis chart beginning on page 9-37 should be referred to for resolution of the problem.

Vacuum System Inspection—Power Unit, Vacuum Brake Release Valve, Vacuum Control Valve and Power Unit Solenoid Valve (Engine Operational)

1. Prior to starting the engine, disconnect the bead chain or actuating cable at the power unit.

2. Disconnect the electrical connectors at the vacuum control and power unit solenoid valves.

3. Actuate both the vacuum control and power unit solenoid valve with jumper wires. This is done by connecting jumper wires from the battery positive terminal to one terminal on each valve and grounding the remaining terminal on each valve with another set of jumper wires.

4. Start the engine and let idle.

5. With brake pedal in free position, diaphragm should pull in to full stroke. Have a helper depress the brake pedal down about 1-1/2 inches and the diaphragm should relax to its free position proving that the vacuum release valve is working and its hose unobstructed.

6. If system will not hold vacuum, remove brake release vent valve hose at power unit and plug power unit hole (manifold vacuum should be open).

7. If power unit draws down then problem condition exists in brake release vacuum vent system.

8. If power unit will not draw down inspect diaphragm and connectors at valves for leaks.

VACUUM CONTROL VALVE CIRCUIT FUNCTIONAL TEST CHART

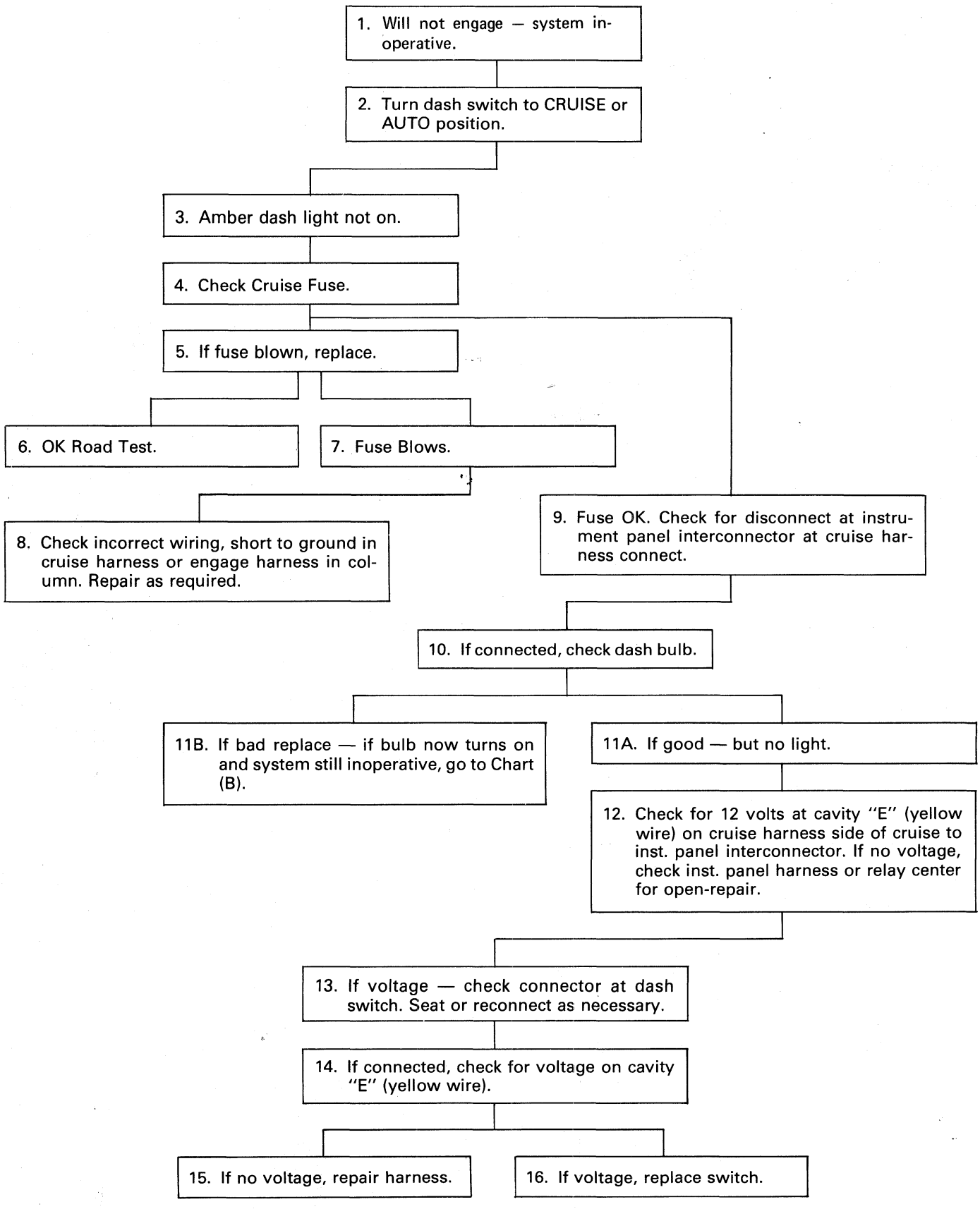
A. DASH SWITCH AT CRUISE OR AUTO

CHECK SHOULD INDICATE	POSSIBLE CAUSE OF MALFUNCTION	CORRECTION
Green engage light should turn on.	Dash switch, harness, relay or bulb	Replace as required.
Control harness relay should energize.	Open in coil relay, or disconnect or open in harness.	Replace or repair as required.
Vacuum control valve should open and there should be vacuum at disconnected hose.	Defective control valve.	Replace as required.
	Obstruction or leak in vacuum supply to valve.	Repair as required.
	Disconnect or open in harness to valve.	Repair as required.

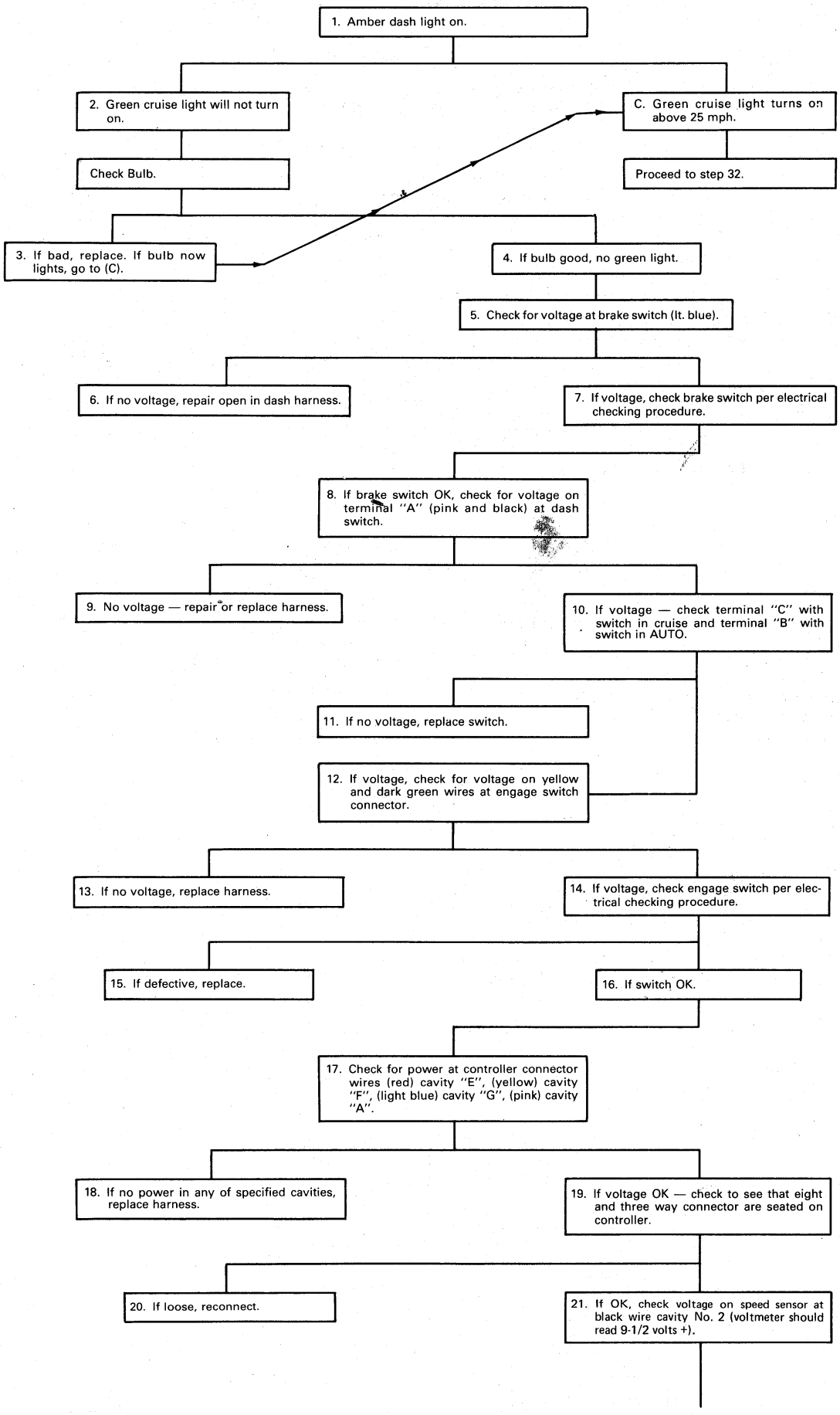
B. REMOVE JUMPER WIRE.

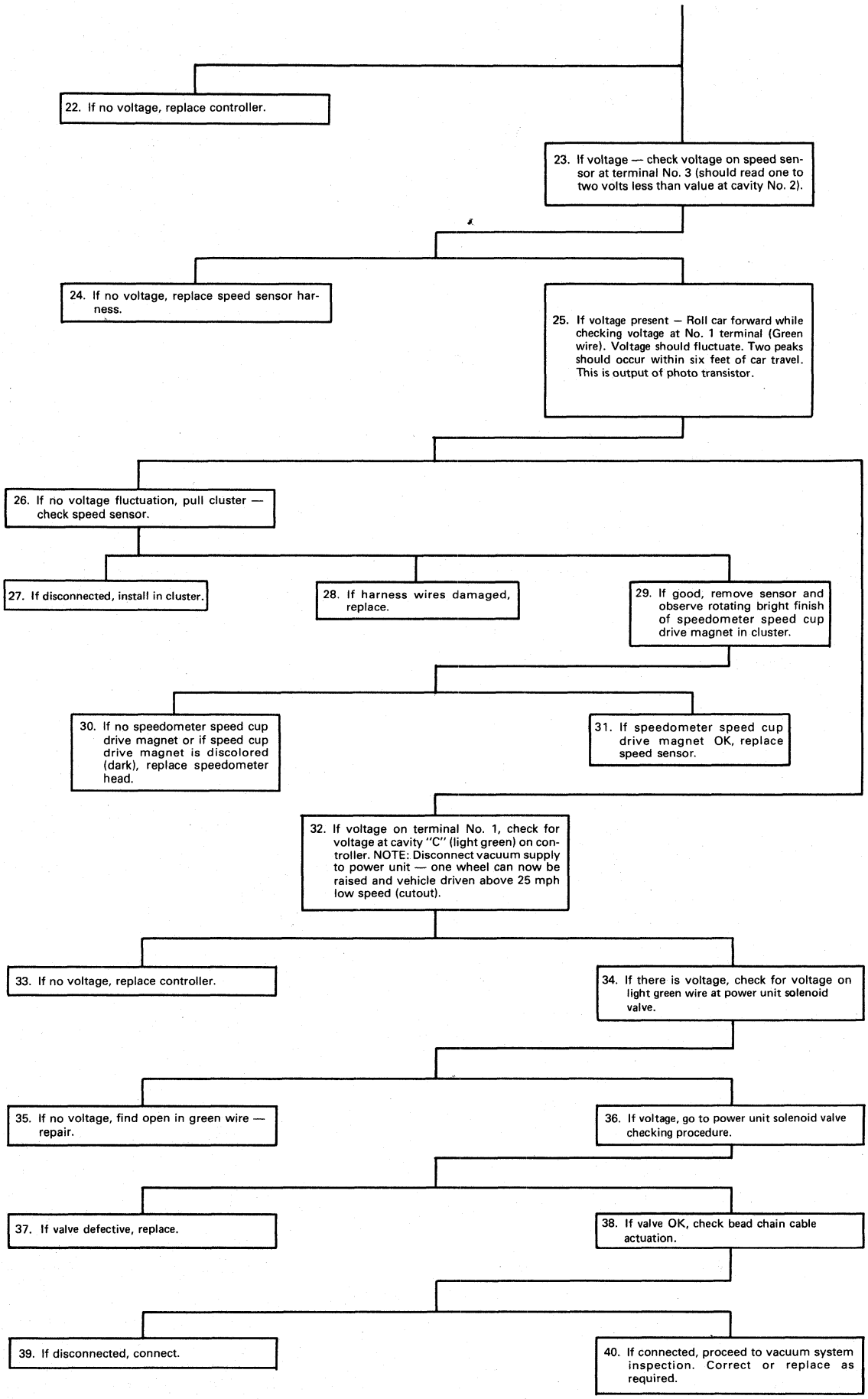
CHECK SHOULD INDICATE	POSSIBLE CAUSE OF MALFUNCTION	CORRECTION
Green engage light should turn out.	Shorted or stuck relay. Harness shorted to ground.	Replace or repair.
Control valve should close, no vacuum at disconnected hose.	Control valve stuck or leaking.	Replace.

CRUISE CONTROL DIAGNOSIS CHART (A)



(B)


1. Amber dash light on.
2. Green cruise light will not turn on.
C. Green cruise light turns on above 25 mph.
Check Bulb.
Proceed to step 32.
3. If bad, replace. If bulb now lights, go to (C).
4. If bulb good, no green light.
5. Check for voltage at brake switch (lt. blue).
6. If no voltage, repair open in dash harness.
7. If voltage, check brake switch per electrical checking procedure.
8. If brake switch OK, check for voltage on terminal "A" (pink and black) at dash switch.
9. No voltage — repair or replace harness.
10. If voltage — check terminal "C" with switch in cruise and terminal "B" with switch in AUTO.
11. If no voltage, replace switch.
12. If voltage, check for voltage on yellow and dark green wires at engage switch connector.
13. If no voltage, replace harness.
14. If voltage, check engage switch per electrical checking procedure.
15. If defective, replace.
16. If switch OK.
17. Check for power at controller connector wires (red) cavity "E", (yellow) cavity "F", (light blue) cavity "G", (pink) cavity "A".
18. If no power in any of specified cavities, replace harness.
19. If voltage OK — check to see that eight and three way connector are seated on controller.
20. If loose, reconnect.
21. If OK, check voltage on speed sensor at black wire cavity No. 2 (voltmeter should read 9-1/2 volts +).


22. If no voltage, replace controller.
23. If voltage — check voltage on speed sensor at terminal No. 3 (should read one to two volts less than value at cavity No. 2).
24. If no voltage, replace speed sensor harness.
25. If voltage present – Roll car forward while checking voltage at No. 1 terminal (Green wire). Voltage should fluctuate. Two peaks should occur within six feet of car travel. This is output of photo transistor.
26. If no voltage fluctuation, pull cluster — check speed sensor.
27. If disconnected, install in cluster.
28. If harness wires damaged, replace.
29. If good, remove sensor and observe rotating bright finish of speedometer speed cup drive magnet in cluster.
30. If no speedometer speed cup drive magnet or if speed cup drive magnet is discolored (dark), replace speedometer head.
31. If speedometer speed cup drive magnet OK, replace speed sensor.
32. If voltage on terminal No. 1, check for voltage at cavity "C" (light green) on controller. NOTE: Disconnect vacuum supply to power unit — one wheel can now be raised and vehicle driven above 25 mph low speed (cutout).
33. If no voltage, replace controller.
34. If there is voltage, check for voltage on light green wire at power unit solenoid valve.
35. If no voltage, find open in green wire — repair.
36. If voltage, go to power unit solenoid valve checking procedure.
37. If valve defective, replace.
38. If valve OK, check bead chain cable actuation.
39. If disconnected, connect.
40. If connected, proceed to vacuum system inspection. Correct or replace as required.

CRUISE CONTROL DIAGNOSIS CHART

CONDITION	CAUSE	CORRECTION
Power unit diaphragm extends to maximum allowable open throttle position. **A.** Position of dash switch has no effect. Vehicle returns to idle with brake application, may duplicate when pedal is released. **B.** Condition occurs only when dash switch is in cruise or auto position. Condition will cancel when panel switch is turned off.	Power unit solenoid valve leaking vacuum.	Replace valve.
	Manifold vacuum connected directly to power unit vacuum vent port.	Reroute hose.
	Unrequested voltage on solenoid feed.	Defective controller — replace.
Erratic engagement and/or unwanted program acceleration.	Severed engage switch harness in column.	Replace.
	Open circuit in yellow wire at connector.	Repair.
Will not cruise at engaged speed.	Leak in power unit.	Replace. Refer to vacuum system inspection.
	Leak in vacuum release valve or hose.	Replace or repair. Refer to vacuum system inspection.
	Throttle actuating cable or bead chain slack, excessive or sticky.	Free throttle linkage and remove slack.
	Kinked or damaged speedometer cable.	Replace.
	Power unit solenoid valve variable orifice misadjusted.	Readjust.
System will not disengage with brake pedal.	Brake release switch inoperative or misadjusted.	Replace or adjust as required.
Cannot engage or adjust cruise speed downward with engage switch.	Inoperative engage switch.	Replace or repair.
System can be engaged below 20 MPH.	Defective controller.	Replace.
Hissing noise when brake pedal disengages system.	Vacuum release valve or, release switch misadjusted.	Readjust valve or replace.
Amber "ON" light will not turn on even through system cruises satisfactorily.	Inoperative bulb.	Replace.
	Open printed circuit on dash switch.	Replace.
"CRUISE" or "AUTO" light will not turn on even though system cruises satisfactorily.	Inoperative bulb.	Replace.
	Open printed circuit on dash switch.	Replace.
	Defective controller.	Replace.
Cruise speed drops when heavy electrical loads are turned on such as headlights, air cond., etc.	Car battery, voltage too low.	Correct battery voltage.

ON-CAR SERVICE

POWER UNIT–(Fig. 9-37, Except Eldorado and Seville)

a. Removal

1. Disconnect electrical connector.
2. Remove 2 screws securing power unit and power unit solenoid valve assembly to mounting bracket.
3. Disconnect throttle cable from power unit.
4. Remove one screw securing power unit solenoid valve to power unit and separate power unit.
5. Disconnect brake release vacuum line and remove power unit.

b. Installation

1. Position power unit solenoid valve to power unit and secure with one screw.
2. Connect brake release vacuum line to power unit.
3. Connect throttle cable to power unit.
4. Position power unit to mounting bracket and secure with 2 screws. Torque to (10-15) inch pounds (1.1 - 1.6) N·m.
5. Connect electrical connector.

POWER UNIT–(Fig. 9-38 Eldorado and Seville)

a. Removal

1. Disconnect electrical connector from power unit.
2. Unclip ball chain at power unit.
3. Remove vacuum hoses to power unit.
4. Remove 2 screws securing power unit to mounting bracket.
5. Remove 1 screw securing power unit solenoid valve and separate power unit.

b. Installation

1. Position power unit solenoid valve to power unit and secure with one screw.
2. Secure unit to mounting bracket using two screws.
3. Clip ball chain to power unit.
4. Connect vacuum hoses at unit.
5. Connect electrical connector to power unit.

ELECTRIC BRAKE RELEASE SWITCH AND VACUUM RELEASE VALVE (Figs. 9-37 and 38)

a. Electric

Service: An inoperative switch must be replaced. Install new switch as described under stop light switch adjustment on page 5-10.

b. Vacuum

Service: An inoperative (sticking, plugged or leaking) valve must be replaced. Be certain vacuum hose to the switch is firmly connected and that it is not cracked or deteriorated.

Adjustment: The vacuum valve should be pushed all the way into the retaining clip. Pull the brake pedal up to the stop to automatically adjust the valve.

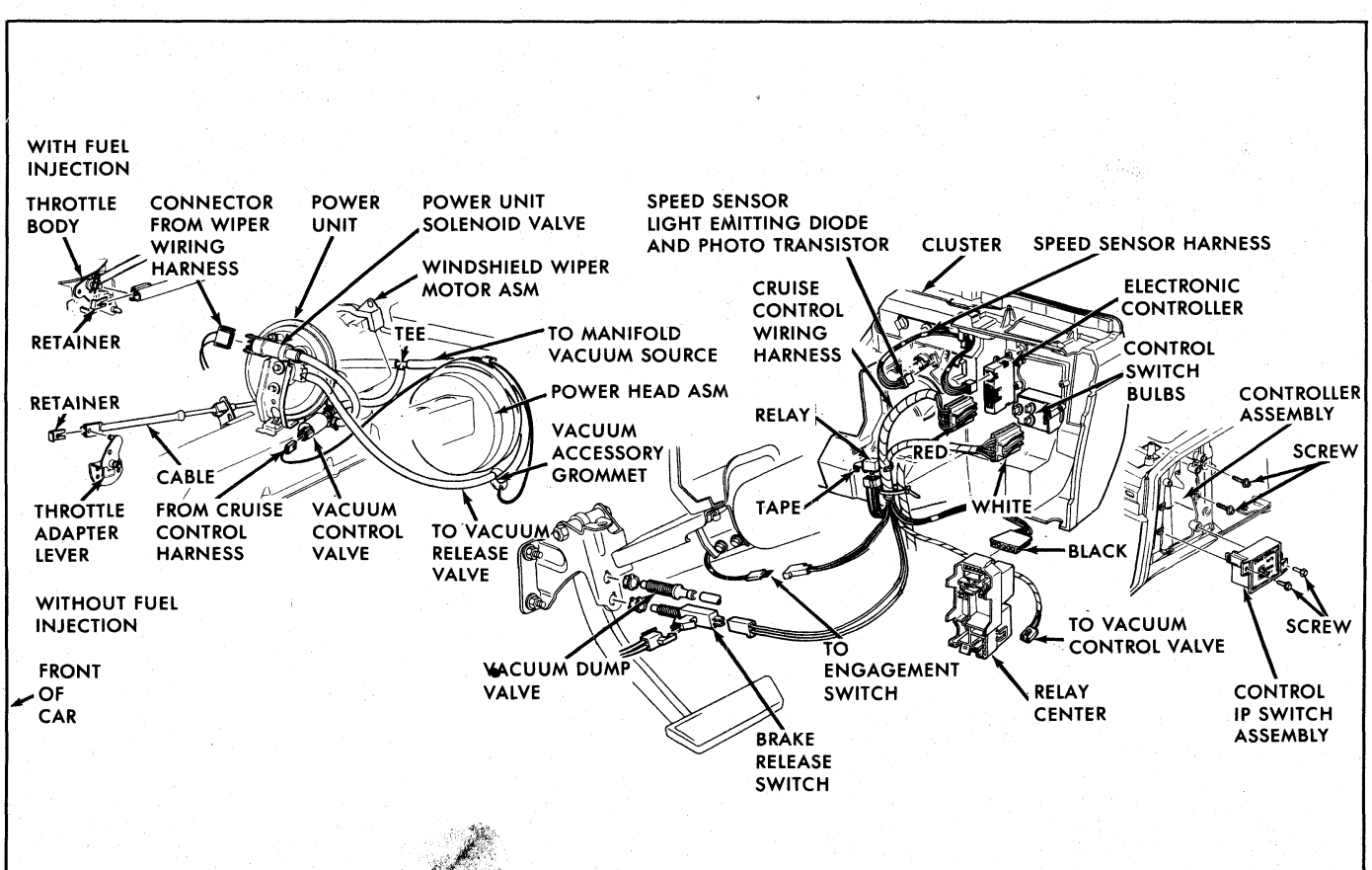


Fig. 9-37 Cruise Control Component Location (Except Eldorado and Seville)

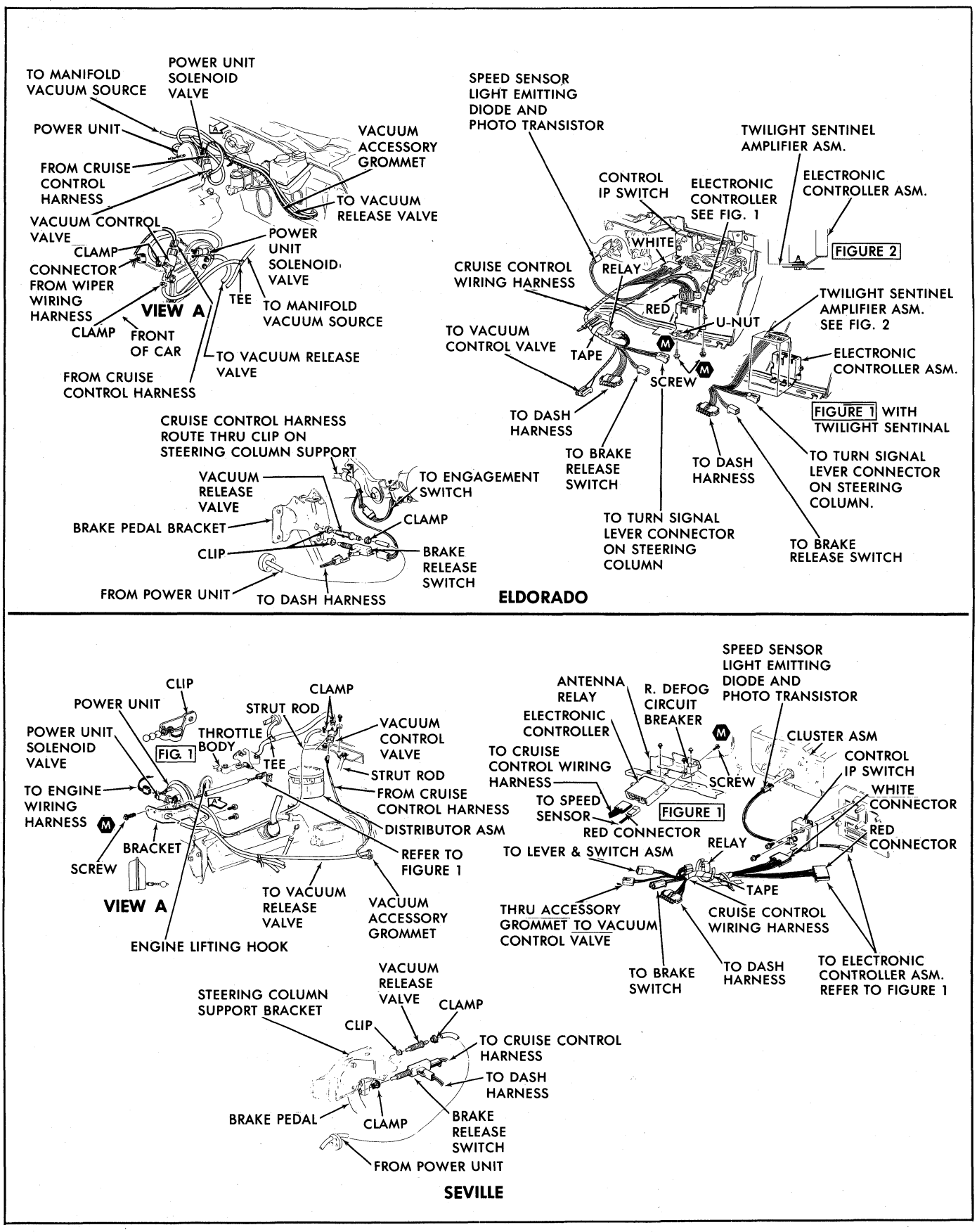


Fig. 9-38 Cruise Control Component Location (Eldorado and Seville)

Engagement Switch

The engagement switch cannot be serviced. The complete turn signal lever must be replaced as an assembly.

a. Removal

1. Disconnect battery ground cable.
2. Remove steering column lower cover and remove tape retaining wire to steering column.
3. Disconnect cruise control switch harness connector and attach a long piece of piano wire to switch connector.
4. Remove steering wheel as described on page 3B-62.

CAUTION: *When laying wheel facing down, place a cloth on work bench to prevent wheel from being scratched or marked.*

5. Remove three screws securing lock plate cover assembly to lock plate and remove cover assembly, Fig. 3B-92.
6. Working through lock plate, remove screw securing turn signal lever and remove lever and harness, Fig. 3B-96. Pull harness up gently so guide wire can be used to install new unit.

b. Installation

1. Attach upper end of piano wire to switch harness connector and pull piano wire at lower end of column, feeding harness into proper location in column.
2. Position turn signal lever on turn signal switch. Working through lock plate, secure lever to switch with one screw. Tighten to 20 inch-pounds.
3. Position cover assembly on upper end of column and install three screws securing cover to lock plate.
4. Install steering wheel as described on page 3B-62.
5. Remove guide wire from switch harness.
6. Disconnect piano wire from switch harness and reconnect harness.
7. Retain harness to column with tape and install steering column lower cover.
8. Connect battery ground cable.

SPEED SENSOR AND HARNESS (Fig. 9-39)

REMOVAL AND INSTALLATION

Access to the speed sensor and harness assembly is gained by partially removing the speedometer cluster and disconnecting the electrical connector at the cluster and electronic controller ends of the harness. Use a small narrow bladed screwdriver to disconnect the sensor connector at the cluster as shown in Fig. 9-39. Gently insert the blade along the outward face of the connector at the middle area, down into the cluster. Release the connector with the narrow blade and lift out the sensor. Refer to the following pages for partial removal of the speedometer cluster for the indicated models: 1.) except Eldorado and Seville, page 8-6., 2.) Eldorado, page 8-24., 3.) Seville, page 8-43.

CAUTION: *Exercise care when partially removing cluster to disconnect speed sensor electrical connector at back of cluster. Pulling the cluster too far outward with the electrical connector still attached to the cluster could damage the cluster or connector or both.*

ELECTRONIC CONTROLLER (Fig. 9-37 Except Eldorado and Seville)

a. Removal

1. Remove left hand instrument panel insert as described on page 8-5.
2. Remove left hand climate control outlet duct extension, page 8-14.

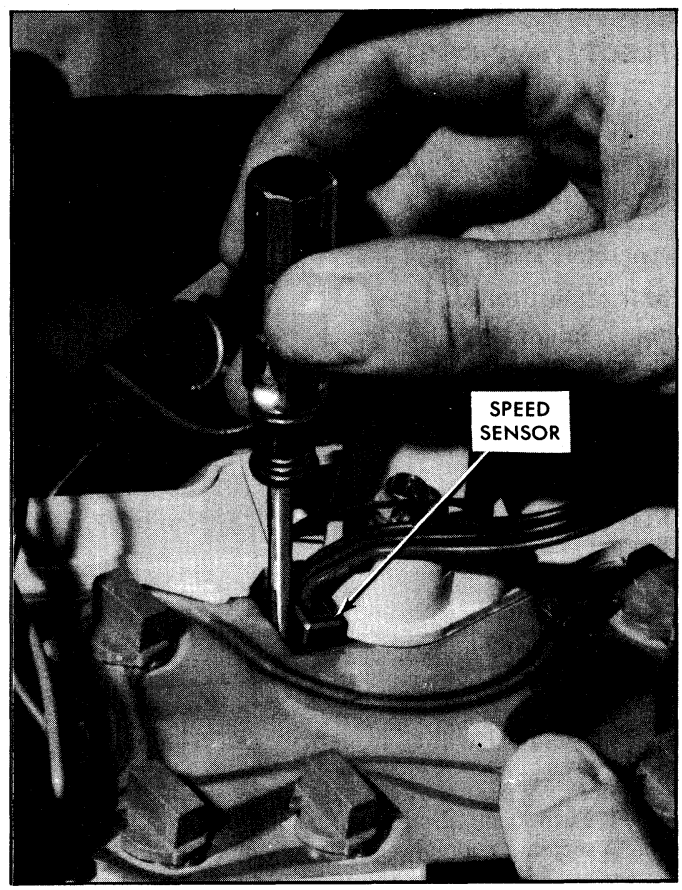


Fig. 9-39 Speed Sensor and Harness

3. Depress lock tab and disconnect 2 electrical connectors from rear of controller.
4. Remove 2 screws securing controller to panel and remove from behind panel.

b. Installation

1. Connect 2 electrical connectors to controller (one red - 8 way edgeboard and (one) 3 - way edgeboard).
2. Secure controller to reinforcement with 2 screws.
3. Reinstall climate control duct extension page 8-14 and left hand instrument panel insert as described on page 8-5.

ELECTRONIC CONTROLLER (Fig. 9-38, Seville)

a. Removal

1. Remove steering column lower cover as described on page 8-42.
2. Disconnect 2 electrical connectors from controller.
3. Remove 2 screws securing controller and bracket to reinforcement.
4. Remove controller from bracket (2 screws).

b. Installation

1. Connect 2 electrical connectors to controller.
2. Secure controller to bracket with 2 screws.
3. Secure controller and bracket to reinforcement with 2 screws.
4. Reinstall steering column cover, page 8-42.

ELECTRONIC CONTROLLER (Fig. 9-38, Eldorado)

a. Removal

1. Remove steering column lower cover as described on page 8-22. Remove 2 screws retaining cruise control or twilight sentinel bracket to reinforcement.

2. Lower controller and bracket and remove 2 connectors and 2 screws holding controller to bracket.

b. Installation

1. Secure controller to bracket with 2 screws and connect 2 connectors.

2. Secure cruise control or twilight sentinel bracket to reinforcement with 2 screws and install steering column lower cover, page 8-22.

POWER UNIT SOLENOID VALVE (Fig. 9-37 and 38)

a. Removal

1. Remove one screw securing solenoid valve to power unit.

2. Disconnect vacuum hose and electrical connector and pull solenoid valve away from power unit.

b. Installation

1. Push solenoid valve into hole in power unit. Take care not to separate end cap and filter from valve body.

2. Secure solenoid valve with one screw.

3. Connect electrical connector and vacuum hose.

POWER UNIT SOLENOID VALVE ADJUSTMENT FOR CORRECTION OF LOCK-IN ERROR

Adjust the solenoid valve with a flat bladed screw driver by turning the screw head located on the valve. Turning the screw towards the "S" position reduces the actual engagement speed. Turning the screw towards the "F" position increases the actual engagement speed.

VACUUM CONTROL SOLENOID VALVE (Fig. 9-37 and 38)

a. Removal

1. Disconnect one electrical connector and two vacuum hoses from valve.

2. Remove one screw securing valve to power unit mounting bracket on all models except Seville or remove one screw from valve mounting bracket located on cowl mid-section for Seville.

b. Installation

1. Secure valve to power unit mounting bracket on all models except Seville or to mounting bracket located on cowl for Seville.

2. Install one electrical connector and two vacuum hoses on valve.

VACUUM CONTROL VALVE RELAY (Figs. 9-37, 38)

The relay is taped to the cruise control harness behind the instrument panel near the electronic controller. It can be removed by removing the tape and disconnecting the electrical connector.

GUIDE-MATIC
GENERAL DESCRIPTION

The Guide-Matic is an optional convenience item that allows the driver to obtain automatic switching of vehicle headlight beams in response to light from approaching vehicle headlights. Provision is included for the driver to obtain manual control or constant low beam if desired.

The system consists of a photo-amplifier, power relay, foot switch, sensitivity control (driver control), and interconnecting wire harness, Fig. 9-40 and 9-41.

The photo-amplifier combines a light sensing photocell and transistorized D.C. amplifier into one unit with sufficient power to operate a power relay for switching the headlight beams. Mounting location is so the amber colored lens has an unobstructed view of approaching vehicle headlights through the grille. Road signs, reflections from the vehicle's own headlights, and other miscellaneous lights require the vertical and horizontal "viewing range" of the photocell to be rather narrow. Since the "viewing range" is narrow, aim of the photo-amplifier is very important. An adjustment screw and aiming level for setting correct vertical aim are integral parts of the unit. Instructions for aiming must be followed carefully for correct operation.

The photo-amplifier is adjusted and sealed at the factory. If a malfunction occurs, the assembly must be replaced. A model-serial number label is attached on the rear of the assembly for field identification.

The power relay is a sealed, single pole, double throw, 12 volt D.C. relay which provides the heavy-duty contacts for switching the headlight beams. The high beams are connected to the "normally closed" contacts.

The foot switch is the same as the regular foot dimmer switch except for an added "momentary contact" grounding circuit. Operating the switch in the normal manner provides either "automatic" control of headlight beams or "low beam" only. In "automatic" position, a slight pressure on top of the switch closes the grounding circuit to provide an "overriding" high beam (regardless of light on the photo-amplifier) for signalling purposes or to determine "automatic" position.

The sensitivity control (driver control) is located directly behind and is concentric with the headlight switch knob. Rotating the ring pointer provides a range of sensitivity and is the only means of adjusting sensitivity in the field, Fig. 9-42. The headlights will automatically dim at maximum distance between approaching vehicles with the controlling pointer set close to the "far" position.

To delay dimming until oncoming traffic is closer, rotate control ring pointer farther away from "far" position.

For non-automatic control of headlight beam, rotate pointer to "OFF" and use the foot dimmer.

Operation–Automatic

Turn headlights on, rotate driver control ring pointer to approximately center of rotation, and place foot switch in "automatic" position. If there is no light ahead, the headlights will be on high beam. No warm-up time is required.

When light from an approaching vehicle's headlights reaches a predetermined level at the photocell's sensing surface, the amplifier will trigger (pull-on) the power relay causing it to switch (dim) the headlights from high to low beam. At the same time the photocell sensitivity is increased to "hold" sensitivity to keep headlights on low beam when approaching driver reduces light by switching to low beam.

If the driver desires his lights to switch when the approaching vehicle is farther away or nearer, he may adjust the driver control. Also if the approaching driver fails to dim, he may signal him by momentarily putting a slight pressure on top of the foot switch to "override" his headlights to high beam. When he removes the pressure, his headlights will revert to low beam if there is still sufficient light ahead.

When the approaching car passes and light is removed from the photocell, the amplifier removes the signal voltage from the power relay coil, causing it to "drop out" and switch back to high beam.

If the road surface is highly reflective (snow, gravel, etc.), the unit may be held on low beam by reflections of its own headlights. If this occurs, slowly rotate driver control counterclockwise towards "OFF" until lights return to high beam. This is maximum usable sensitivity for the particular road surface.

Operation–Manual

Rotate driver control pointer to extreme counterclockwise position (off) as indicated. The foot switch will now operate conventionally, switching headlights from high to low beam. High beam position will represent "automatic" position of the foot switch.

Operation–Low Beam

Place foot switch in "low beam" position. Headlights will remain on low beam until foot switch is changed to "automatic" position. Over-riding action is not available since power relay is disconnected from the photo-amplifier.

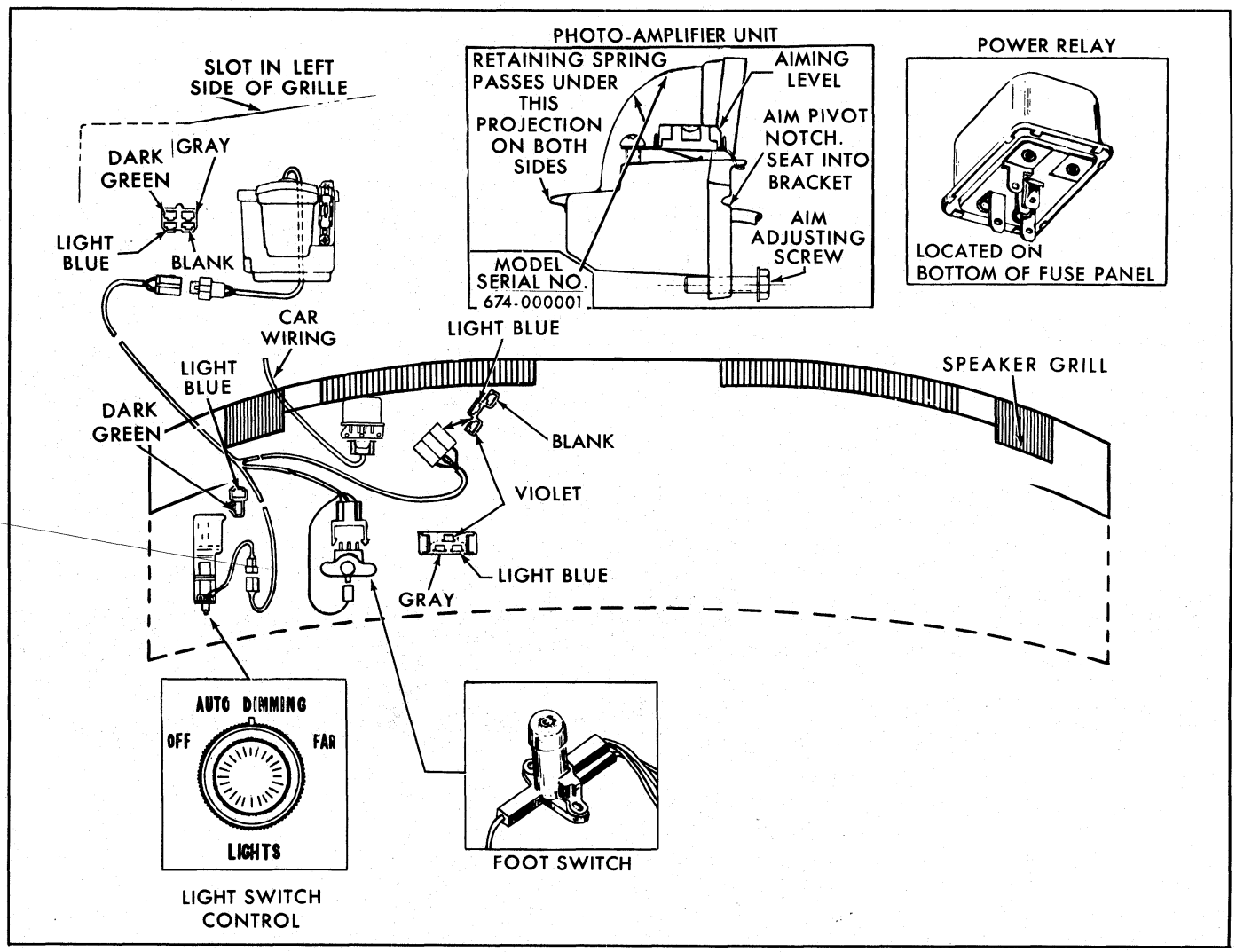


Fig. 9-40 Guide-Matic Components (Except Seville)

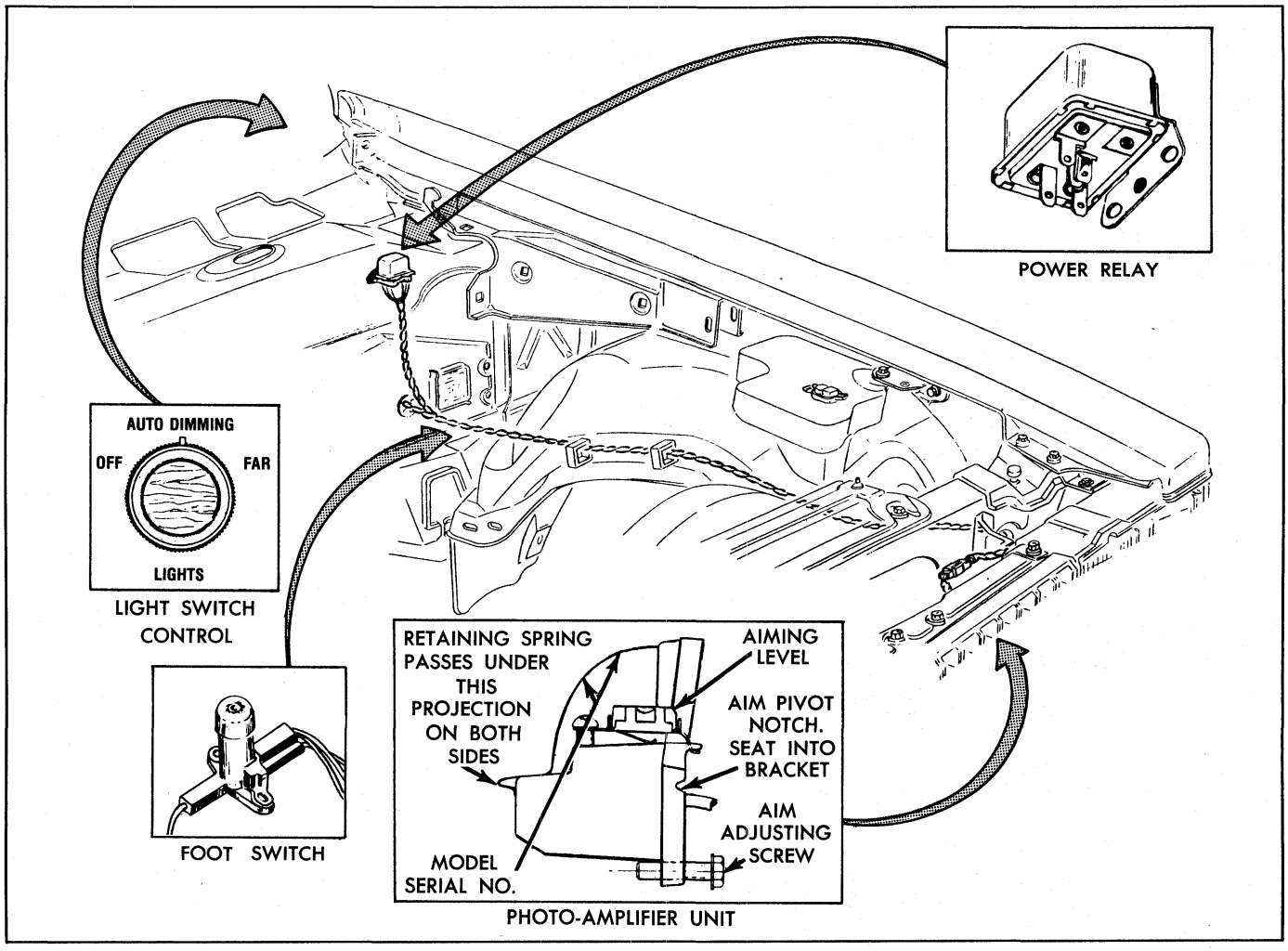


Fig. 9-41 Guide-Matic Components (Seville)

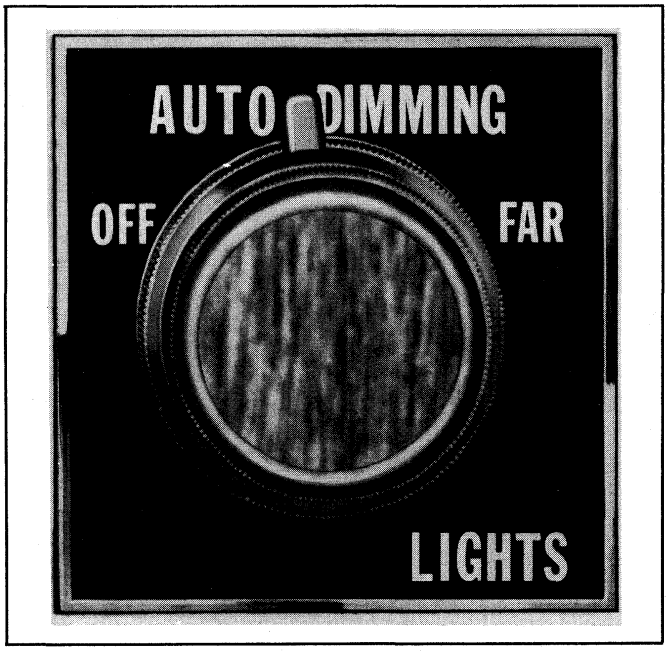


Fig. 9-42 Sensitivity Control Ring

DIAGNOSIS

Quick Check of System

1. Disconnect photo-amplifier 4-way connector at left side of radiator.

2. Operate engine at fast idle.

3. Turn light switch on. Headlights should switch between high and low beam when foot switch is depressed.

4. Insert a jumper wire between the wiring harness connector light blue and gray wire terminals. Headlights should remain in low beam in both positions of foot switch. Remove jumper wire.

5. Turn headlights OFF. Touch one lead of an ohmmeter to the dark green wire in the wiring harness and the other to the light blue wire. Rotate the driver control ring from off to far. The meter should start at 0 ohms, peak at approximately 2,500 ohms and then return back to approximately 500 ohms (specs. are broad).

6. Depress foot switch slightly. With ohmmeter connected as described in previous step, ohmmeter reading should drop to zero when foot switch is slightly depressed.

7. If system operated as described, all components have been positively checked out except the photo-amplifier. If the system passes the positive check of the wiring harness as outlined but fails to check out functionally, replace the photo-amplifier.

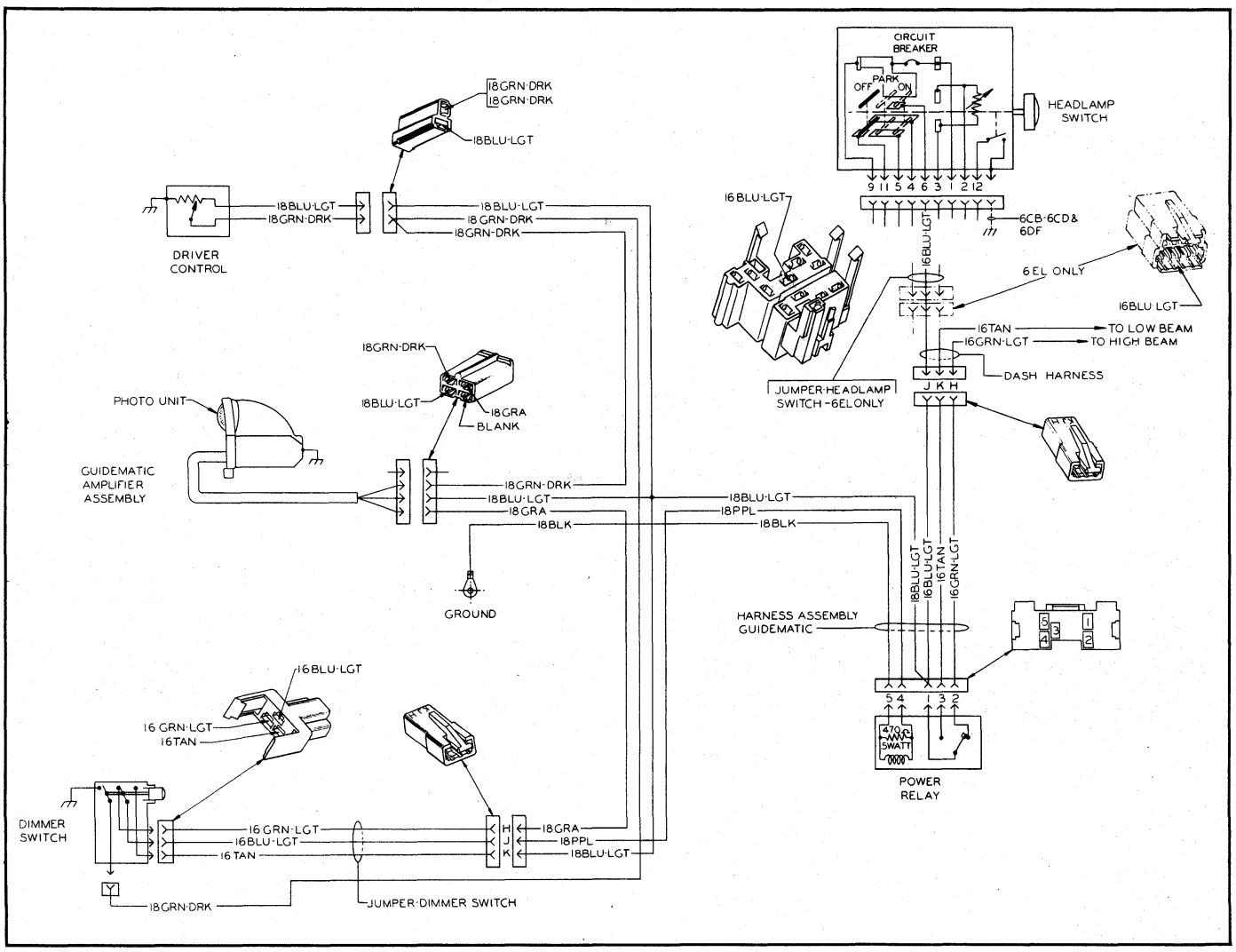


Fig. 9-43 Guide-Matic Circuit Diagram (Except Seville)

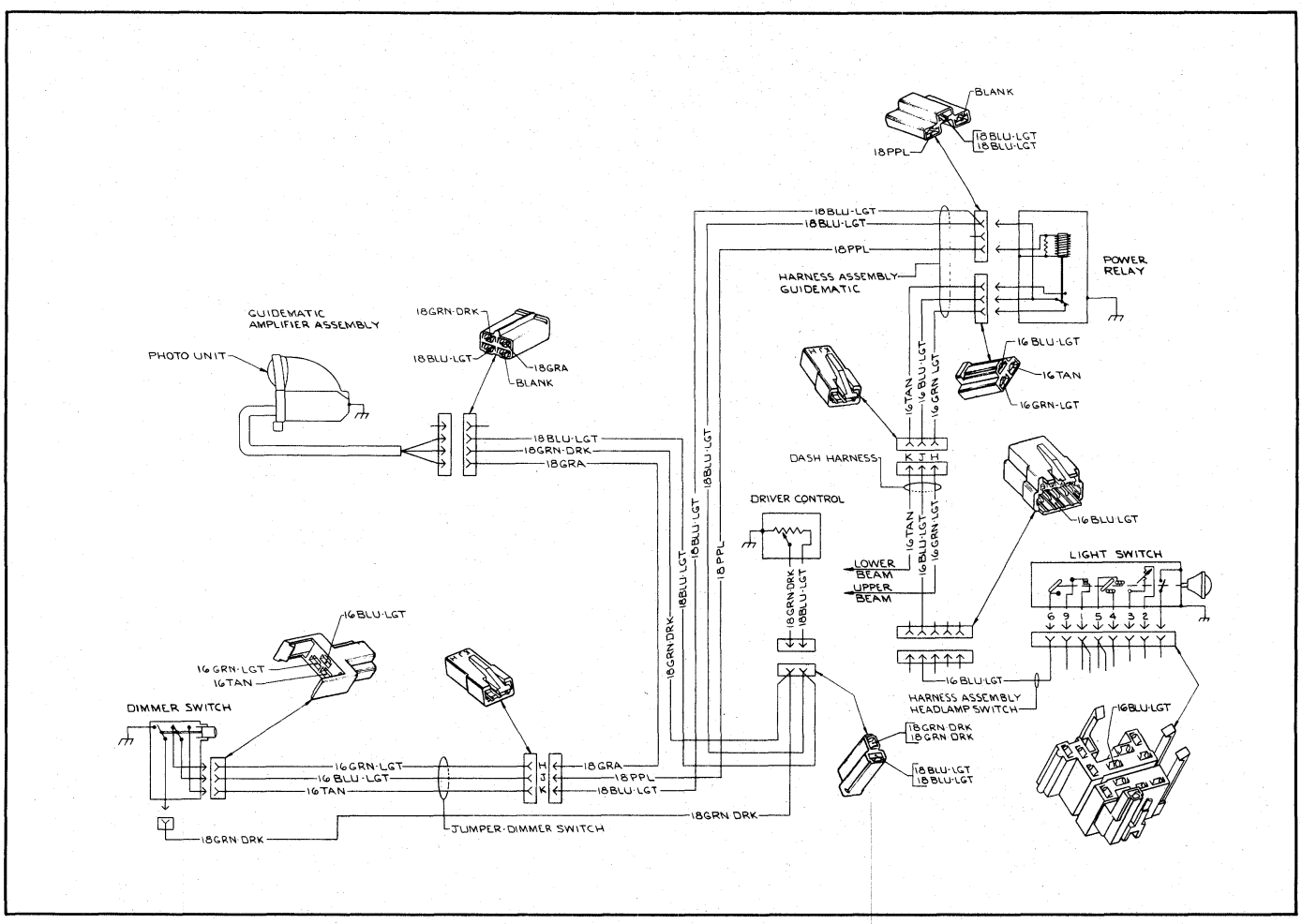
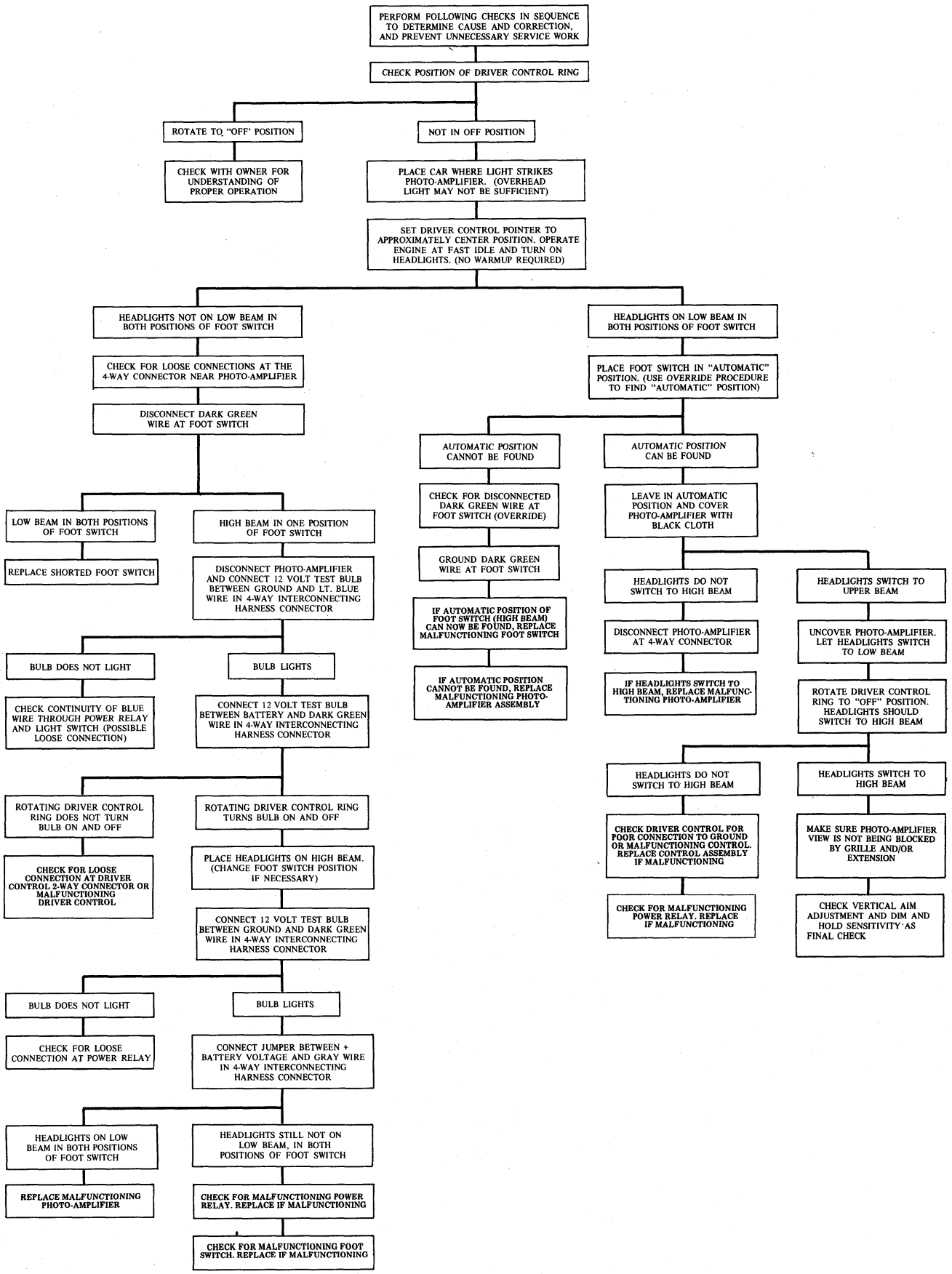


Fig. 9-44 Guide-Matic Circuit Diagram (Seville)

GUIDE-MATIC DIAGNOSIS CHART



ON-CAR SERVICE

Photo-Amplifier Vertical Aiming Adjustment (Fig. 9-45)

Be sure that headlamps are aimed properly to avoid reflection of light to the photo-amplifier causing it to hold low beam. Mechanical aimer tool number J-25300 (or equivalent) should be used to aim headlamps. Be sure to follow the tool equipment manufacturer's instructions along with observing applicable state and local headlamp aiming regulations.

Accurate vertical aim of the photo-amplifier is essential to proper performance of the Guide-Matic system. If the photo-amplifier is aimed too low, reflected road light from the vehicle's own headlights can cause the Guide-Matic to be slow in returning headlights to high beam or hold them on low beam. The unit must be aimed as low as possible, however, to provide maximum tolerance for car loading, Fig. 9-45.

1. Photo-amplifier vertical aiming should be performed with vehicle unloaded, trunk empty except for spare tire, gas tank at least half full, and tires at correct pressure.

NOTE: It is not necessary to comply with car load or trunk load specifications if vehicle is equipped with Automatic Level Control.

2. Locate vehicle on level floor (level within 1/4 inch fore and aft).
3. Rock car sideways and up and down to equalize springs.
4. Raise car hood for access to photo-amplifier.
5. Adjust vertical aiming screw at front of photo-amplifier until bubble is centered in the level assembly.
6. Clean lens if dirty.

Sensitivity Control Switch

The procedure for removing and installing the guide-matic sensitivity control switch is described on page 8-7 (except Eldorado and Seville) or page 8-30 (Eldorado) or page 8-50 (Seville).

Photo-Amplifier Unit (Fig. 9-45, Except Eldorado and Seville)

a. Removal

1. Disconnect negative battery cable at battery.
2. Remove the left and right hand front end fillers as described on page 2C-6.
3. Disconnect four-way (3 wire) electrical connector near photo-amplifier.

CAUTION: *Do not pull on cable sheathing otherwise leads could be damaged.*

4. Loosen screw securing photo-amplifier unit to mounting bracket and release retaining spring.
5. Carefully remove photo-amplifier unit from mounting bracket.

b. Installation

1. Connect retaining spring to photo-amplifier unit.
2. Install photo-amplifier unit on mounting bracket and secure with screw.
3. Connect four-way (3 wire) electrical connector near photo-amplifier.

NOTE: Make sure connector is firmly installed.

4. Install the left and right hand front end fillers as described on page 2C-6.
5. Connect negative battery cable at battery.
6. Adjust vertical aim as described above.

NOTE: Vertical aiming adjustment is essential for proper operation.

LENS CLEANING

Lens cleaning can be accomplished with a swab on the end of a pencil inserted thru the grille opening.

Photo-Amplifier Unit (Fig. 9-45), (Eldorado)

a. Removal

1. Disconnect negative battery cable at battery.
2. Disconnect four-way (3 wire) electrical connector near photo-amplifier.

CAUTION: *Do not pull on cable sheathing otherwise leads could be damaged.*

3. Loosen screw securing photo-amplifier unit to mounting bracket and release retaining spring.
4. Carefully remove photo-amplifier unit from mounting bracket.

b. Installation

1. Connect retaining spring to photo-amplifier unit.
2. Install photo-amplifier unit on mounting bracket and secure with screw.
3. Connect four-way (3 wire) electrical connector near photo-amplifier.

NOTE: Make sure connector is firmly installed.

4. Connect negative battery cable at battery.
5. Adjust vertical aim as described above.

NOTE: Vertical aiming adjustment is essential for proper operation.

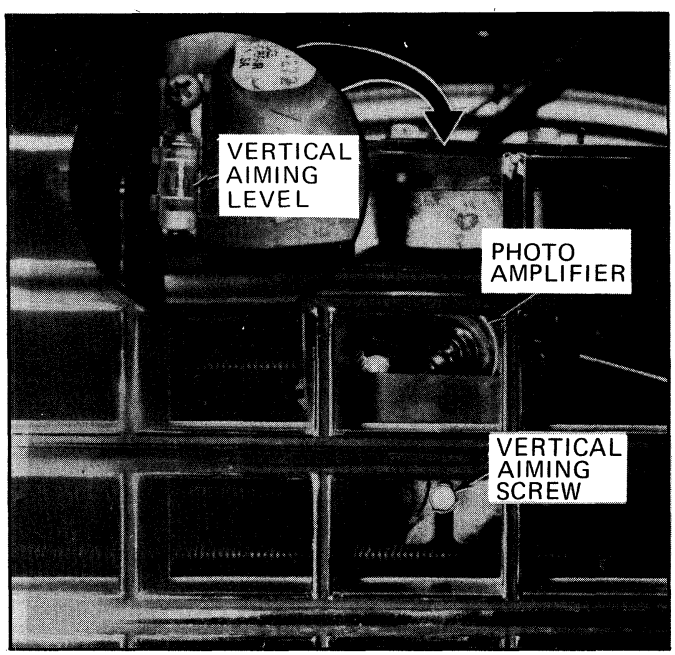


Fig. 9-45 Vertical Aiming Adjustment

Photo-Amplifier Unit (Fig. 9-45, Seville)

a. Removal

1. Disconnect negative battery cable at battery.
2. Disconnect photo-amplifier four-way (3 wire) electrical connector located at the left side of the radiator.

CAUTION: *Do not pull on cable sheathing otherwise leads could be damaged.*

3. Loosen vertical aiming screw securing photo-amplifier unit to mounting bracket and release retaining spring.
4. Carefully remove photo-amplifier unit from mounting bracket.

b. Installation

1. Position photo-amplifier unit to mounting bracket and connect retaining spring.
2. Tighten vertical aiming screw until screw makes contact with mounting bracket.
3. Connect four-way (3 wire) electrical connector at left side of radiator.

NOTE: Make sure connectors are fully joined together.

4. Connect negative battery cable at battery.
5. Adjust vertical aim as described on page 9-51.

NOTE: Vertical aiming adjustment is essential for proper operation.

Power Relay Unit (Fig. 9-41, Seville)

a. Removal

1. Disconnect negative battery cable at battery.
2. Disconnect two three-way electrical connectors from power relay unit.
3. Remove two screws that hold power relay unit to front of dash, just above power brake unit, and remove power relay.

b. Installation

1. Position power relay unit against front of dash, above power brake unit and secure with two screws.
2. Connect two three-way connectors to power relay unit.
3. Connect negative battery cable to battery.

Power Relay Unit (Fig. 9-40, Except Seville)

The relay is located on the bottom of the fuse panel and can be removed by pulling outward.

Foot Switch

a. Removal

1. Disconnect negative battery cable at battery.
2. Remove left side kick pad.
3. Remove rubber boot from foot switch.
4. Partially raise floor carpet to gain access to foot switch.
5. Disconnect one-way and three-way electrical connectors at foot switch.
6. Remove two screws that hold foot switch to floor pan and remove foot switch.

b. Installation

1. Install foot switch on floor pan and secure with two attaching screws.
2. Connect one-way and three-way connectors to foot switch.
3. Reposition floor carpet and install left side kick pad.
4. Install rubber boot on foot switch.
5. Connect negative battery cable to battery.

TWILIGHT SENTINEL
GENERAL DESCRIPTION

The twilight Sentinel is an optional convenience item that provides an ambient light-sensitive automatic on-off control of the lights normally controlled by the light switch. In addition, for night visibility when leaving the vehicle, it will keep the lights turned on for a preselected period of time after the ignition is turned off. Lights will turn off automatically after this pre-selected time period elapses.

The system consists of a light sensitive photocell assembly, transistorized amplifier, and a time delay control which includes an on-off switch, Fig. 9-46. Connections to the vehicle lights parallel the regular light switch connections therefore requiring the light switch to be turned off to obtain automatic control.

The photocell assembly is mounted with its sensitive surface face up, to obtain an unobstructed view of skylight through the windshield. Mounting location is under the left front speaker grille.

The amplifier unit is mounted on the lower instrument panel next to the headlight switch with a serial number label attached to the side facing the fuse block.

The time delay and on-off switch control is located directly behind and concentric with the regular light switch knob, Fig. 9-47.

The electrical circuit for the Twilight Sentinel is shown in Figs. 9-48 and 9-49.

Operation-Automatic

The Twilight Sentinel system will operate automatically when the following conditions are met: the ignition switch must be on, the headlight switch must be off, and the control ring pointer, Fig. 9-47 must be turned on (any position on the dial counterclockwise from "OFF" position). The system will now turn lights on automatically when daylight reduces to the point at which road illumination becomes necessary. As daylight increases in the morning to the point at which illumination is no longer necessary, it will turn lights off.

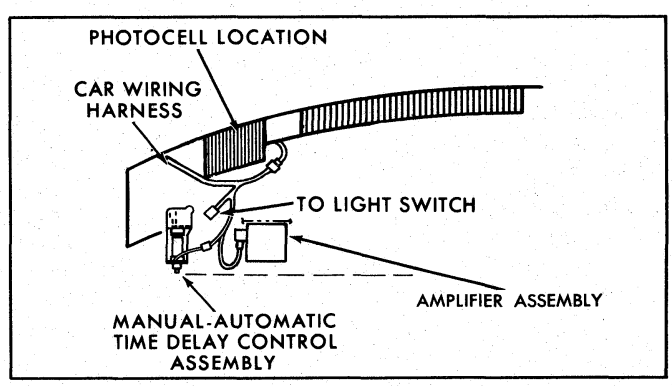


Fig. 9-46 Twilight Sentinel Components

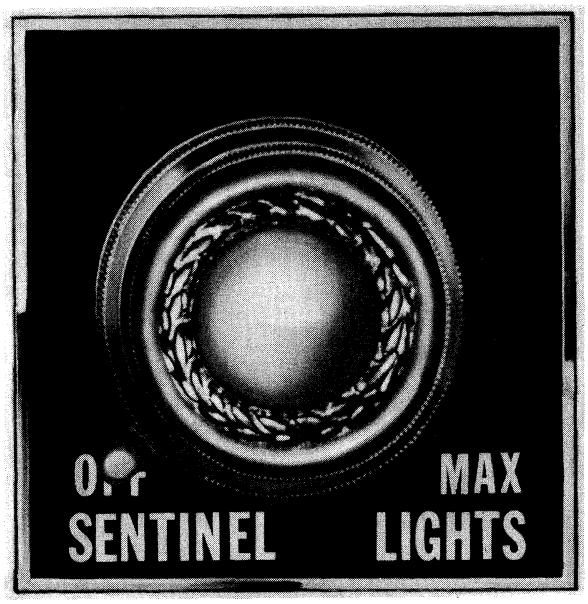


Fig. 9-47 Twilight Sentinel Control Lever

A time delay circuit in the amplifier reduces the possibility of undesired switching on or off of lights while passing under viaducts, trees, bright lights, etc. The time delay is nominally 10 to 30 seconds, but in some units it could be as high as 60 seconds. The length of the time delay is set in production and cannot be altered in the field.

The variable time delay control ring adjusts only the time delay period during which the lights will remain on after ignition is turned off. The driver may preselect any desired time delay from a few seconds to a maximum of 1 1/2 to 4 1/2 minutes.

Additional side lighting can be obtained by turning on a cornerring light.

Operation-Manual

Should there be an occasion when lights are undesirable such as in tunnels requiring lights off, or if Twilight Sentinel malfunctions, rotate time delay turn-off control ring pointer to "Off" position. This disables the Twilight Sentinel by disconnecting the ground circuit. Lights will now operate only by use of the regular light switch.

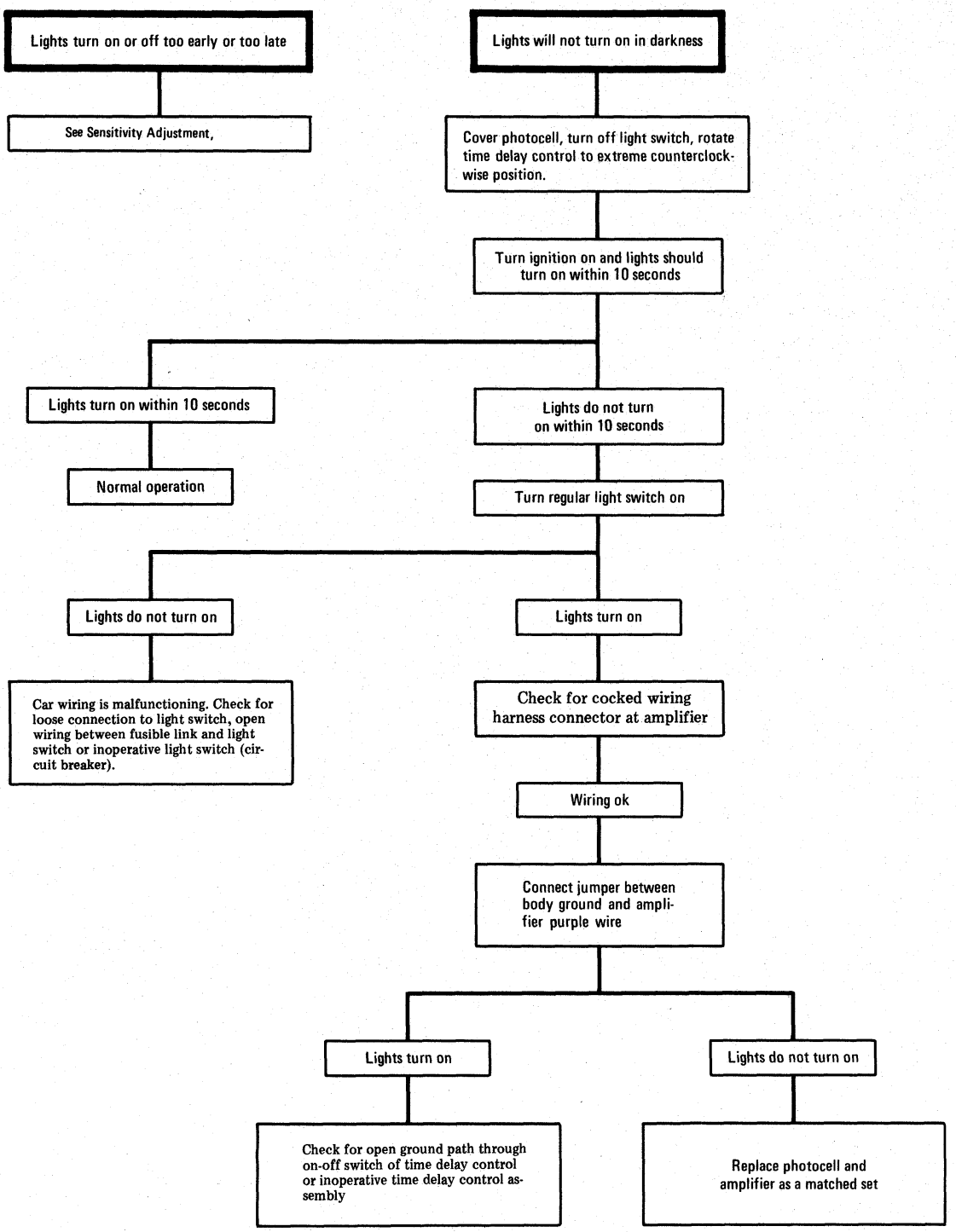
If lights are desirable during daylight hours, the driver can use either of two methods:

1. Turn on lights by operating regular light switch. The headlight switch is wired in parallel with the Twilight Sentinel. This bypasses the system whether the control ring pointer is on or off. If this method of manual operation is selected, lights will remain on after the ignition is turned off; however, when the driver opens the door to leave the car, a warning buzzer grounded through the door jamb switch reminds the driver to turn off the lights if the ignition switch is turned off.

2. Cover the photocell to block light exposure. This will cause the lights to turn on and still permit the Twilight Sentinel to turn lights off in the normal manner when ignition is turned off. (If cell has been exposed to light, the time delay must elapse before lights will turn on).

DIAGNOSIS

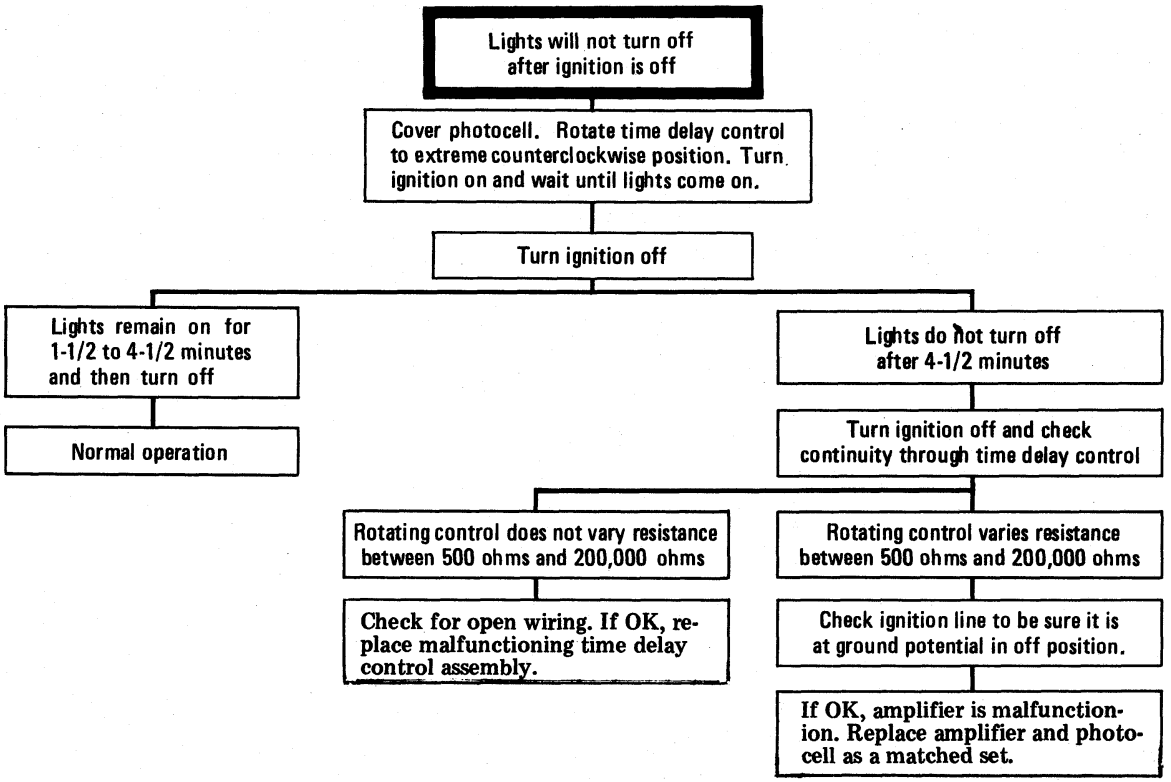
TWILIGHT SENTINEL DIAGNOSIS CHART

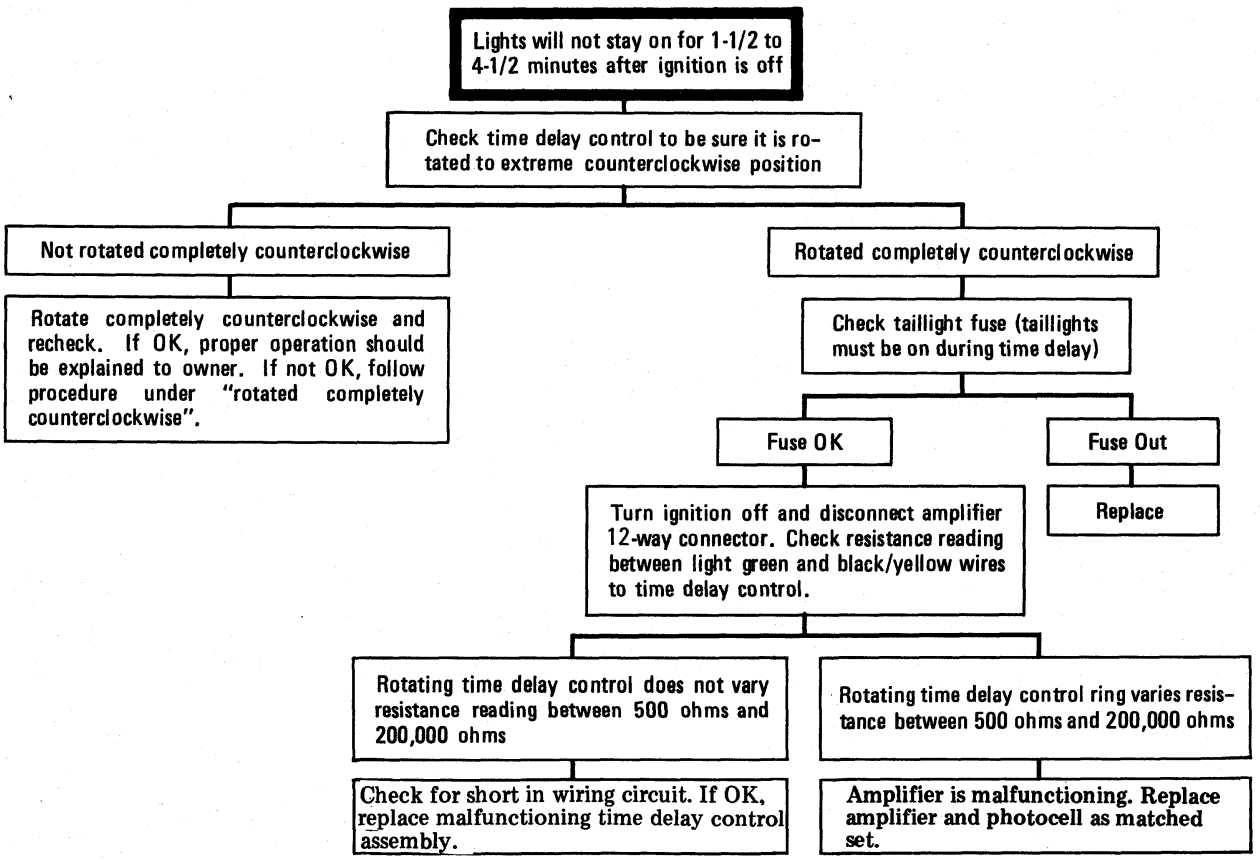


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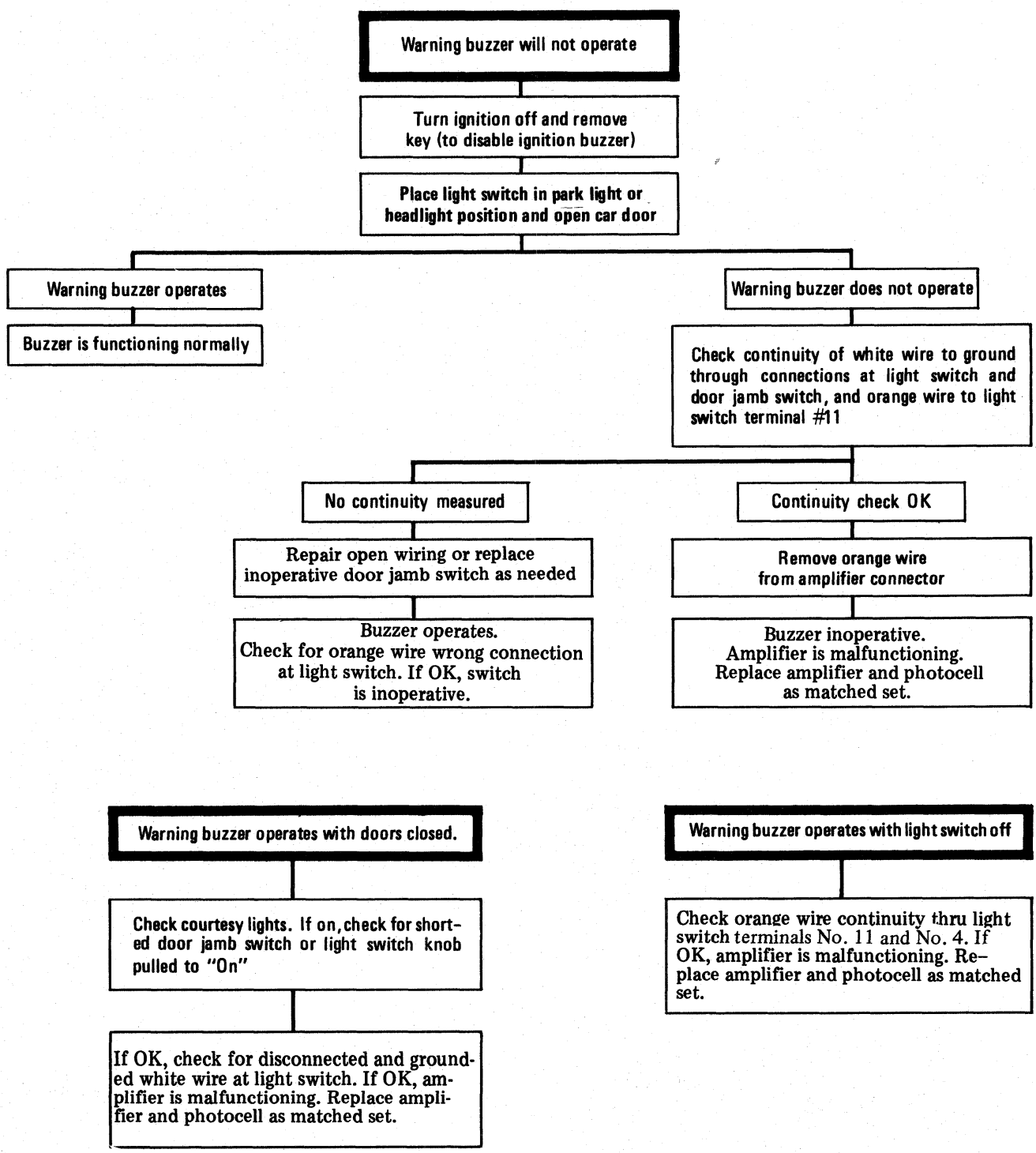


TWILIGHT SENTINEL DIAGNOSIS CHART (Cont'd)





TWILIGHT SENTINEL DIAGNOSIS CHART (Cont'd)



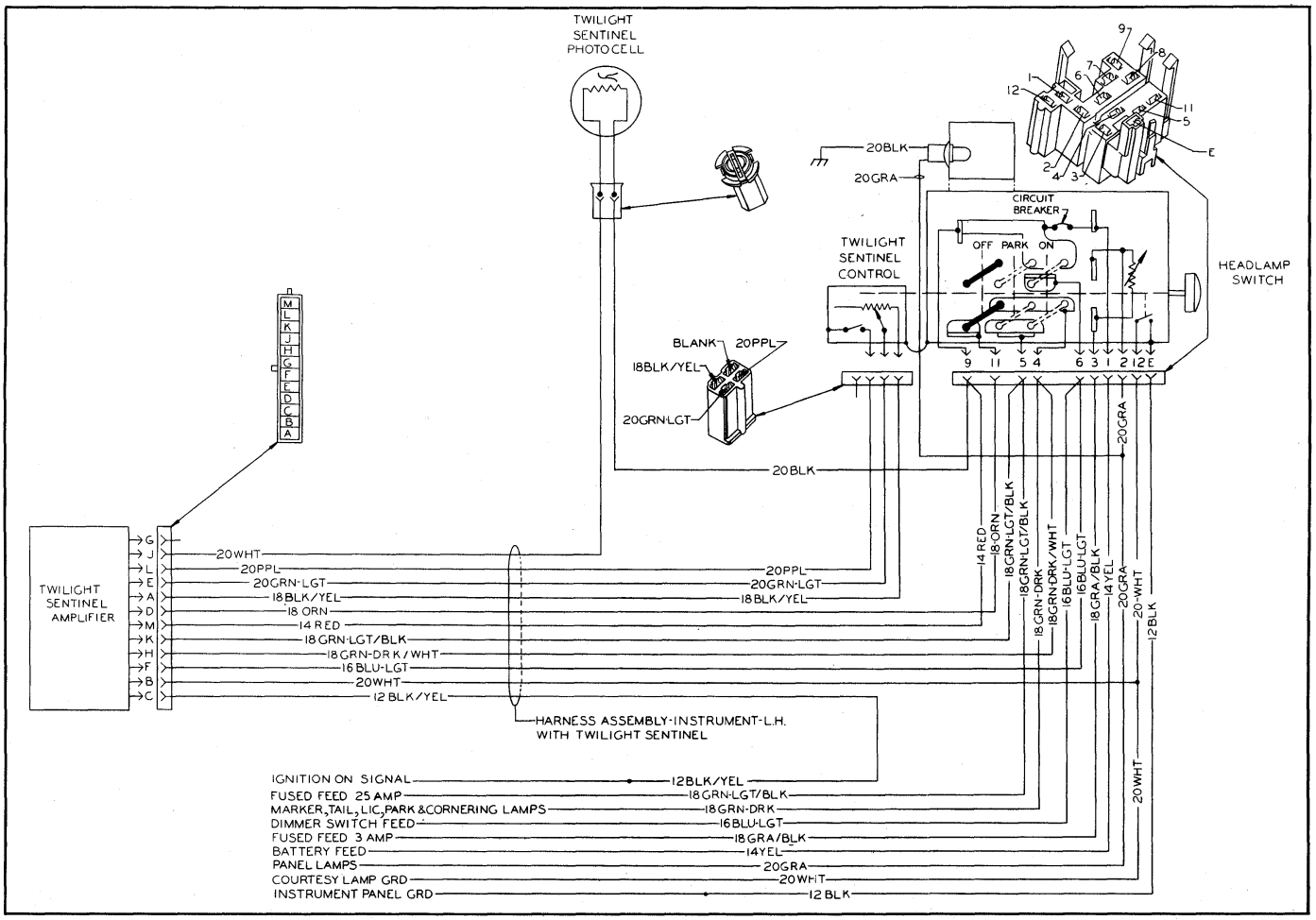


Fig. 9-48 Twilight Sentinel Circuit Diagram (Except Eldorado and Seville)

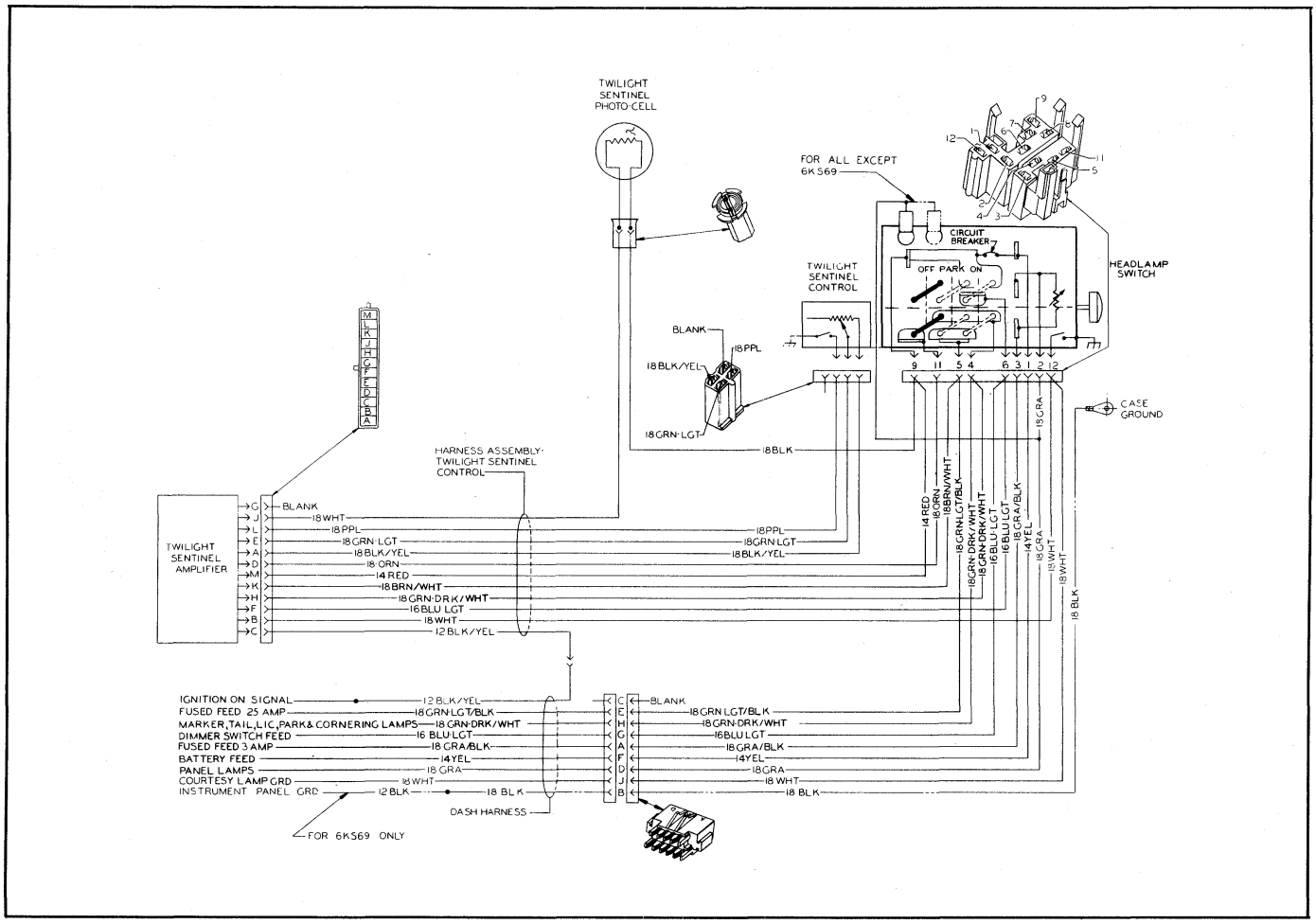


Fig. 9-49 Twilight Sentinel Circuit Diagram (Eldorado and Seville)

ON-CAR SERVICE

Operation and Correction

a. Twilight Sentinel Check List

1. Make sure photocell opening located in front LH speaker grille is unobstructed and the headlight switch is in "Off" position.

2. Adjust Twilight Sentinel control ring midway between "Off" and "Max".

3. Hold lighted flashlight or trouble light directly over photocell opening.

NOTE: Failure of the Twilight sentinel to comply with steps 4, 5a, 5c, or 8 below indicates malfunctioning unit. In such a case, replace twilight sentinel amplifier and photocell unit.

4. Turn ignition key to "On" position. Headlights and taillights must remain off.

5. Remove flashlight or trouble light and cover photocell opening with a heavy dark cloth:

a. Headlights and taillights must turn "On" within one minute.

b. Turn ignition switch to "Off" position.

c. Headlights and taillights must turn "Off" (within 3 minutes normally).

6. Remove cloth cover from photocell opening.

7. Pull headlight switch out to "On" position.

8. Open left front door. Warning buzzer must sound.

b. Headlights Turn On in Daylight When Ignition is Turned On

Some cars equipped with Twiilight Sentinel may experience a condition where the headlights turn on in daylight when the ignition is turned on.

Whenever this happens, the most likely cause is a "disconnect" or "open" in the photocell leads, or the photocell itself has dropped from its mounting hole in the radio speaker grille and is laying somewhere in darkness under the instrument panel top cover (thus the lights go on, even in daytime).

A connected photocell will show resistance anywhere from 3,000 to 50,000 ohms (3 to 50 on the Rx1K scale) depending on the light level in the shop. If the resistance reading varies when the photocell is covered, connections in the lead wires are okay.

An open circuit will be indicated by a maximum reading on the meter, usually infinity. If an open is indicated, check to see if the photocell wires are making contact in the photocell socket.

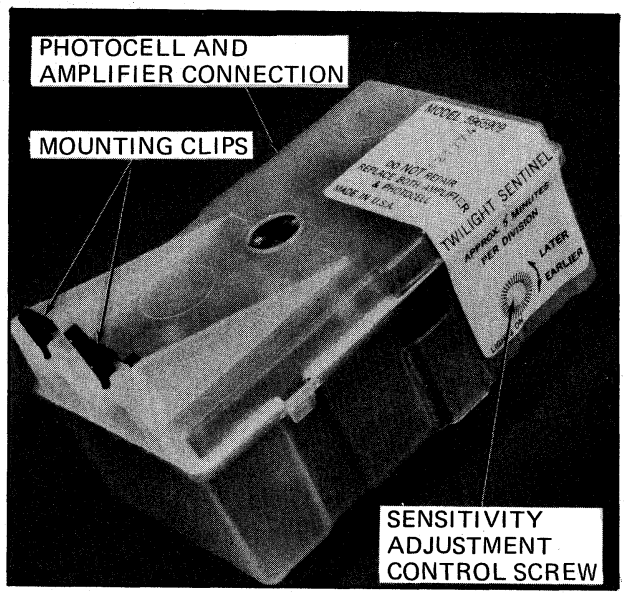


Fig. 9-50 Sensitivity Adjustment Control Screw

Sensitivity Adjustment

If a photocell or amplifier is malfunctioning, both must be replaced as a matched set since no provision is made for adjusting a mismatched set. However, if the owner is dissatisfied with evening turn-on time or morning turn-off time, a recommended procedure to advance or retard turn-on time by 15 minutes is given below.

a. Headlights Turn On Too Late In Evening (Or Off Too Early In Morning)

1. Leave ignition and lights turned off.
2. Cover photocell so no light strikes it.
3. Take resistance reading between J and L terminals in amplifier connector.
4. See Figs. 9-48 and 9-49. Adjust control screw clockwise until resistance reads one-half of value read in Step 3.
5. If amplifier has been previously adjusted set resistance value to 4100-4500 ohms.

b. Headlights Turn On Too Early In Evening (Or Off Too Late In Morning)

Follow same procedure as described in Steps 1 through 5 above **except** under Step 4 adjust control screw counterclockwise until resistance reads one and one-half times value read in Step 3.

Control Switch

The procedure for removing and installing the twilight Sentinel control switch is described on page 8-7 (except Eldorado and Seville), or page 8-30 (Eldorado), or page 8-50 (Seville).

Photocell Unit

The procedure for removing and installing the Twilight Sentinel photocell unit is described on page 8-4 (except Eldorado and Seville), or page 8-26 (Eldorado), or page 8-52 (Seville).

Amplifier Unit

The procedure for removing and installing the Twilight Sentinel amplifier unit is described on page 8-4 (except Eldorado and Seville), or page 8-26 (Eldorado), or page 8-52 (Seville).

REAR WINDOW DE-FOGGER

GENERAL DESCRIPTION

The rear window De-Fogger option is available only as a factory installed accessory.

The rear window De-Fogger is an electrically heated back glass. It does not use a blower motor, hoses or ductwork. The circuit diagrams are illustrated in Figs. 9-51 thru 53.

The switch for controlling the De-Fogger is located in the accessory switch panel, to the right of the steering column. Momentarily moving the spring loaded switch to the "ON" position energizes a time-delay relay. Current then flows from the relay to the back glass. Electrically conductive horizontal grid lines are bonded to the inside of the back glass. When the grid lines are subjected to current flow, they heat the glass and remove fog from the glass surface.

A green indicator light in the switch glows whenever the De-Fogger is operating. When the switch is pulsed on, the relay allows current to flow for approximately ten minutes, then shuts off. Additional periods of heating operation can be obtained each time the switch is pulsed on. Pulsing the switch "ON" while the De-Fogger is in operation extends the heating period beyond the normal delay cycle. The De-Fogger can be manually shut off at anytime during its time delay cycle: by momentarily moving the control switch to the "OFF" position. Turning off the ignition switch also turns off the De-Fogger.

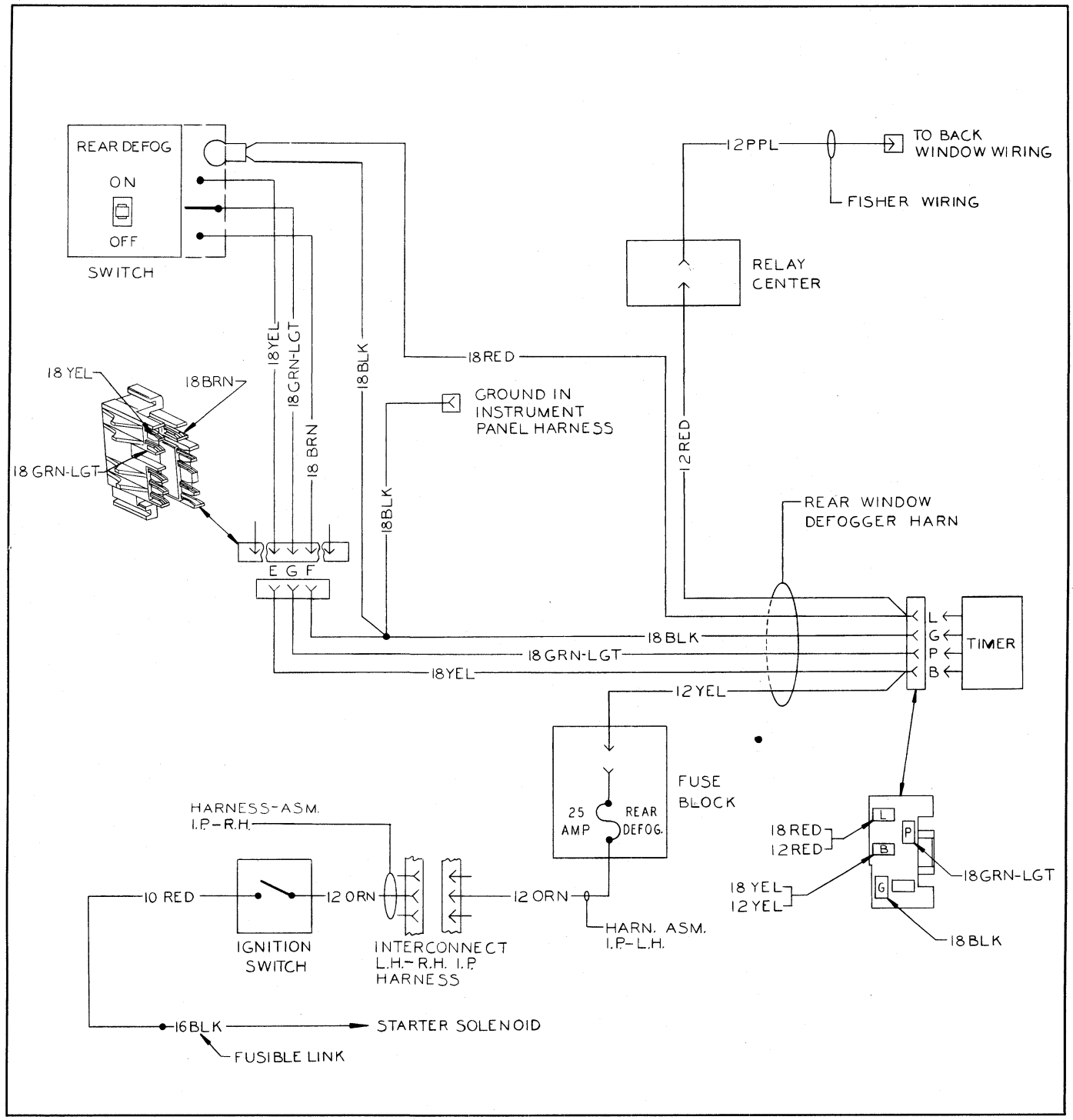


Fig. 9-51 Rear De-Fogger Circuit Diagram (Except Eldorado and Seville)

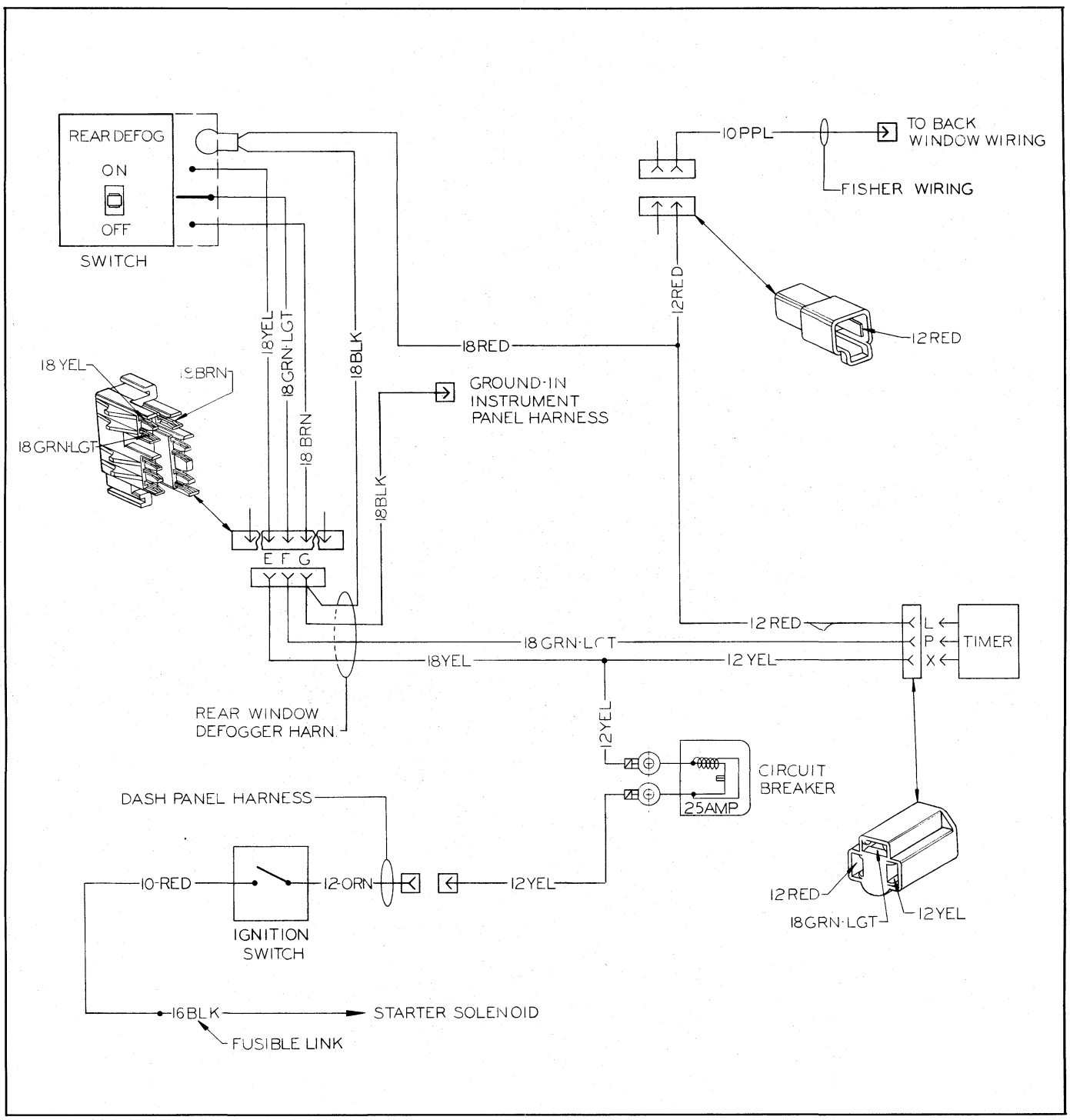


Fig. 9-52 Rear De-Fogger Circuit Diagram (Eldorado)

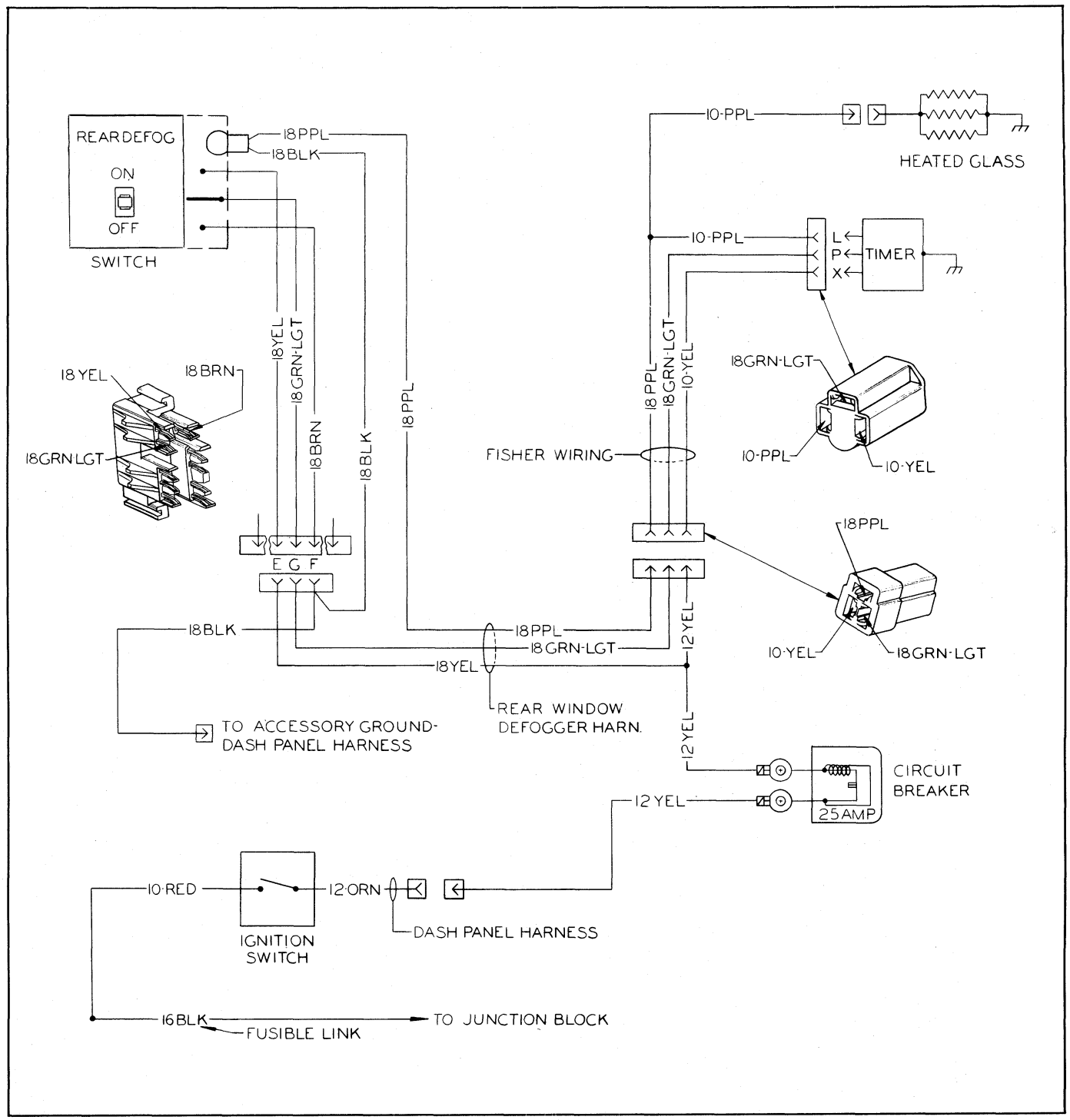


Fig. 9-53 Rear De-Fogger Circuit Diagram (Seville)

DIAGNOSIS

De-Fogger Test (Except Seville)

This test is designed as an on car check using a nonpowered test light.

1. Turn ignition key to "ON" position and pulse de-fogger switch to "ON" position. Rear window glass should feel warm to touch after 3 minutes of operation. If so, explain de-fogger operation to owner. If glass does not feel warm, proceed.

2. On Eldorado, check de-fogger circuit breaker located in the yellow wire between the fuse block and jumper harness on the lower edge of the instrument panel to the left of the steering column. If malfunctioning, replace and check system operation.

Check the 25 amp. fuse in the bottom of the fuse panel on all vehicles except Eldorado and Seville.

3. On Eldorado, disconnect single wire connector (red wire from purple wire) located behind instrument panel to left of steering column. On all cars except Eldorado and Seville the single wire connector is located in the relay center to the left of the fuse block. Wire colors are the same as Eldorado (red wire from purple wire). Leaving ignition key in "ON" position, pulse de-fogger switch to "ON". Connect test light from red wire to ground. If test light and de-fogger switch indicator light come on, the rear window circuit is open. This open may be the connector (purple wire) to the heating element lead, the heating element or the ground wire attachment. Reconnect wiring connector. If light in switch panel does not light, proceed with check.

4. On Eldorado, remove lower steering column cover to gain access to timer relay located on the left side of the instrument panel lower support.

The timer relay is located on top of the fuse panel on all models except Eldorado and Seville. Remove wiring connector from relay. With ignition key in "ON" position, connect test light between the yellow wire in the connector and ground. Test light should light. If test light does not light, the 3-way (Eldorado) or 4-way (except Eldorado and Seville) connector or the switch is malfunctioning. If light comes on, proceed with check.

5. Reconnect wiring connector to timer relay. Leaving ignition key in "ON" position, connect test light between "L" terminal on relay (red wire) and ground. Pulse de-fogger switch to "OFF" to cancel time delay cycle of relay. Pulse de-fogger switch to "ON" position, starting new time delay cycle, and release. Test light should light. If check did not perform as outlined in this step, replace timer relay and check system operation.

6. If all previous checks do not locate cause of inoperative condition, test de-fogger switch using procedure outlined on this page.

De-Fogger Test (Seville)

This test is designed as an on car check using a non-powered test light.

1. Turn ignition key to "ON" position and pulse de-fogger switch to "On" position. Rear window glass should feel warm to touch after 3 minutes of operation. If so, explain de-fogger operation to owner. If glass does not feel warm proceed.

2. Check de-fogger 25 amp. circuit breaker located on the lower instrument panel tie bar, to the left of the lower steering column cover. Check for secure mounting and wiring connections and check system operation.

3. Open hood and check for blown fusible link. Fusible link (#16 black wire) is attached to the junction block, located to the left of the windshield wiper motor. If link is blown, the black wire will be separated. Refer to page 8-85 for replacement of fusible link. Check for unwanted ground in system before attempting to start de-fogger cycle. If fusible link is o.k., proceed with check.

4. Disconnect single wire connector (purple wire) located behind instrument panel to left of steering column. Leaving ignition key in "On" position, pulse de-fogger switch to "On". Connect test light from male half of purple wire connector to ground. If test light and de-fogger switch indicator light come on, the rear window circuit is open. This open may be the connector (purple wire) to the heating element lead, the heating element or the ground wire attachment. Reconnect wiring connector. If light does not light, proceed with check.

5. Remove trunk trim from left hand side to gain access to timer relay located on rear quarter panel reinforcement strut. Remove wiring connector from relay. With ignition key in "On" position, connect test light between the yellow wire in the connector and ground. Test light should light. If test light does not light, the 3-way connector or the switch is faulty. If light comes on, proceed with check.

6. Reconnect wiring connector to timer relay. Leaving ignition key in "On" position, connect test light between "L" terminal on relay (purple wire) and ground. Pulse de-fogger switch to "Off" to cancel time delay cycle of relay. Pulse de-fogger switch to "On" position, starting new time delay cycle, and release. Test light should light. If check did not perform as outlined in this step, replace timer relay install trunk trim and check system operation.

7. If all previous checks do not locate cause of inoperative condition, test de-fogger switch using procedure outlined below.

De-Fogger Switch Test

1. Remove switch as outlined on page 8-8 (Exc. Eldorado and Seville) or page 8-31 (Eldorado) or page 8-47 (Seville).

2. Connect self-powered test light across yellow and light green wires. Test light should now be off. Pulsing De-Fogger switch to "ON" position should turn test light on. Remove test light lead from yellow wire and connect it to brown lead, leaving other lead on light green wire. Pulsing switch to "OFF" position should make test light come on.

3. Visually check switch light bulb. If filament of light bulb is intact, reinstall light bulb and socket into switch housing. If light bulb does not light or filament is broken, the bulb should be replaced.

4. Install switch as outlined on page 8-8 (Exc. Eldorado and Seville) or page 8-31 (Eldorado) or page 8-47 (Seville).

ON-CAR SERVICE

De-Fogger Switch Removal and Installation

The procedure for removing and installing the accessory switch panel is described on page 8-8 (Exc. Eldorado and Seville) or page 8-31 (Eldorado) or page 8-47 (Seville).

De-Fogger Timer Relay Removal and Installation (Except Eldorado and Seville)

The relay is located on top of the fuse panel and can be removed by pulling outward.

De-Fogger Timer Relay Removal and Installation (Eldorado)

a. Removal

1. Remove lower steering column cover as outlined on page 8-21.
2. Disconnect electrical wiring connector from relay.
3. Remove two screws securing relay to upper steering column support and remove relay.

b. Installation

1. Position relay to upper steering column support and secure with two screws.
2. Connect electrical wiring connector to relay.
3. Install steering column lower cover as outlined on page 8-21.

De-Fogger Timer Relay Removal and Installation (Seville)

a. Removal

1. Open trunk and remove trunk trim from left hand side.
2. Disconnect electrical wiring connector from relay.
3. Remove two screws securing relay to left hand rear quarter panel reinforcement strut and remove relay.

b. Installation

1. Position relay to left hand rear quarter panel reinforcement strut and secure with two screws.
2. Connect electrical wiring connector to relay.
3. Install trunk trim and test operation of unit. Close trunk.

THEFT DETERRENT SYSTEM

GENERAL DESCRIPTION

The Electronic Theft Deterrent System is designed to provide additional protection for the vehicle, its contents, and trunk and underhood areas, when it has been properly armed.

Alarm Description

The alarm pulsates the vehicle's horns at a rate of 50 cycles per minute, along with the simultaneous flashing of the low beam headlights, parking, tail, license and side marker lamps. In order to conserve vehicle battery power, the alarm shuts off after three to seven minutes of operation and re-arms.

Hood Switch

A plunger-type hood switch is located on the left side of the radiator upper support in a position where it can sense a small movement of the hood. It is a grounding type switch similar to those used on door lock pillars. On Seville, the switch is located on the right side of the hood lock plate.

Door and Trunk Locks

The door and trunk locks are equipped with tamper switches. These switches will activate the alarm system if the lock cylinders are tampered with, either by attempting to pull out, push in or rotate the cylinder from its normally installed position.

Fuses

Two in-line fuses are used to protect the system. One 25 amp. fuse is located between the controller and the horn-battery feed and the other, a 20 amp. fuse, between the controller and the external lamps battery feed.

Controller

The solid state controller contains electronic components and power relays. Its operation is two stage, as it must become "Armed" before it can be activated. Attempts to violate the vehicle activate the alarm instantly. The Delco electronics controller can be serviced on an exchange basis.

Location of Parts (Fig. 9-54, Except Eldorado and Seville)

The electronic controller is located on the lower instrument panel to the left of the radio receiver where it is accessible after removing the center instrument panel insert and radio receiver. The security system indicator lamp is located in the tell-tale lamp panel. The hood sensing switch is installed on the left side of the radiator upper support in a position inaccessible when the hood is closed or on "safety". The switch operates as the hood raises to its secondary latch or "safety" position. The 20 amp. and 25 amp. fuse are each located in-line above the speedometer cluster.

Location of Parts (Fig. 9-55, Eldorado)

The electronic controller is located beneath the instrument panel center reinforcement support, where it is accessible only after removing the instrument panel pad assembly. The security system indicator lamp is located in the accessory tell-tale lamp panel. The hood sensing switch is installed on the lefthand side of the radiator cradle tie bar in a position inaccessible when the hood is closed or on "Safety". The switch operates as the hood raises to its secondary latch or "Safety" position. The two in-line fuses are located side by side above the radio, one fuse (20 amp.) in the yellow wire and one (25 amp.) in the black with red strip wire.

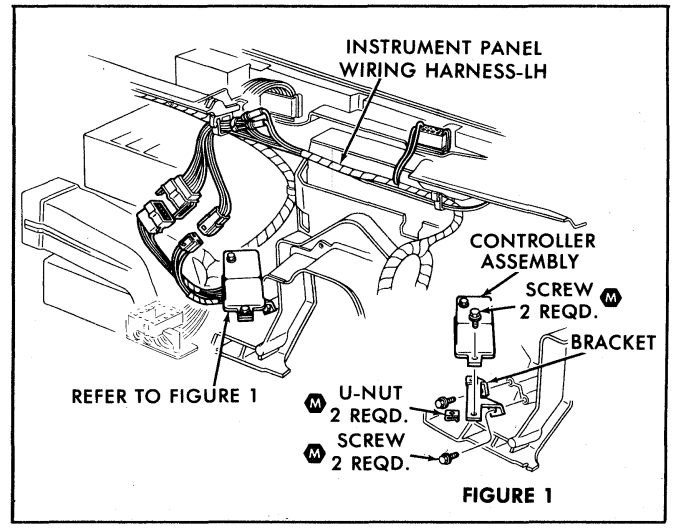


Fig. 9-54 Theft Deterrent Components (Except Eldorado and Seville)

Location of Parts (Fig. 9-56, Seville)

The electronic controller is located behind the instrument panel to the right of the glove box, where it is accessible only after removing the glove box liner. The security system indicator lamp is located in the accessory tell-tale lamp panel. The hood sensing switch is installed on the right-hand side of the hood lock plate in a position inaccessible when the hood is closed or on "Safety". The switch operates as the hood raises to its secondary latch or "Safety" position. The two in line fuses are located side by side above the glove box liner, one fuse in the yellow wire and one in the black with yellow stripe wire.

Arming

After ignition turn off, the "Security System" lamp in the tell-tale panel will begin flashing when any door is opened. Activating the electric door lock switch to "Lock", causes the security lamp to illuminate steadily. When the last door is closed, the security lamp goes out and the system is armed. With the system armed, the trunk may be entered without setting off the alarm by opening the lock with the key.

Disarming

The system is disarmed by unlocking the door with the key or by turning the ignition on. Alarm shut down is accomplished only by unlocking the door with the key.

If the driver wants to prevent arming the system after using the "Door Lock" rocker switch, the switch can be moved to the **unlock** position **before** closing all doors. He may also cancel the arming process by rotating the ignition switch to the "ON" position, then back to lock. Rotating the ignition switch will not cancel the alarm once it is activated.

The doors may be locked mechanically using the lock rocker switch or door key without arming the system. The door key will disarm and deactivate the system. The ignition key in the ignition lock can only disarm the system, (before the alarm is activated).

Automatic Shut Down

Once the alarm is set-off, it will continue to operate, for a period of approximately 3 to 7 minutes and then shut off to conserve battery power. If the locks have not been damaged, the system will rearm itself.

If a lock has been damaged the "SECURITY SYSTEM" light flashes to alert the driver that the system has activated and the car should be inspected for theft and lock damage. The light does not flash with ignition on, but will continue to flash when the ignition is off.

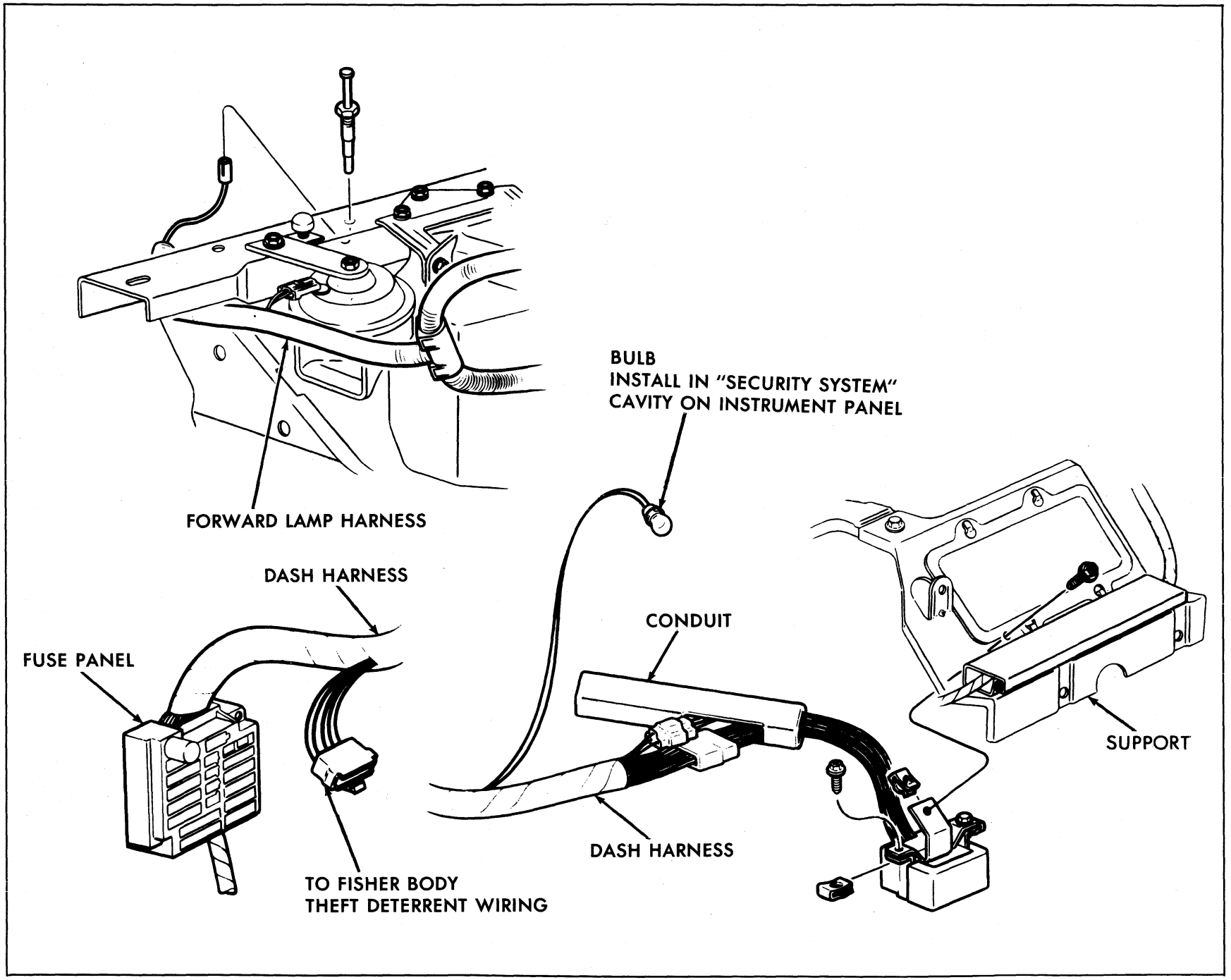


Fig. 9-55 Theft Deterrent Components (Eldorado)

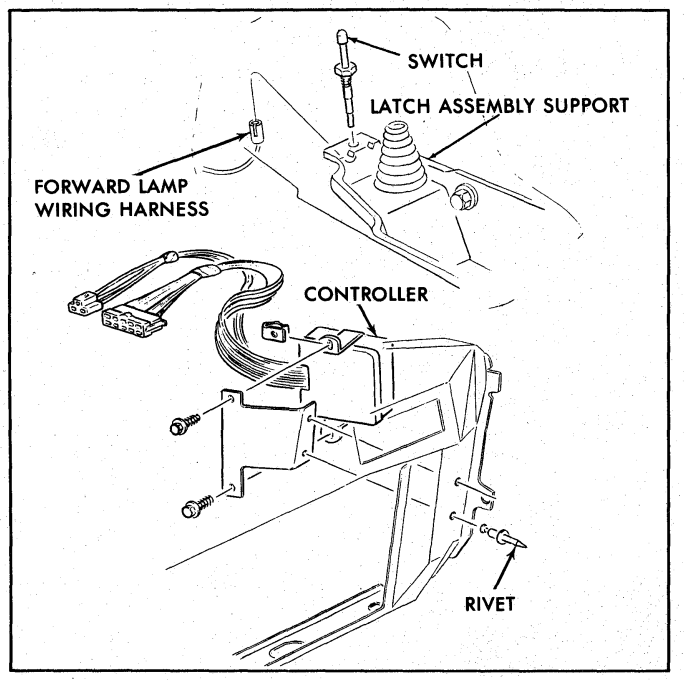


Fig. 9-56 Theft Deterent Components Chart (Seville)

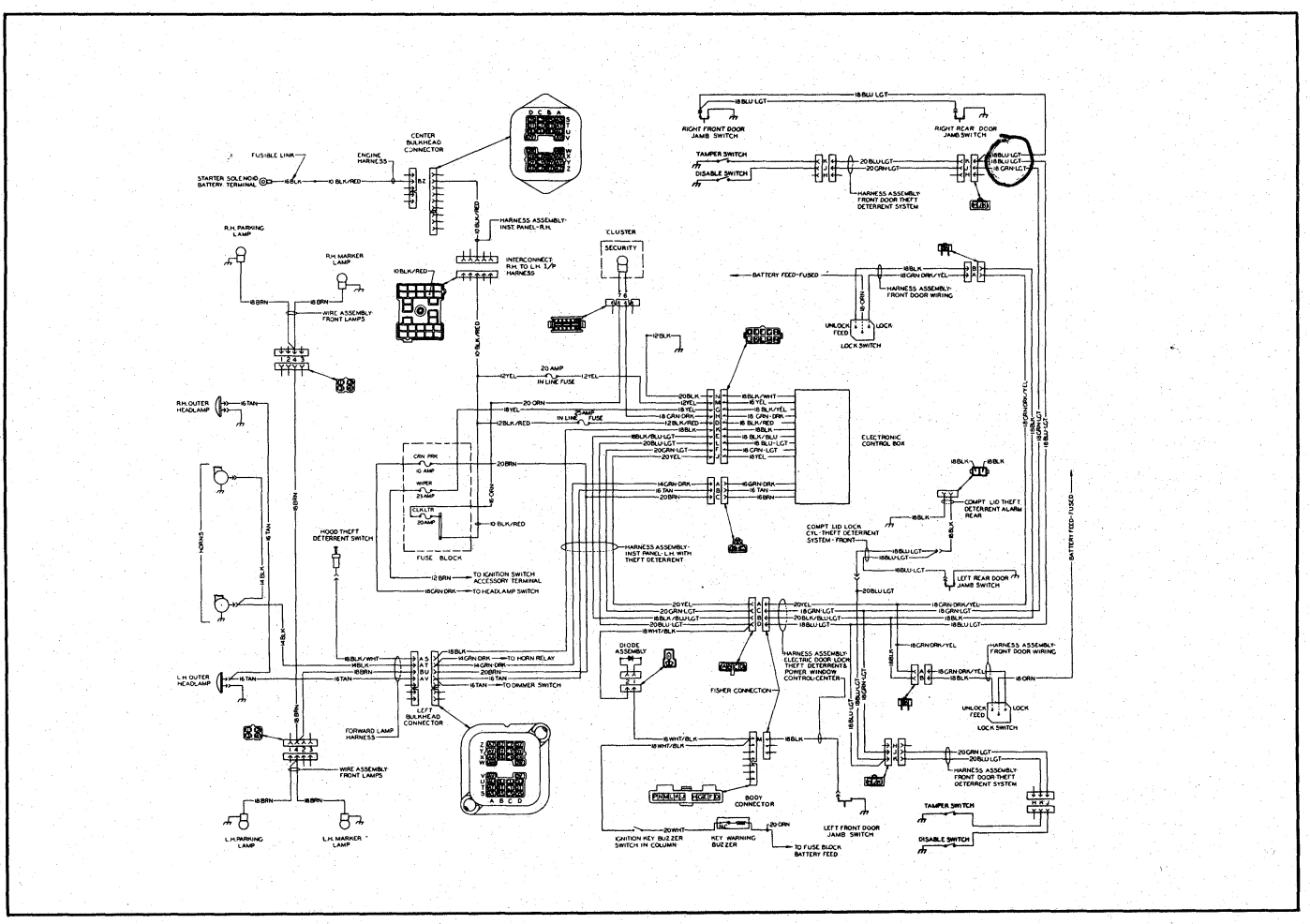


Fig. 9-57 Theft Deterrent Circuit Diagram (Except Eldorado and Seville)

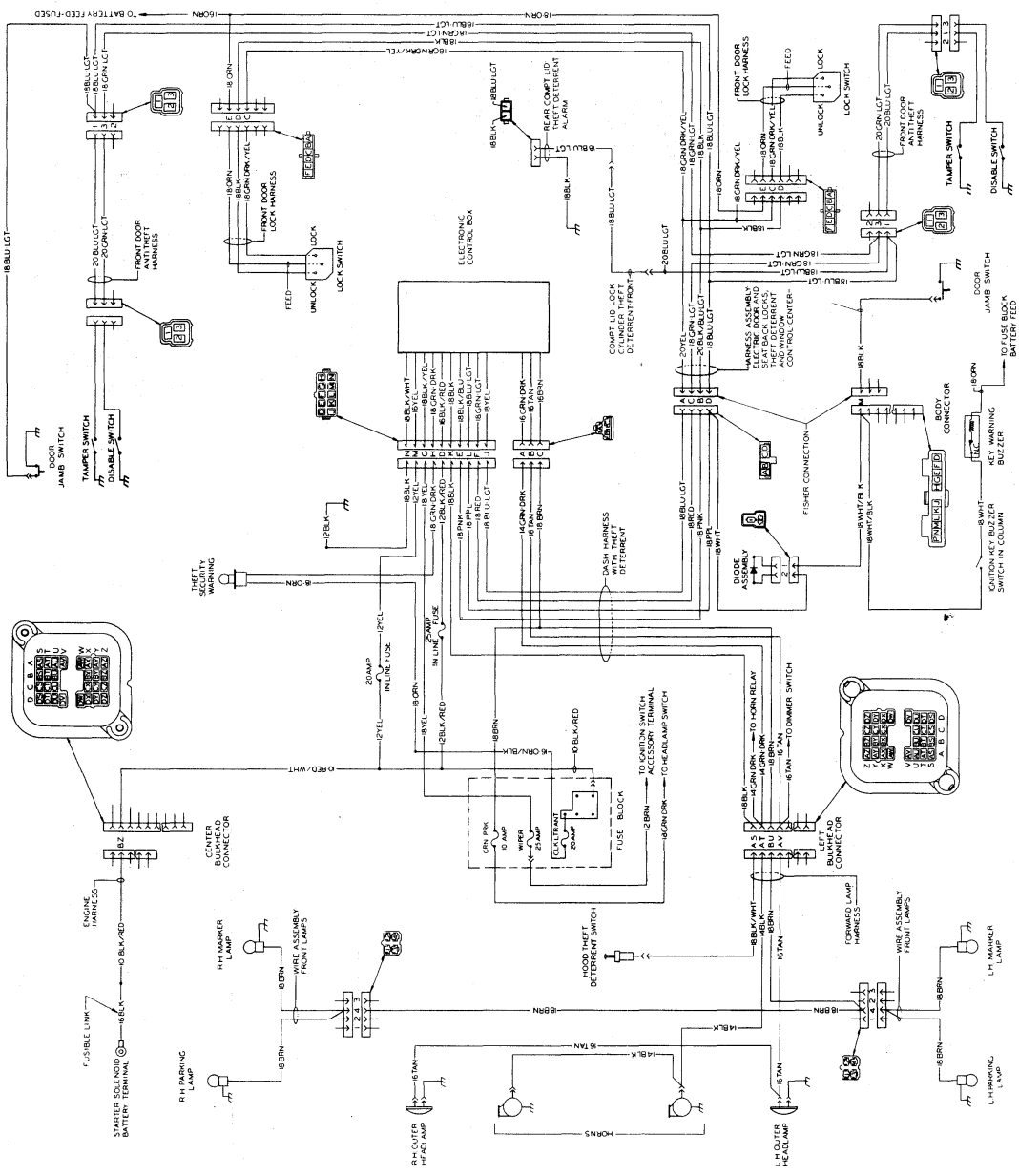


Fig. 9-58 Theft Deterrent Circuit Diagram (Eldorado)

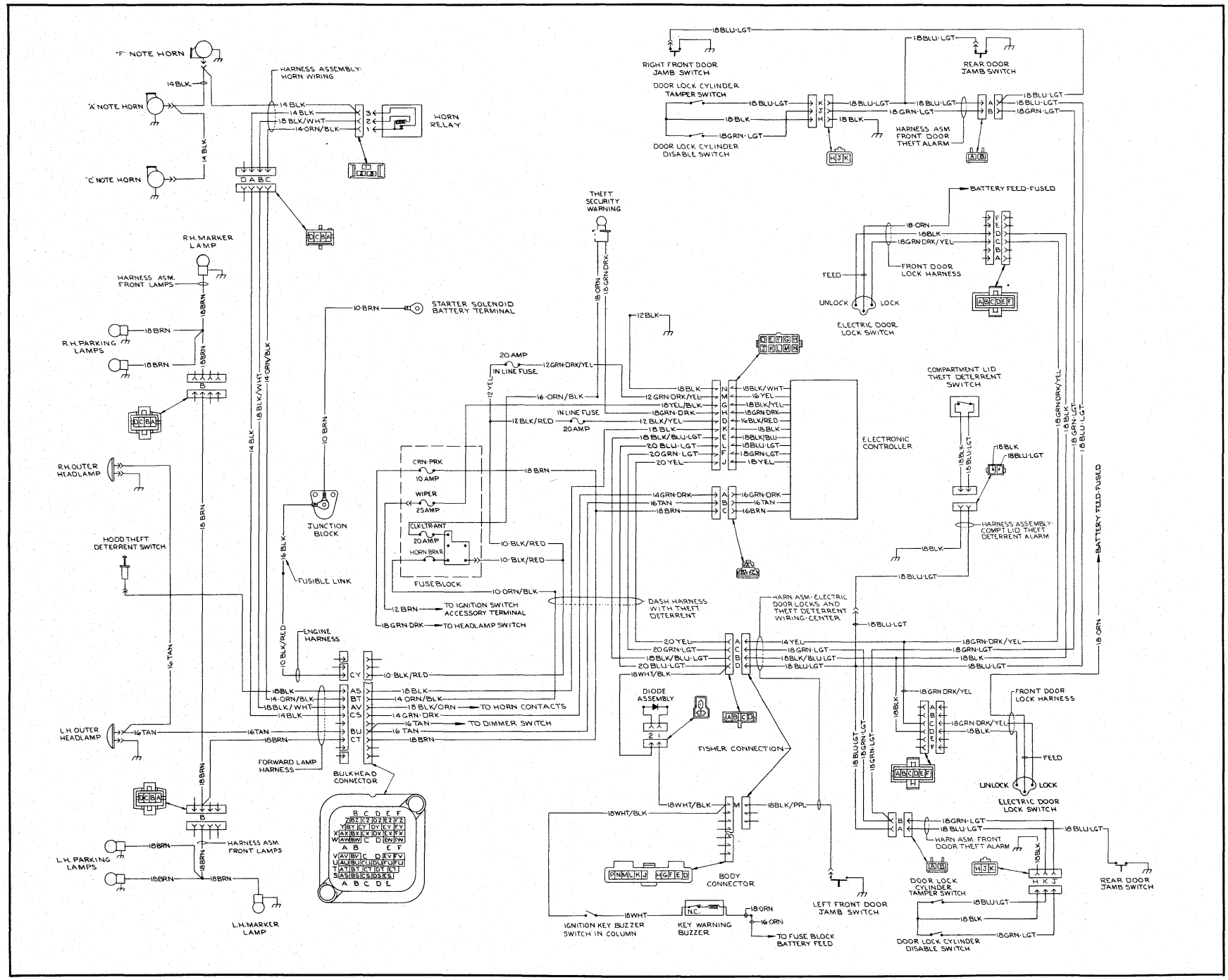


Fig. 9-59 Theft Deterrent Circuit Diagram (Seville)

THEFT DETERRENT CHART (Except Seville)

Before using the "**THEFT DETERRENT DIAGNOSIS CHART**", check the following inter-related electrical components for proper operation:

1. Horns
2. Exterior Lamps
3. Trunk, Door Lock Adjustments
4. Electric Door Lock Circuits

NOTE: Some system malfunctions DO NOT affect the operation of the tell-tale light. Therefore, a complete testing of proper alarm function is required in order to detect some problems).

NOTE: When diagnosing system if instrument panel pad has been removed the 3 wire connector at the controller may be disconnected to eliminate horn and light operation. The relay clicking sound from inside the controller will indicate when system alarm is operating.

COMPLAINT	PROBABLE CAUSE	CORRECTION
System totally inoperative.	Open in one of the following wires: 1. Ground wire (black) in controller cavity N. 2. Battery feed. 3. Electric door lock wire. 4. Blown fuses. 5. Malfunctioning Controller.	Repair or replace as needed. Same as above. Same as above. (If fuse in yellow wire is blown, horn only will activate. If fuse in black with red stripe wire is blown, system will not operate.) Replace after investigating previously listed causes.
	Check for loose connectors at controller to instrument panel harness or instrument panel harness to body harness.	Repair or replace as needed.
Inoperative horn and/or headlamps, and/or marker lamps in alarm mode.	Malfunctioning Controller.	Replace after investigating previously listed causes.
Unable to reverse arming process with "UNLOCK" switch.	Open in door "UNLOCK" wire circuit. Malfunctioning controller.	Inspect circuit from door lock to controller, Fig. 9-57 or 9-58. Replace after investigating previously listed causes.
"SECURITY SYSTEM" tell-tale light inoperative.	Check "Clk Ltr Ant" fuse. Check bulb. Check wiring to bulb for shorts or open condition.	Repair or replace as needed.
System operates normally except alarm will not activate when hood opened.	Open in hood switch wire. Inoperative hood switch. Malfunctioning controller.	Repair or replace as needed. Same as above. Replace after investigating previously listed causes.
System operates normally except does not disarm at one or both doors.	A. Try to disarm system by opening other door lock with key. If system disarms, check for: 1. Open light green wire to problem door. 2. Malfunctioning door key lock switch. 3. Open ground wire (white) inside door	Repair or replace as needed. Same as above. Repair as needed.

THEFT DETERRENT (Except Seville) (Cont'd.)

COMPLAINT	PROBABLE CAUSE	CORRECTION
System operates normally except does not disarm at one or both doors. (Cont.)	B. If system cannot be disarmed from either door: 1. Check for open at 18 red wire at controller with door lock cylinder in unlock position. 2. Malfunction controller.	 Repair or replace as needed. Replace after investigating previously listed causes.
Security light will not go out upon closing doors, and system will not arm.	LOCK CYLINDER VIOLATED or unwanted ground at door jamb switches, door and trunk tamper switches or pinched wires leading to these components. Door and trunk lock tamper switches out of adjustment.	Check for unwanted ground in light blue wire (cavity D) in body to dash harness connector. Repair as necessary. Readjust or replace as necessary.
Alarm activates when depressing door lock button when equipped with illuminated lock cylinder option.	Unwanted ground at door jamb switch.	Remove wires from door jamb switch and install wires so that illuminated lock cylinder feed (18 white) is separated from theft deterrent wiring (18 blue).
Alarm activates by itself.	Check for too close adjustment of hood and door jamb switches. Check for corrosion or disconnect a hood jamb switch.	Readjust or replace as necessary. Repair or replace as necessary.
System cannot be armed - tell-tale O.K.	1. Check for ground at #18 red to #18 green wire at body to dash harness connector (cavity C). 2. Courtesy lights do not shut off, also.	Repair or replace as needed. Repair grounding condition
System cannot be armed - tell-tale O.K.	Check for ground at #18 red wire at controller.	Repair or replace as needed.
Drivers door only will not generate alarm.	Open diode in dash harness. (See Fig. 9-59)	Replace diode.
Key buzzer activated by all doors.	Diode shorted.	Replace diode.

THEFT DETERRENT DIAGNOSIS CHART (Seville)

Before using the "**THEFT DETERRENT DIAGNOSIS CHART**", check the following inter-related electrical components for proper operation:

1. Horns
2. Exterior Lamps
3. Trunk, Door Lock Adjustments
4. Electric Door Lock Circuits

NOTE: Some system malfunctions DO NOT affect the operation of the tell-tale light. Therefore, a complete testing of proper alarm function is required in order to detect some problems.

COMPLAINT	PROBABLE CAUSE	CORRECTION
System inoperative.	Open in one of the following wires: 1. Ground wire. 2. Battery feed. 3. Electric door lock wire. 4. Blown fuses. 5. Blown fusible link.	Repair or replace as needed. Same as above. (If fuse in yellow wire is blown, horn only will activate. If fuse in black with yellow stripe wire or fusible link is blown, system will not operate.)
	Check for loose connectors at controller to instrument panel harness or instrument panel harness to body harness.	Repair or replace as needed.
Unable to reverse arming process with "UNLOCK" switch.	Open in electric door "UNLOCK" wire.	Repair or replace as needed.
"SECURITY SYSTEM" tell-tale light inoperative.	Check (CLK-LTR-ANT) 20 amp. fuse in fuse block. Check bulb. Pink feed wire to bulb pinched.	Repair or replace as needed.
System operates normally except alarm will not activate when hood opened.	Open in hood switch wire. Inoperative hood switch. Malfunctioning controller.	Repair or replace as needed. Same as above. Replace after investigating previously listed causes.
System operates normally except does not disarm with door key.	A. Try to disarm system by opening other door lock with key. If system disarms, check for: 1. Open light green wire. 2. Malfunctioning door lock switch.	 Repair or replace as needed. Same as above.
	B. If system cannot be disarmed from either door: 1. Check for open at 18 red wire at controller with door lock cylinder in unlock position.	 Repair or replace as needed.

THEFT DETERRENT (Seville) (Cont'd.)

COMPLAINT	PROBABLE CAUSE	CORRECTION
Security light will not go out upon closing doors, and system will not arm.	LOCK CYLINDER VIOLATED or unwanted ground at door jamb switches, door and trunk tamper switches or pinched wires leading to these components.	Repair or replace as needed.
	Door and trunk lock tamper switches out of adjustment	Readjust or replace as necessary.
Alarm activates when depressing door lock rocker when equipped with illuminated lock cylinder option.	Unwanted ground at door jamb switch.	Remove wires from door jamb switch and install wires so that illuminated lock cylinder feed (18 white) is separated from theft deterrent wiring (18 blue).
Alarm activates by itself.	Check for too close adjustment of hood and door jamb switches, or corroded jamb switches.	Readjust or replace as necessary.
System cannot be armed - tell-tale O.K.	Check for ground at #18 red wire at controller.	Repair or replace as needed.
Drivers door only will not generate alarm.	Open diode in dash harness, see Fig. 9-59.	Replace diode.
Key buzzer activated by all doors.	Diode shorted.	Replace diode.

ON-CAR SERVICE

CONTROLLER (Fig. 9-54, Except Eldorado and Seville)

a. Removal

1. Unlock door with key.
2. Disconnect negative battery cable.
3. Remove center instrument panel insert as described on page 8-8.
4. Remove radio receiver unit as described on page 9-23.
5. Disconnect controller wiring connections.

NOTE: Controller is located directly behind the right hand remote mirror control.

6. Remove 2 screws securing controller to lower instrament panel and remove controller.

b. Installation

1. Position controller to lower instrument panel assembly and secure with 2 screws.
2. Connect controller wiring connectors.
3. Install radio receiver as described on page 9-23.
4. Install center instrument panel insert as described on page 8-8.
5. Connect negative battery cable and tighten to 70 in. lbs.

Controller (Fig. 9-55, Eldorado)

a. Removal

1. Unlock door with key.
2. Disconnect negative battery cable.
3. Remove instrument panel pad assembly.
4. Disconnect controller wiring connectors from wiring harness connectors, located just above radio receiver.

NOTE: Controller is located beneath the instrument panel center reinforcement support).

5. Remove mounting screw securing controller and mounting bracket to reinforcement support and remove controller.

NOTE: Repairs cannot be made to the Delco Electronics controller. If inoperative, it can be exchanged or repaired at a listening post service center.

b. Installation

1. Position controller and mounting bracket and secure with one screw.
2. Connect controller wiring connectors to wiring harness connectors.
3. Remain in vehicle and lower left front window.
4. Remove ignition key, open door, lock door with electric door lock switch, exit vehicle and close door.

and open door. Alarm should activate. To stop alarm, insert key in door lock and turn to "Unlock" position.

5. Install instrument panel pad assembly and connect battery cable.

Controller (Fig. 9-56, Seville)

a. Removal

1. Unlock door with key.
2. Disconnect negative battery cable.
3. Remove glove box liner.
4. Disconnect controller wiring connectors from wiring harness connectors, located at the controller.

NOTE: Controller is located to the right of the glove box liner, behind the instrument panel.

5. Remove mounting screws securing controller and mounting bracket to instrument panel bracket and remove controller.

NOTE: No repairs can be made to the controller. If inoperative, it must be replaced.

b. Installation

1. Position controller and mounting bracket to instrument panel bracket and secure with two screws.
2. Connect controller wiring connectors to wiring harness connectors.
3. Install glove box liner and connect negative battery cable.
4. Remain in vehicle and lower left front window.
5. Remove ignition key, open door, lock door with electric door lock switch, exit vehicle and close door. Move manual door locking rocker and open door. Alarm should activate. To stop alarm, insert key in door lock and turn to "Unlock" position.

Hood Sensing Switch

a. Removal

1. Open hood.
2. Reach under left hand side of radiator cradle tie bar (right hand side of hood lock plate on Seville) and disconnect wiring from sensing switch.
3. Remove nut securing switch to tie-bar and remove switch.

b. Installation

1. Position switch through tie bar (hole in hood lock plate on Seville) and secure with nut.
2. Reach under tie bar and connect wiring to switch.
3. Close hood.
4. With door and window open, move electric door lock switch to "Lock" position and close door.
5. Check system by opening hood.

c. Switch Adjustment

NOTE: Make certain that hood is properly aligned and hood primary and secondary latches are properly adjusted.

1. Exert upward pressure at left front corner of locked hood.
2. If alarm sounds, remove switch, adjust upward and shim with washer(s) as required.
3. Lower hood and re-arm system. Repeat Steps 1 and 2. Alarm should not sound.
4. Pull hood release cable; alarm should sound. If alarm does not sound, stretch hood pop-up spring to raise hood fully to secondary latch position.

FUEL MONITOR SYSTEM

LOW FUEL LEVEL WARNING INDICATOR

GENERAL DESCRIPTION

The Low Fuel Level Warning Indicator is standard on Seville and an optional accessory on all other series cars and is mounted in the fuel gage, Fig. 9-60. A red light emitting diode next to the "E" empty mark on the gage will glow when the fuel level in the tank is low. The light glows more brightly as the fuel level drops.

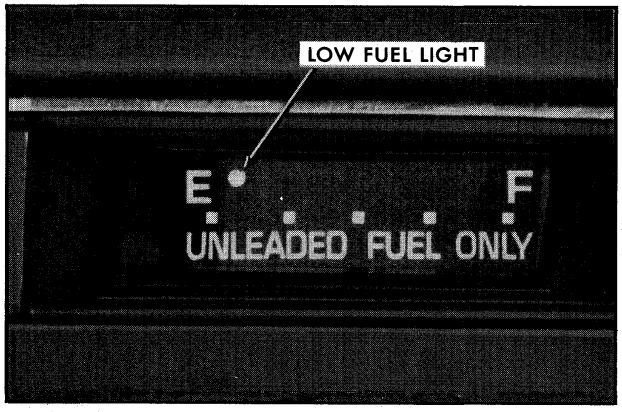


Fig. 9-60 Low Fuel Level Warning Indicator

DIAGNOSIS

Diode Test

This test is designed as an on-car check using a non-powered test light.

1. Turn ignition switch to "On" position.

2. Pull down on fuel filler door and disconnect tan wire connector from body end panel connector, Fig. 9-61.

3. Connect one lead of test light to terminal in end panel connector and other end to rear bumper (ground). Test lamp should light, fuel gage needle should drop to "E" mark and low fuel diode light should glow. If so, system is operating normally. Remove test light, join connectors together and turn ignition off. See Electrical Instrument Diagnosis on page 8-90 and 91, for inoperative fuel tank unit.

4. If test does not operate as described above, reconnect test light for proper ground and retest.

5. If only test light operates without pointer going to "E", fuel gage is inoperative. If pointer goes to "E" and diode does not light, diode or low fuel mylar within gage unit is inoperative. See electrical instruments diagnosis as stated in step 3 above.

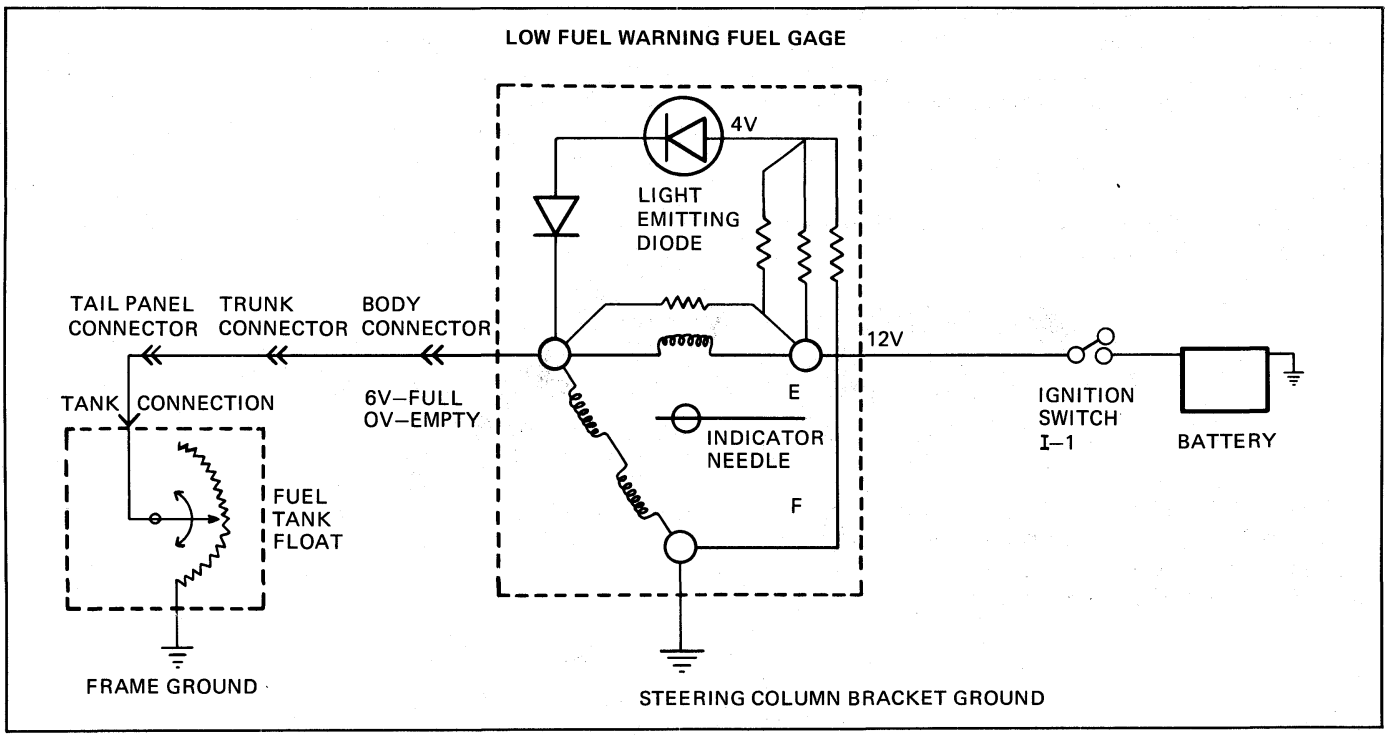


Fig. 9-61 Low Fuel Level Circuit Diagram

FUEL ECONOMY INDICATOR SYSTEM
GENERAL DESCRIPTION

The Fuel Economy Indicator System. Fig. 9-62 is standard on Seville and optional on other models. It has a green and amber indicator light in the accessory telltale panel, a fuel economy (vacuum and electrical) switch mounted at the center bulkhead connector Fig. 9-63 and an interconnecting vacuum hose and tee.

On light throttle acceleration and cruising, the green indicator light glows to denote relatively economical fuel consumption. On heavy acceleration, the amber indicator light glows to denote relatively high consumption of fuel. The amber indicator will also glow when the ignition is turned "On" with the engine stopped.

A dual contact, manifold vacuum sensing switch lights the proper indicator, to agree with the amount of fuel being used. Both indicators should not light during the transition from one color to another, Fig. 9-64.

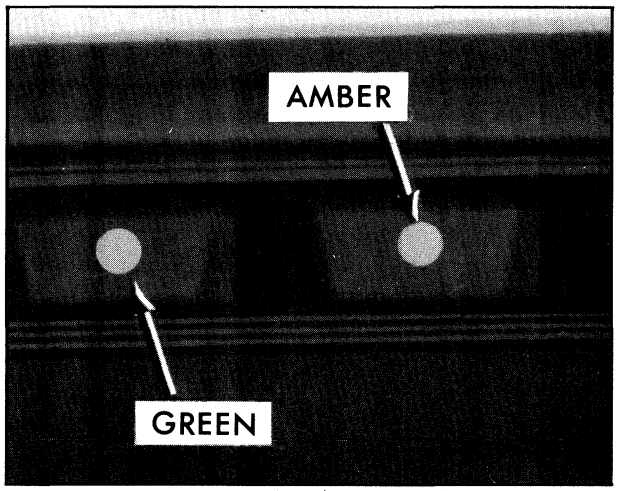


Fig. 9-62 Fuel Economy Indicator Lights

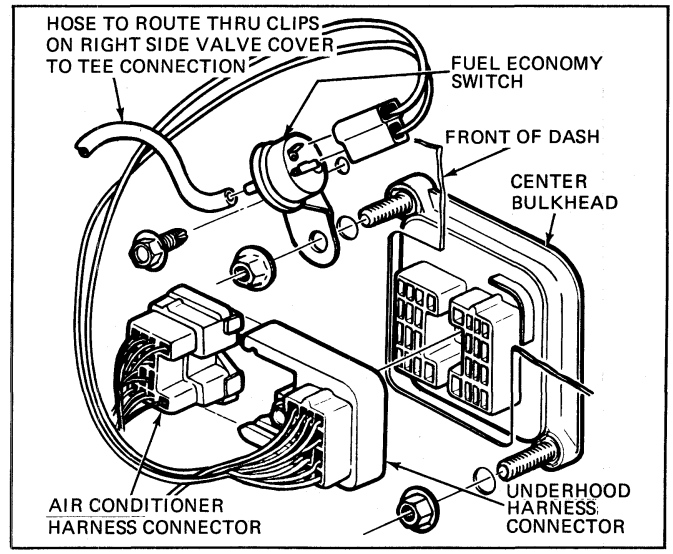


Fig. 9-63 Fuel Economy Indicator Components

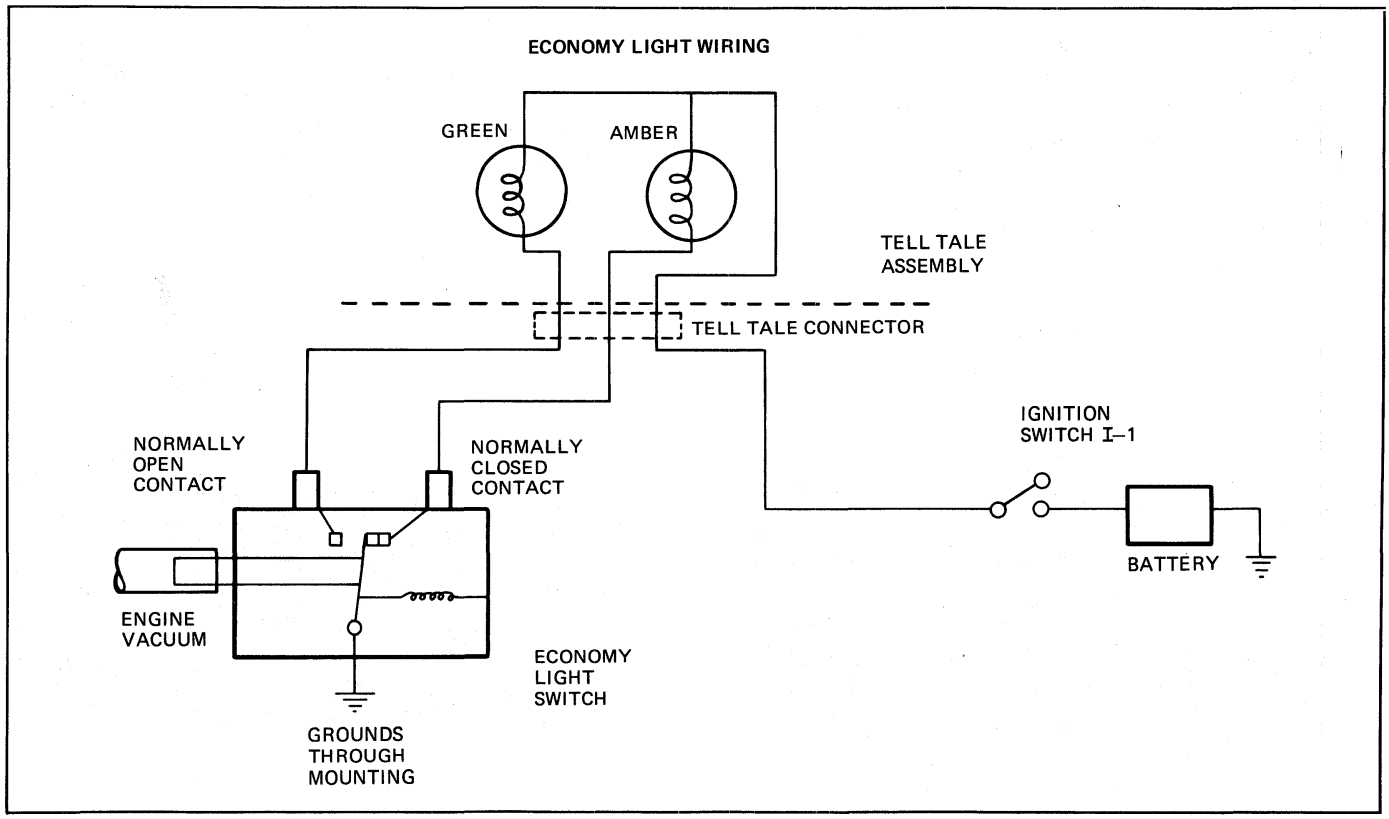


Fig. 9-64 Fuel Economy Indicator System Circuit Diagram

DIAGNOSIS

Functional Test

1. Turn ignition switch to "On" position and ground each terminal at economy switch. Both amber and green indicators should glow. If not, check for burned out or missing indicator bulbs.

2. Turn ignition switch to "On" position; amber indicator should glow. If not, check for loose or disconnected wires at fuel economy switch or poor ground. If none of the above correct operation, replace switch.

3. Start engine and allow to idle. Green indicator should glow. If it does not glow, check for a plugged, kinked or leaking vacuum hose between fuel economy switch and vacuum source. Check for loose or disconnected wires at fuel economy switch or poor ground. If none of the above correct operation, replace switch.

4. Tool J-23738 hand operated vacuum pump may be used to check the vacuum switch without running the engine.

SUNROOF

GENERAL DESCRIPTION

An electrically operated motor-driven Sunroof, Figs. 9-65 and 9-66 is available as an optional feature. The Sunroof permits opening of a sliding roof panel to admit sunshine and outside air into the passenger compartment.

Operation

The Sunroof is operated by a two-position switch labeled "SUN ROOF", Fig. 9-67 located in the accessory switch panel. To open roof panel, with ignition ON, the control switch is moved downward toward the letters "OPN". The roof panel then retracts down and rearward, moving on guide rails (Fig. 9-66) from the flush roof position back into a storage space between the headlining and the roof. To close the roof panel, the switch is moved upward, toward the letters "CLS". The panel then moves forward in the guide rails and, as it nears the end of forward travel, the rear portion moves upward on two ramps, Fig. 9-66. This positions the panel flush with the roof and seals it tightly in the opening.

The Sunroof can be left partially open by releasing the control switch at any position in either direction of its travel.

Manual Operation

The Sunroof can be closed manually in the event it should fail to close when the control switch is moved to the "CLS" position. To do this, remove the small round plug located in the center of the headlining near the front edge of the roof opening to gain access to the winding gear. Remove the plug by grasping with fingers and pulling outward, Fig. 9-68. Remove the screw (visible when plug is removed) using hex end of crank handle provided in glove box.

The threaded end of crank handle is screwed into the winding gear, Fig. 9-69. Turn crank handle clockwise to close the roof. Remove the crank handle, install and tighten the screw securely, then replace the round plug.

NOTE: The crank handle can be used only to close the roof.

Design and Construction Features

The Sunroof is actuated by a two-way electric motor mounted near the center of the windshield header area, Fig. 9-70. The motor drives an auxiliary unit with a gear on the output shaft. This gear, in turn, drives two flexible gear cables that are attached to the roof panel and control its movement, Fig. 9-71.

Four plastic drain tubes, two on each side, are incorporated in the windshield pillar area and in the rear quarter area to catch water seepage that may bypass the weatherstrip seal around the roof opening. The two forward tubes, Fig. 9-72 are routed from the roof panel trough down through the right and left windshield pillars, and out through the rocker panels. The rear drain tubes are routed through the rear quarter panel and drain through the rear wheel housings.

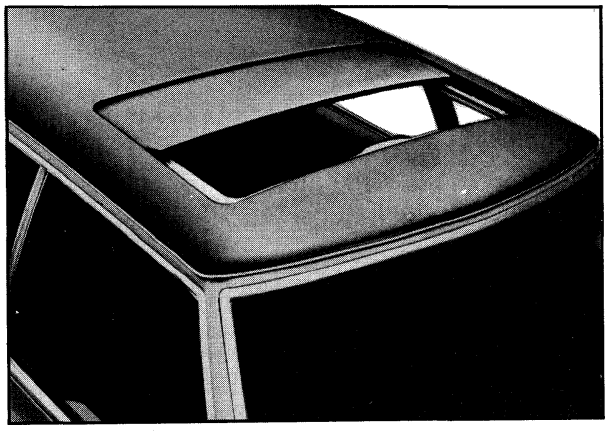


Fig. 9-65 Sunroof Partially Opened

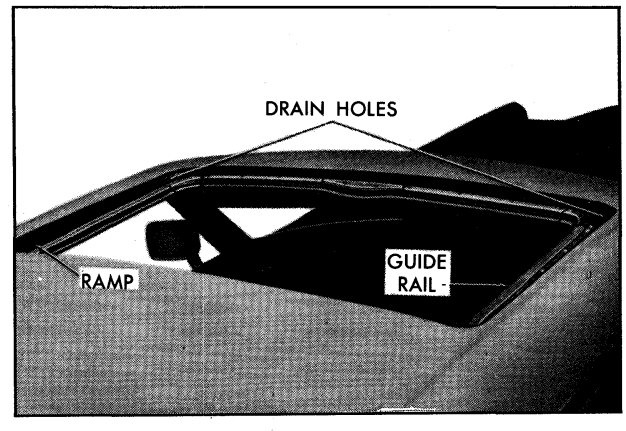


Fig. 9-66 Sunroof Fully Opened

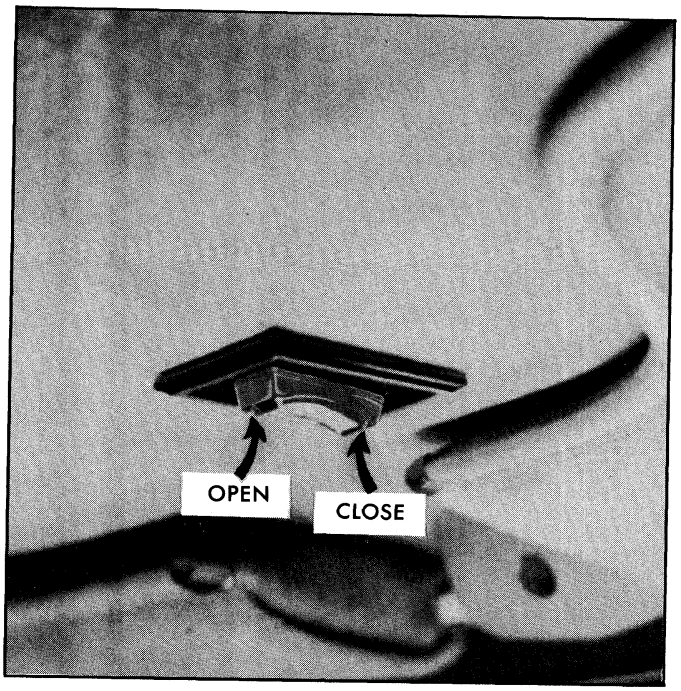


Fig. 9-67 Sunroof Control Switch

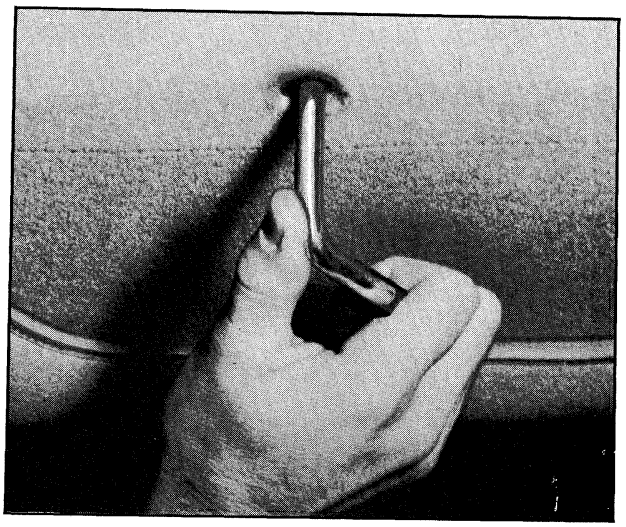


Fig. 9-69 Closing Sunroof with Crank Handle

Electrical System

The electrical circuit for the sunroof is protected by a 30 amp. body circuit breaker located in the fuse block.

Electrical power for the system is supplied from the fuse block through a red wire to the switch in the headliner. Two wires - black for the open cycle and light green for the close cycle - are routed from the switch to the motor.

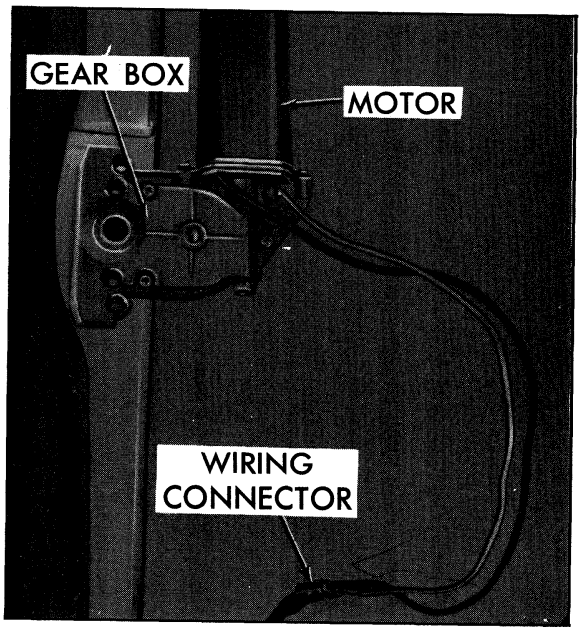


Fig. 9-70 Motor And Drive Unit Location

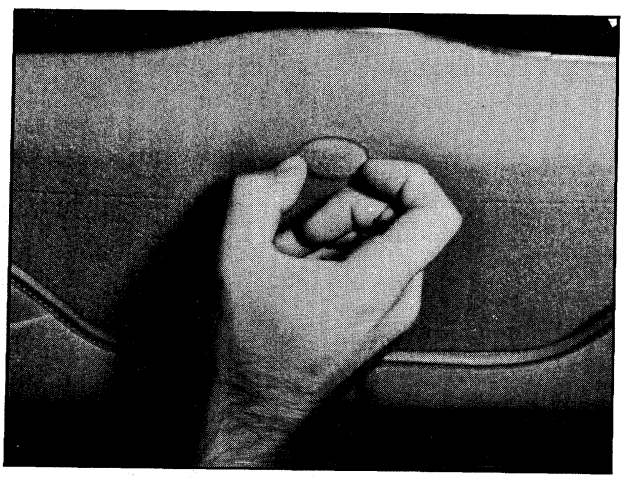


Fig. 9-68 Removing Winding Gear Access Plug

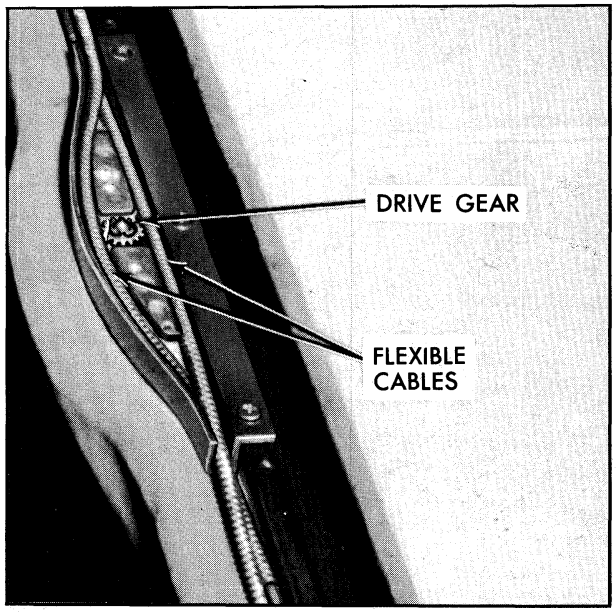


Fig. 9-71 Drive Gear And Cables

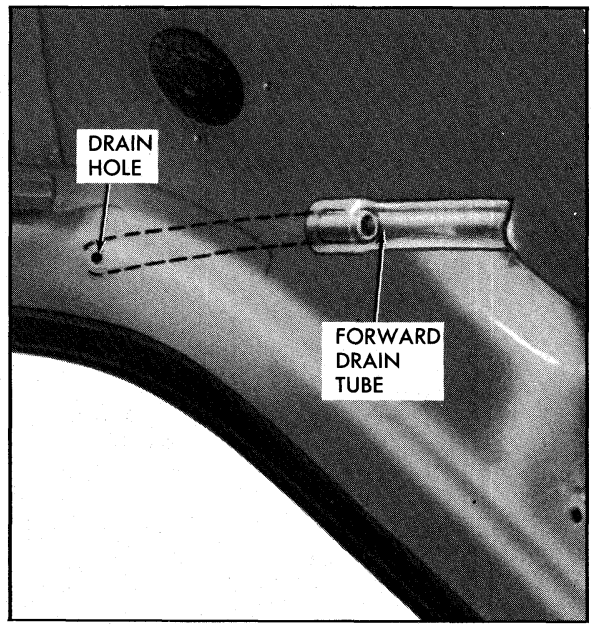


Fig. 9-72 Forward Drain Tube Left Side

DIAGNOSIS

Diagnosis of Inoperative Panel

1. Motor runs, panel does not rise.

a. Panel does not run due to mechanical resistance, see "Panel Does Not Run True" and "Cable Guide Alignment" under "On Car Service". Drive cables may be disconnected or broken.

b. Front slides are tilted and require alignment; see "Ramp Alignment" under "On Car Service".

2. Motor Does Not Run.

a. Check continuity of circuit breaker and wiring connector at control switch.

b. Check control switch to assure electrical continuity to motor.

c. Check wiring and connections to motor. Check motor ground wire.

d. Replace motor.

ON-CAR SERVICE

Headlining Panel

a. Removal

1. Open roof panel slightly.

2. Unsnap forward portion of headlining panel by gently prying downward. Fig. 9-73.

3. Open roof panel to within three inches of full open position to permit rear of headlining frame to fall clear of roof panel rear hooks.

4. Grasp headlining panel front edge and pull it forward and out of side guide rail lower tracks.

b. Installation

1. Retract roof panel to full open position.

2. Align headlining panel with side guide rail lower tracks and move rearward into proper position.

3. Close roof panel part way, leaving it open approximately three inches.

4. Position headlining snaps to holes in panel and tap into place with heel of hand. Fig. 9-74.

Adjustments and Related Repairs

a. Panel Alignment, Front Left or Right

1. To obtain a flush fit with the roof on one side of front of roof panel, loosen both front slide screws, Fig. 9-75.

2. Turn knurled adjuster nut counterclockwise to raise roof panel and clockwise to lower panel, Fig. 9-75.

3. After proper alignment is obtained, tighten screws.

4. Adjust opposite front slide in same manner if required.

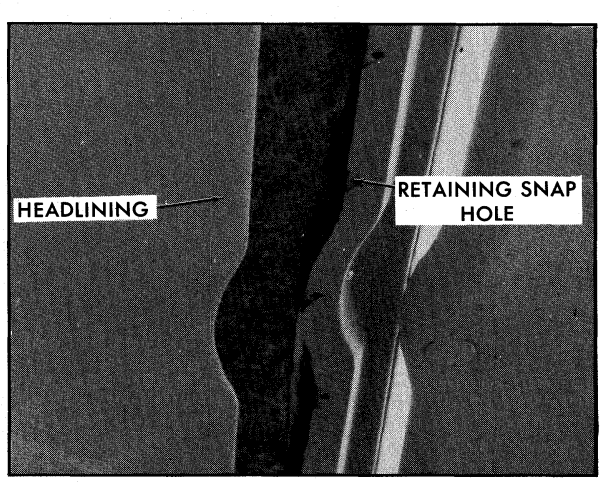


Fig. 9-73 Headlining Panel Removal

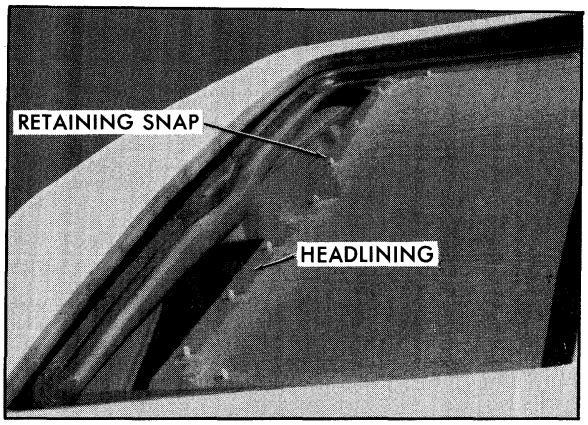


Fig. 9-74 Headlining Snaps

b. Panel Alignment, Rear Left or Right

1. To obtain a flush fit with the roof on one side of rear of roof panel, loosen 3/8" locknut on rear slide, Fig. 9-76.
2. Slide pin up or down in channel to obtain proper height and tighten lock nut.
3. After proper alignment is obtained, tighten lock nut.
4. Adjust opposite rear slide in same manner, if required.

c. Ramp Alignment

1. If roof panel does not rise into roof opening during closing cycle, remove headlining panel from roof panel and open roof panel to full rearward position.
2. Examine ramps in drainage channel, Fig. 9-66 to determine if they are properly aligned with lifting elements at rear of panel.

NOTE: The point where lifting element makes contact with ramp can be seen on rearward slope of ramp, Fig. 9-77.

3. To adjust ramp, loosen both screws, locate ramp in proper position and tighten screws.
4. Close roof panel and note lifting action of panel.
5. If necessary, readjust ramps until proper lifting of roof panel is obtained.

d. Panel Does Not Run True

1. Close roof panel to determine which side of panel jams.
2. Open roof panel, remove drive housing center cover and pry off drive cable retaining clip, Fig. 9-78.

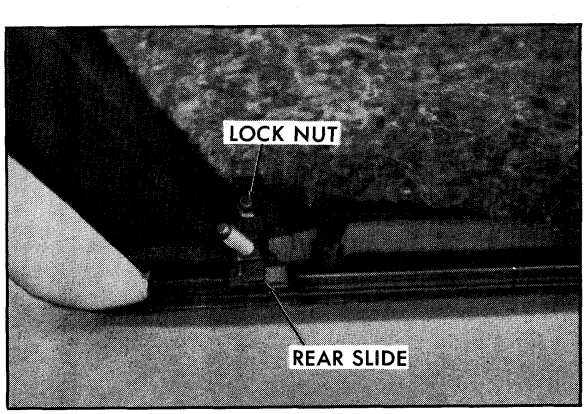


Fig. 9-75 Front Panel Alignment

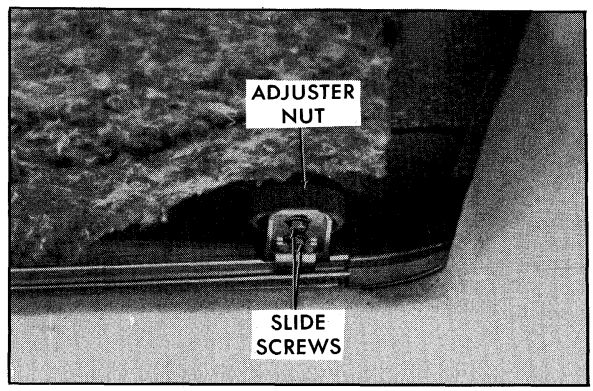


Fig. 9-76 Rear Panel Alignment

WARNING: THE CLIP IS MADE OF SPRING STEEL. HOLD HAND OVER CLIP WHEN REMOVING TO PREVENT RAPID SPRING-UP WHEN PERFORMING THIS STEP.

3. To move right hand side of roof panel forward, lift right cable at front of pinion and pull it one or more teeth to the left.
4. Install retaining clip and drive housing cover and check operations.
5. To move left hand side of roof panel forward, perform similar operation on left cable.

NOTE: Do not move panel while cable is off pinion.

e. Cable Guide Alignment

1. If roof panel jams during its travel, check both front corner lower elbow guides for alignment with front and side guides.
2. If necessary, shim lower elbow guides to move guides inboard for alignment with adjacent guides.

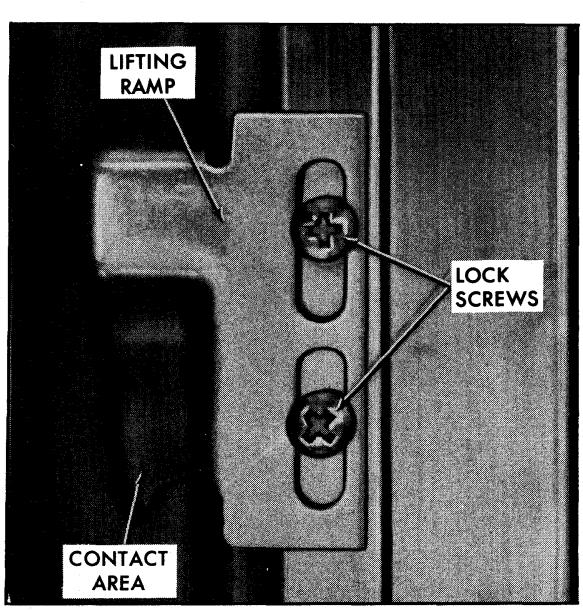


Fig. 9-77 Lifting Ramp

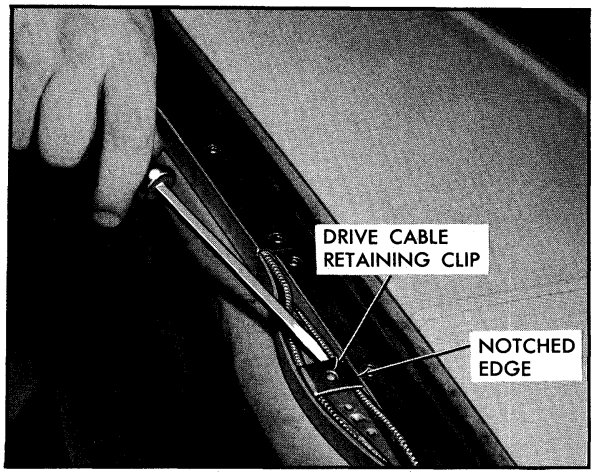


Fig. 9-78 Removing Drive Cable Retaining Clip



Fig. 9-79 Removing Drive Cable Housing Cover

3. If panel fails to rise, the joints of cable slides are out of alignment (guide rail, corner and connection guides, and cable drive housing) and are jamming cable drive.

a. Loosen screws retaining the guide rails, corner and connector rails, and cable drive housing a few turns.

b. Retighten the screws one by one, continually activating the drive mechanism.

c. Where necessary, realign those points where resistance is felt.

Sunroof Switch Removal and Installation

To remove sunroof control switch place fingers on either side of switch panel and pull directly downward. To install, push carefully back into position making sure both sides are engaged.

Motor and Gear Box Assembly

a. Removal

1. Open Sunroof to three-quarter full open position.

2. Disconnect negative battery cable.

3. Remove left and right windshield side garnish moldings, roof side rail garnish moldings, both sun visor assemblies, and center sun visor bracket.

4. Remove left and right windshield upper garnish moldings.

5. Carefully pull headlining from front roof inner panel at top of windshield area sufficiently to gain access to Sunroof motor and gear box assembly, Fig. 9-70.

6. Remove foam insulator padding in front of roof panel opening adjacent to motor and gear box assembly.

7. Disconnect motor electrical wiring connector.

8. Remove drive cable housing cover, Fig. 9-79.

9. Remove left and right elbow corner guides.

WARNING: THE CLIP IS MADE OF SPRING STEEL. HOLD HAND OVER CLIP WHEN REMOVING TO PREVENT RAPID SPRING-UP WHEN PERFORMING THIS STEP.

10. Using a small screwdriver, carefully pry up drive cable retaining clip, Fig. 9-78.

11. Pull drive cables out of upper and lower front guides, observing routing of cables in guides for installation purposes.

12. Remove three screws retaining drive cable housing and remove housing.

13. From top area, remove two gear box assembly retaining screws and remove gear box assembly with motor.

b. Installation

1. Position motor and gear box assembly in drive cable housing.

2. Install two retaining screws.

3. Install drive cable housing with three retaining screws.

4. Insert ends of cables into guides, observing same cable routing as as when removed. Lubricate cables and drive gear with #70 grade lubriplate or equivalent.

5. Install right and left elbow corner guides.

NOTE: Alignment of lower elbow corner guide is of utmost importance.

6. Install cable retaining clip by pressing down firmly with thumb.

7. Install drive cable housing cover.

8. Connect motor electrical wiring connector and battery cable and check operation of system.

9. Apply cement to foam insulation padding and install padding.

10. Apply trim cement sparingly to forward edge of roof panel. Starting at center, position headlining to front roof inner panel forward edge. Smooth out all wrinkles, working from center to outboard ends.

11. Install roof side rail garnish moldings, windshield upper and side garnish moldings, center sun visor bracket and sun visors.

CAUTION: *Be careful not to pinch drain tubes when installing windshield side garnish moldings.*

12. Close Sunroof.

Sunroof Panel, Rear Slide, and Cable (Fig. 9-81 and 9-82)

a. Sunroof Panel Removal

1. Open roof panel slightly.
2. Unsnap forward portion of headlining panel by gently prying downward.
3. Open roof panel further to within three inches of full open position, to permit rear of headlining frame to fall clear of roof panel rear hooks.
4. Grasp headlining panel front edge and pull it forward and out of side guide rail lower tracks.
5. Close roof and push headlining panel to full rearward position.
6. Remove outboard screw from each front slide assembly, Fig. 9-83.
7. Loosen inboard slide screw and rotate each front slide assembly inboard to clear guide rail, Fig. 9-84.
8. Pull each rear slide and cable assembly inboard and out of slide retainer hole in roof panel, Fig. 9-85.
9. Lift roof panel at front edge and pull panel forward and out of roof opening.

b. Rear Slide and Cable Removal

NOTE: If only one cable is malfunctioning, replace both. This assures parallel travel of roof panel.

1. Remove drive cable housing cover, Fig. 9-79.
2. Remove both front upper elbow guides.

WARNING: THE CLIP IS MADE OF SPRING STEEL. HOLD HAND OVER CLIP WHEN REMOVING TO PREVENT RAPID SPRING-UP WHEN PERFORMING THIS STEP.

3. Using screwdriver, pry off drive cable retaining clip.
4. Pull free end of one cable out of guide rail and drive housing, and pull cable and rear slide assembly forward to front corner, Fig. 9-86.
5. Remove slide from guide track and pull cable out of front guide, Fig. 9-80.
6. Remove opposite cable in same manner.

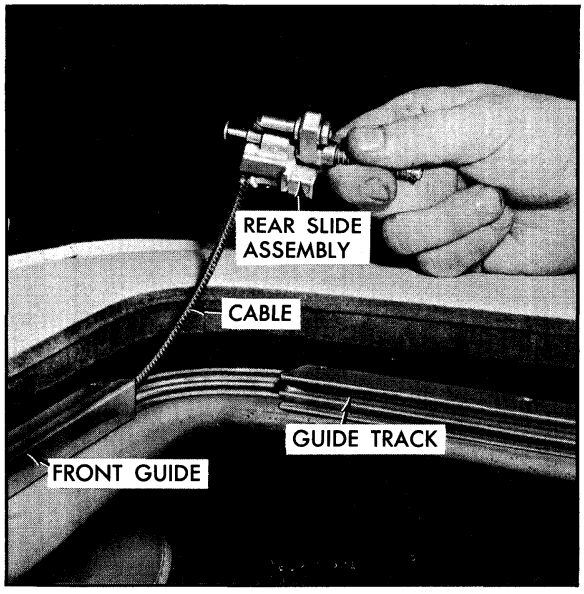


Fig. 9-80 Removing Rear Slide And Cable

c. Rear Slide and Cable Installation

1. Position left rear slide in guide track and move slide and cable assembly back until slide is centered with the fifth side guide rail screw from the front, Fig. 9-87.
2. Slide free end of cable into upper front guide, Fig. 9-88 and route cable through the curved front center track in drive cable housing and into lower track on right side. Do not engage cable in drive pinion teeth, Fig. 9-89.
3. Install right slide and cable assembly in same manner as left slide and cable assembly, except that right cable is routed in straight center track in drive cable housing and into lower track on left side, Fig. 9-89.

NOTE: Make sure right slide is centered with fifth screw from front right guide rail. Do not engage cable in drive pinion teeth.

4. Check both front corner lower elbow guides for alignment with front and side guides. If necessary, shim lower elbow guide to move guide inboard for alignment with adjacent guides.
5. Lubricate cables at the areas of the elbow guides with #70 grade lubriplate or equivalent and install both front corner upper elbow guides.
6. Recheck rear slides for center position with fifth screw from front on side guide rails, Fig. 9-87. With slides in this position, engage cables in drive pinion teeth.

CAUTION: *This operation is critical to assure roof panel alignment and prevent cable breakage.*

7. Lubricate cables and drive pinion teeth with #70 grade lubriplate or equivalent and install drive cable retaining clip.
8. Install drive cable housing cover, being careful not to overtighten screws.
9. Actuate switch to check cable operation, then return rear slides to fifth screw from front on side guide rails.

b. Roof Panel Installation

1. With headlining panel in full rearward position, install roof panel into roof opening.

CAUTION: *Hold roof panel in a nearly horizontal position when placing panel into roof opening to assure that stop on center rear edge of roof panel does not damage passenger compartment headlining.*

2. Move each front slide assembly outboard and install slides on guide rail upper tracks.
3. Install outboard screws and tighten both screws on each slide, Fig. 9-75.
4. Push roof panel to full forward position by hand.
5. Lift rear of roof panel upward and actuate control switch to position rear slides into alignment with holes on slide retainers on roof panel, Fig. 9-85.
6. Engage each rear slide pin into retainer hole and install retainer spring plate on slide pin.
7. Actuate switch, check operation of roof panel, and note fit of panel to roof. If any adjustments are necessary, refer to "adjustments and related repairs" under service information part of this section.
8. Install headlining on roof panel.

Drain Hose Replacement

a. Front Drain Hose

1. Perform Steps 3, 4 and 5, in "motor and gear box removal procedure", page 9-82 and carefully pull headlining away from top of windshield area sufficiently to gain access to either front drain hose, Fig. 9-72.

2. Remove kick pad trim panel.

3. Remove hose from drain tube outlet at top.

NOTE: Adhesive is used to secure hose to outlet.

4. Using a piece of flexible wire or cord, attach new hose to lower end of old hose and pull new hose into position while removing old hose.

5. Secure new hose to drain tube outlet with weatherstrip adhesive.

6. Install headlining, garnish moldings, sun visors, and bracket as described in "motor and gearbox installation procedure", page 9-82 Steps 11 and 12.

b. Rear Drain Hose

1. Pull down headlining at rear corner to gain access to hose.

2. Remove hose from drain tube outlet at top.

3. Using a piece of flexible wire or cord, attach new hose to lower end of old hose and pull new hose into position while removing old hose.

Weatherstrip Replacement

a. Removal

1. With Sunroof panel closed, mark joint of roof opening weatherstrip rear edge and roof panel weatherstrip front edge on both the roof panel and roof at both sides of vehicle.

2. Remove roof panel assembly from vehicle, as described on page 9-83.

3. Remove weatherstrips from roof panel opening and from rear edge of roof panel.

b. Installation

1. Clean surfaces using a suitable cement solvent.

2. Apply weatherstrip cement to both surfaces.

3. Position roof opening weatherstrip slightly below flush of roof and align one end of weatherstrip with mark on roof assembly. Cement weatherstrip to roof opening.

4. Install weatherstrip on rear edge of roof panel in same manner as roof opening weatherstrip described in Step 3.

NOTE: Roof panel weatherstrip is also retained with trim nails.

5. Install roof panel assembly into roof opening, as described on page 9-83.

Periodic Maintenance

a. Lubrication

1. During cable replacement, lubricate cables with #70 grade lubriplate or equivalent.

2. Periodically clean off any dirt that may have accumulated on guide rail covers.

CAUTION: *Do not lubricate top surface of guide rail covers as this will cause streaks on headlining material.*

b. Drain Tubes

1. During regular maintenance, check the two drain holes at the front corners of the roof panel, Fig. 9-66 to make certain they are open and free of foreign material. If drains are plugged, they can be cleaned with an air hose or flexible wire. If they cannot be cleaned in this manner, they must be replaced.

2. To clean rear drain tubes, use an air hose or flexible wire from the bottom of the tubes.

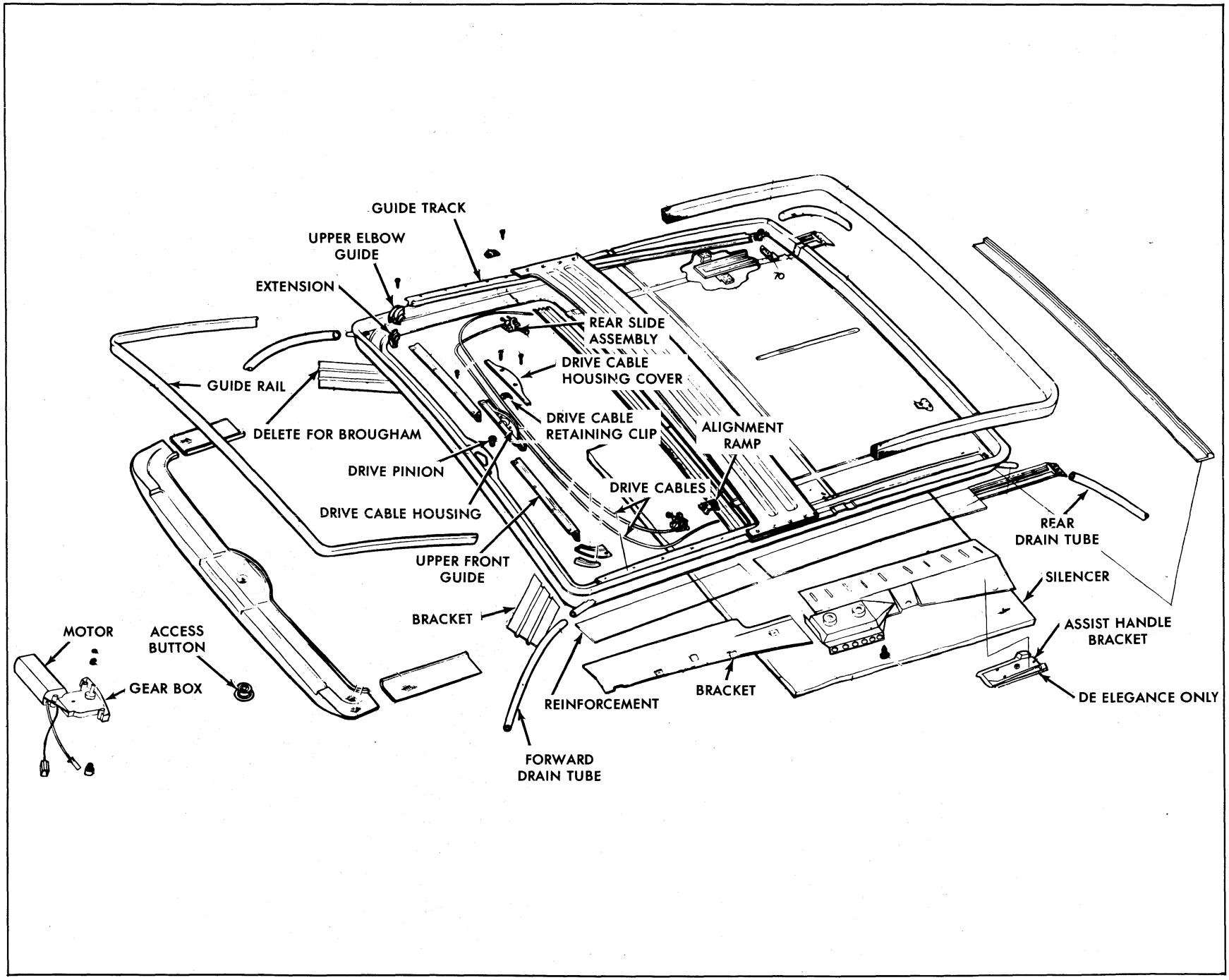


Fig. 9-81 Sunroof Disassembled

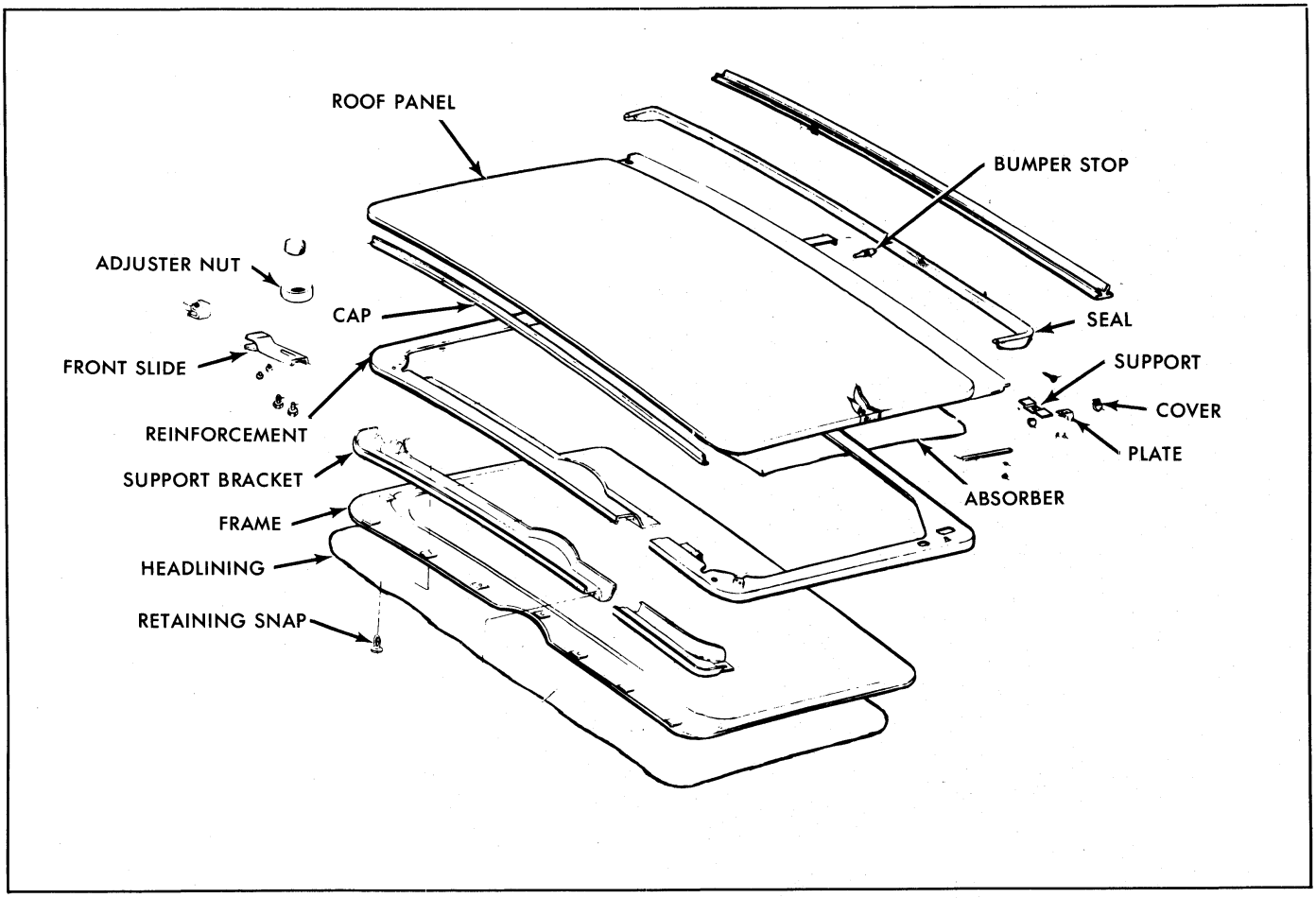


Fig. 9-82 Roof Panel Disassembled

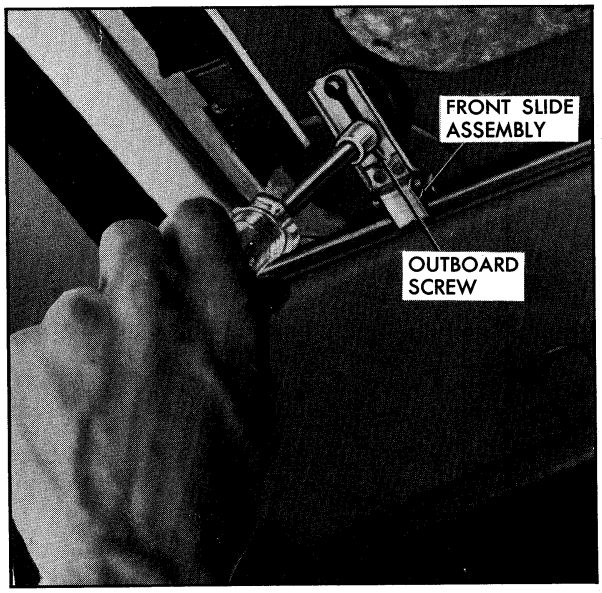


Fig. 9-83 Removing Outboard Screw From Front Slide Assembly

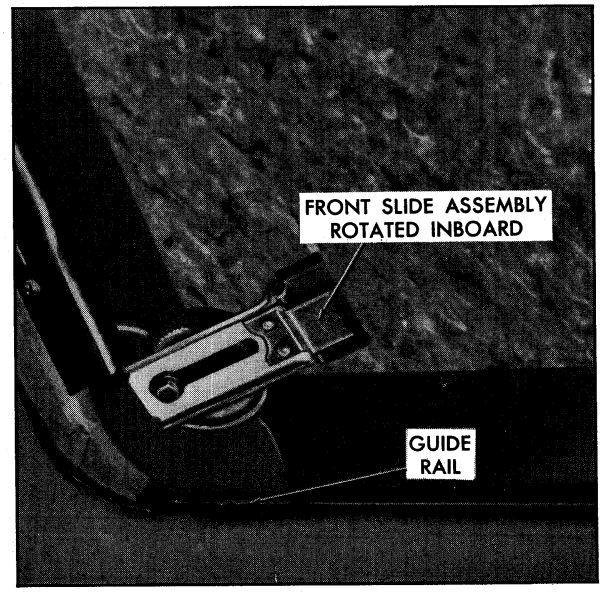


Fig. 9-84 Front Slide Assembly Clear Of Guide Rail

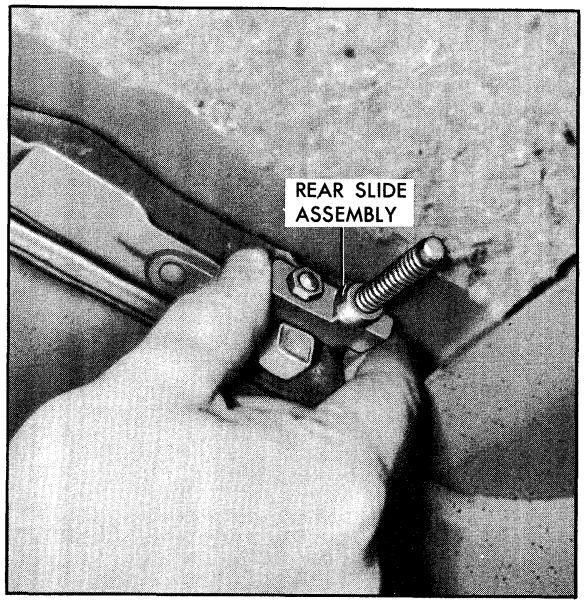


Fig. 9-85 Removing Rear Slide And Cable Assembly From Retainer

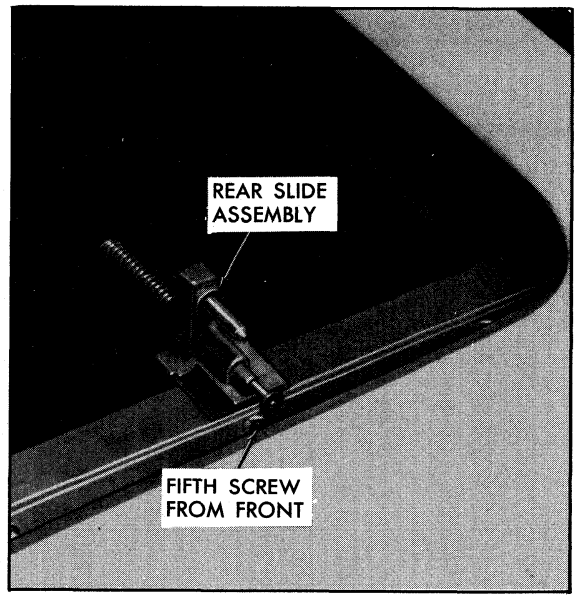


Fig. 9-87 Rear Slide In Centered Position

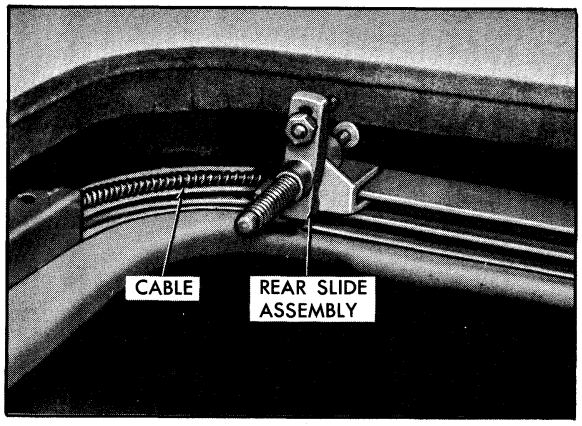


Fig. 9-86 Cable And Slide Assembly Pulled Forward

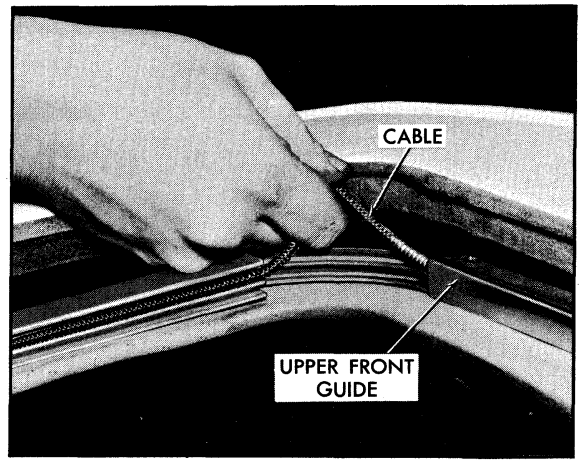


Fig. 9-88 Installing Cable Into Upper Front Guide

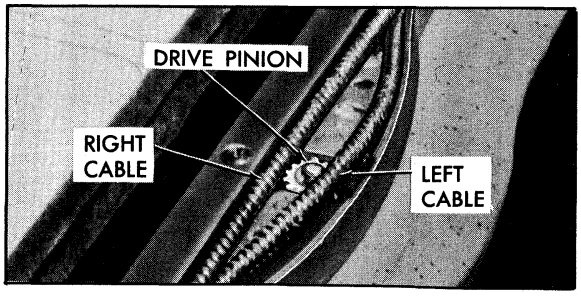


Fig. 9-89 Drive Cables Installed

ASTROROOF

GENERAL DESCRIPTION

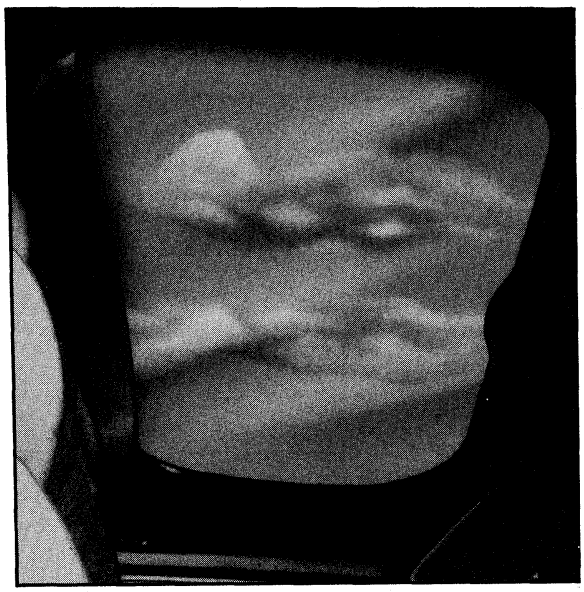


Fig. 9-90 Astroroof

The Astroroof, Fig. 9-90, consists of a specially treated safety glass panel that allows skylight to enter the passenger compartment. It is equipped with a sliding sunshade that can be closed to block out light. The sunshade is moved by pulling or pushing the handle to obtain the desired settings. To completely close the shade, push its forward edge into the groove at the front of the roof.

The Astroroof incorporates an electrically operated sliding panel that can be opened to admit outside air and light. The sliding panel is operated by a switch in the instrument panel.

DIAGNOSIS

Water Leaks

A water leak occuring in the area of the halo molding is usually caused by an inadequate seal between the Astro roof glass and the metal frame. The metal frame and glass are hermetically sealed. To correct a leak between the metal frame and the glass, remove the roof panel from the car. Use a clear auto glass silicone sealer and apply a bead around the edge of the metal frame.

NOTE: Do not attempt to pry the metal frame away from the glass to apply the sealer, as this could result in glass breakage.

ON-CAR SERVICE

NOTE: For additional service information, refer to the sunroof section.

Halo Molding

NOTE: To perform adjustments or repairs on an Astroroof, it is necessary to remove the halo molding.

a. Removal

1. Slide sunshade all the way open.
2. Open roof to halfway position.
3. Remove three screws from front of halo molding.
4. Close roof to within three inches of the fully closed position.
5. Pull the forward center portion of the halo molding downward so the horizontal tabs at the front of the molding are removed from the track.
6. Close roof and slide halo molding forward, pulling downward on the rear center section of the molding to disengage the horizontal slide surface from the track assembly, and remove halo molding.

b. Installation

1. Position rear slide surface of the halo molding into the track assembly pulling downward on the rear center section of the molding to engage the slide surfaces into the track.
2. Slide halo molding to the rear and open the roof panel about halfway.
3. Pull the forward center portion of the molding downward so the horizontal tabs at the front of the molding can be installed into the track.
4. Position halo molding and secure with three attaching screws.
5. Close roof.

Sunshade

a. Removal

1. Remove the halo molding as outlined above.
2. Open roof to full open position.
3. From outside of the car, deflect the sunshade upward in the center to disengage from the track and slide the sunshade forward and out of the car.

b. Installation

1. From outside of the car, deflect the sunshade upward in the center and engage rear corners into the track.
2. Move the sunshade to the full open position.
3. Close roof panel.
4. Install halo molding as outlined above.

1. Hood front spear molding
2. Hood side molding
3. Door belt front molding
4. Door belt rear molding
5. Quarter panel belt side molding
6. Belt side molding front joint cap
7. Interior upper quarter trim panel L.H.
8. Interior upper quarter trim panel R.H.
9. Top band molding
10. Half-top vinyl cover
11. Half-top vinyl pad
12. Back glass interior trim panel
13. Belt side molding rear joint cap
14. Script - name plate "Biarritz"
15. Opera outside light assembly
16. Roof outer panel cap assembly

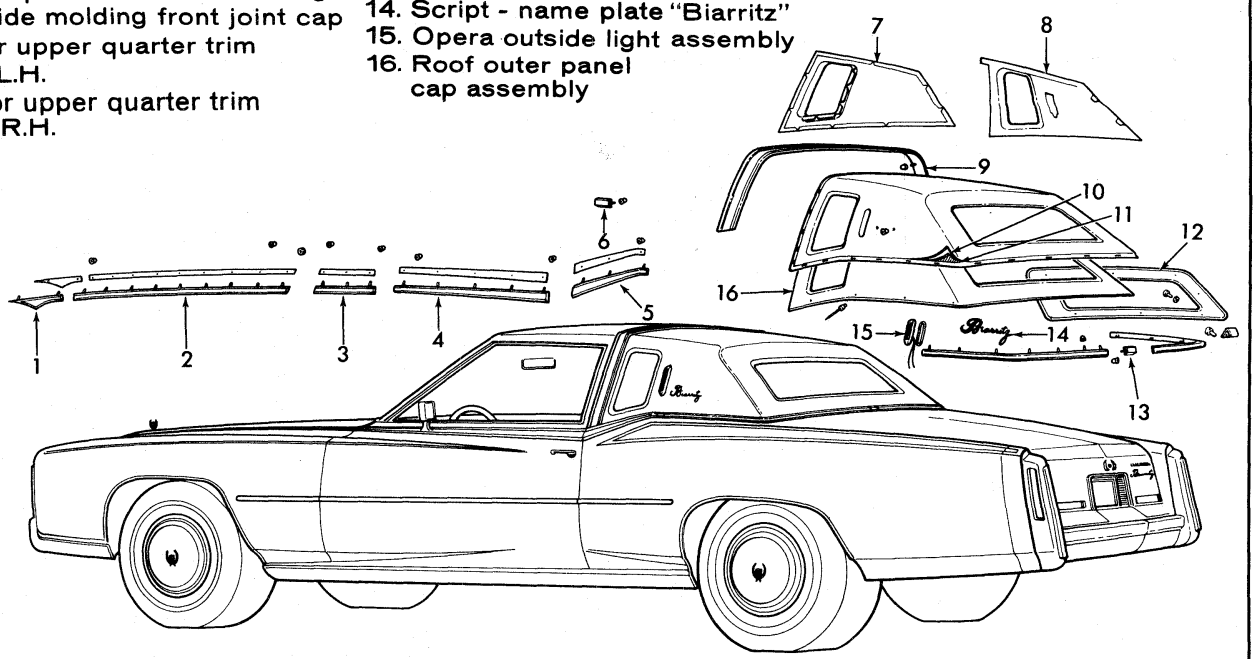


Fig. 9-91 Eldorado Custom Biarritz Top

GENERAL DESCRIPTION

All moldings are retained by nuts and or studs and barrel-type nuts, as shown in Fig. 9-91. Moldings having front and rear retaining nuts require removal of the nuts before the molding can be pried loose from the barrel nuts.

In cases where a barrel nut may be pried out with the molding stud, replace the barrel nut before installing molding.

When prying out or installing moldings, always work from one end of molding. Care must be exercised not to damage or chip paint during all procedures.

Hood front spear moldings, left and right, are retained by two nuts that must be removed before the hood side moldings can be removed or installed.

Door belt moldings are two-piece, with the front molding retained by one nut and studs, and the rear molding retained by a stud and nut.

Belt side moldings are retained by studs, joint caps and also by three nuts each under sealer wads accessible from inside trunk compartment.

ON-CAR SERVICE

Vinyl Top and Cap Assembly Removal and Installation (Removal Fig. 9-91)

1. Disconnect negative battery cable.
2. Remove belt side back molding joint cap, roof top band moldings, quarter panel belt side moldings, "Biarritz" script nameplates on sail panels, and opera lamps.
3. Being careful not to damage or puncture headlining, remove interior upper quarter trim panels, and back window trim panel.
4. Remove interior side upper garnish moldings.
5. Remove interior sail panel lights.
6. Remove quarter window glass retained by clips.
7. Carefully peel back vinyl top material and foam paddings from edge of fiberglass cap sufficiently to gain access to cap-retaining "pop" rivets around perimeter of cap.

NOTE: A single-edge razor blade can be used to smoothly separate the foam padding material from the fiberglass cap surface for sufficient access to cap-retaining pop rivets. Rivets are located approximately 3/4" from edge and approximately every 7" around perimeter. Approximately 34 rivets are used to retain the cap.

8. Using 1/8" diameter drill bit (with 3/8" depth stop on drill to prevent drilling through headlining and interior parts), drill rivets out.
9. Being careful not to pry the cap excessively, to avoid cracking cap, remove cap with vinyl top and padding as an assembly.

NOTE: If necessary, use sharp metal yardstick as a tool to separate any insulating silicone sealer between cap and roof, to permit less flexing of cap assembly during removal.

NOTE: Back glass removal and installation can now be performed, following regular back glass R I procedures.

Installation

1. Using flat scraper, clean roof and cap surfaces of any excess adhesive and sealer high spots that would interfere with a smooth appearance of the assembly installation.
2. With aid of helper, position cap and top assembly on roof.
3. Secure cap and top assembly to roof with 1/8" dia. pop rivets, using same holes in cap and roof.
4. Apply RTV 108 silicone rubber adhesive sealer (or equivalent) around edge of cap and between cap and roof, and around back glass-to-cap edges, and vinyl top edges.
5. Using flat-bladed tool (rounded at edges to avoid cuts or tears to material), tuck top material overlap around back window, and around cap edges. Smooth out all wrinkles.
6. Install quarter window, interior quarter trim panels, back glass trim panel, sail panel lights, all removed moldings, opera lamps, Biarritz script nameplates, and nuts.
7. Apply thin bead of sealer along forward base edge of roof top moldings after installation.
8. Remove excess sealant from assembly.
9. Connect negative battery cable.

AUTOMATIC DOOR LOCKS

GENERAL DESCRIPTION

Automatic door locks are an optional convenience item available on all cars. The system is in addition to and operates in conjunction with the electric door locks which are a standard feature on all cars.

All doors will automatically lock after the following:

1. Driver is seated.
2. All doors are closed.
3. Ignition switch "ON".
4. Transmission selector in "drive".

If a passenger(s) exits while the driver remains seated and the transmission selector is in "drive", any and all doors that are opened will relock automatically when all doors are again closed.

To unlock a door(s) with the driver seated and the transmission selector in "drive", the doors must be unlocked either with the electric door lock switch or the manual door lock button. However, with the transmission selector in "park", "reverse", or "neutral", either door on coupes or either front door on sedans may be opened from the inside by merely actuating that inside door handle.

The "driver must be seated" provision avoids the possibility of the driver being inadvertently locked out of the car. The electric door lock switch must be used after parking to lock all doors.

To enter, a standard key is used to unlock either the left or right (front) door. All other doors remain locked until unlocked either with the electric door lock switch or the manual lock button.

Door Handle Switches

Front door inside handles each contain a normally open switch. When the handle is actuated the switch closes completing a circuit to the logic module.

Component Parts Back-Up Light Switch (Fig. 9-92)

A specific back-up light switch is used when automatic door locks are ordered. The terminals on the right are to a switch normally open in "park", "reverse", and "neutral". In "drive" or "lo" the switch contacts close and complete a circuit to the logic module which actuates the electric door lock solenoids (provided that the driver's seat is occupied).

Driver's Seat Sensor

The driver's seat sensor is a normally open switch as used on seat belt interlock cars. Weight of the driver closes the switch and completes a circuit to ground from the logic module.

Logic Module

The logic module is located on the cowl near the left side below the body cross car conduit. Electrical power to the logic module is supplied through the courtesy light circuit.

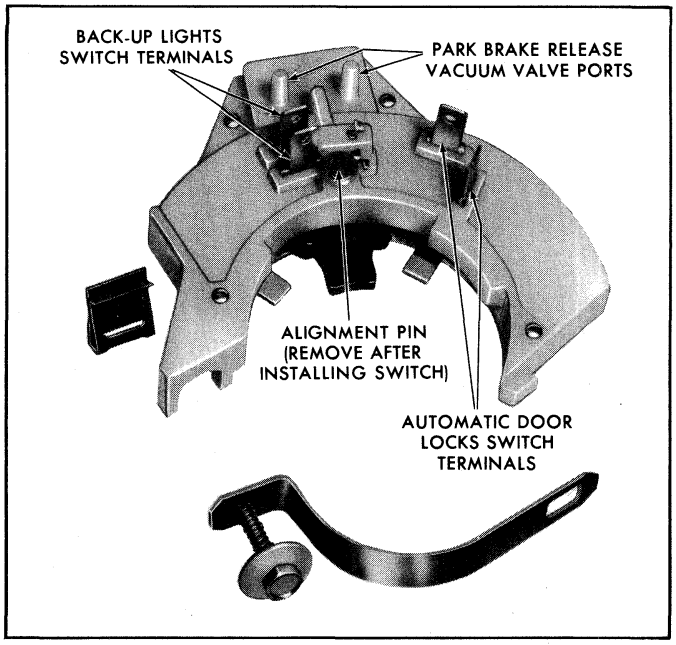


Fig. 9-92 Back-Up Lamp Switch

NOTE: The logic module circuit board is serviced separately. To avoid shorting the module when replacing the board, remove the 20 amp "body" fuse before servicing.

Unlock Relay

Two unlock relays are used. Both are taped to the logic module.

Lock Relay

The lock relay is mounted above the left hand kick panel near the body accessory wiring junction block. The wire near the lock relay attached to the shroud behind the kickpad is the ground wire for the logic module.

DIAGNOSIS AND SERVICE INFORMATION

Back-up lamp switch removal, installation and adjustment is described on page 8-110.

A complete automatic door lock wiring circuit diagram is provided in Fig. 9-93.

Complete diagnosis procedures and service information is provided in the 1977 Body Service Manual.

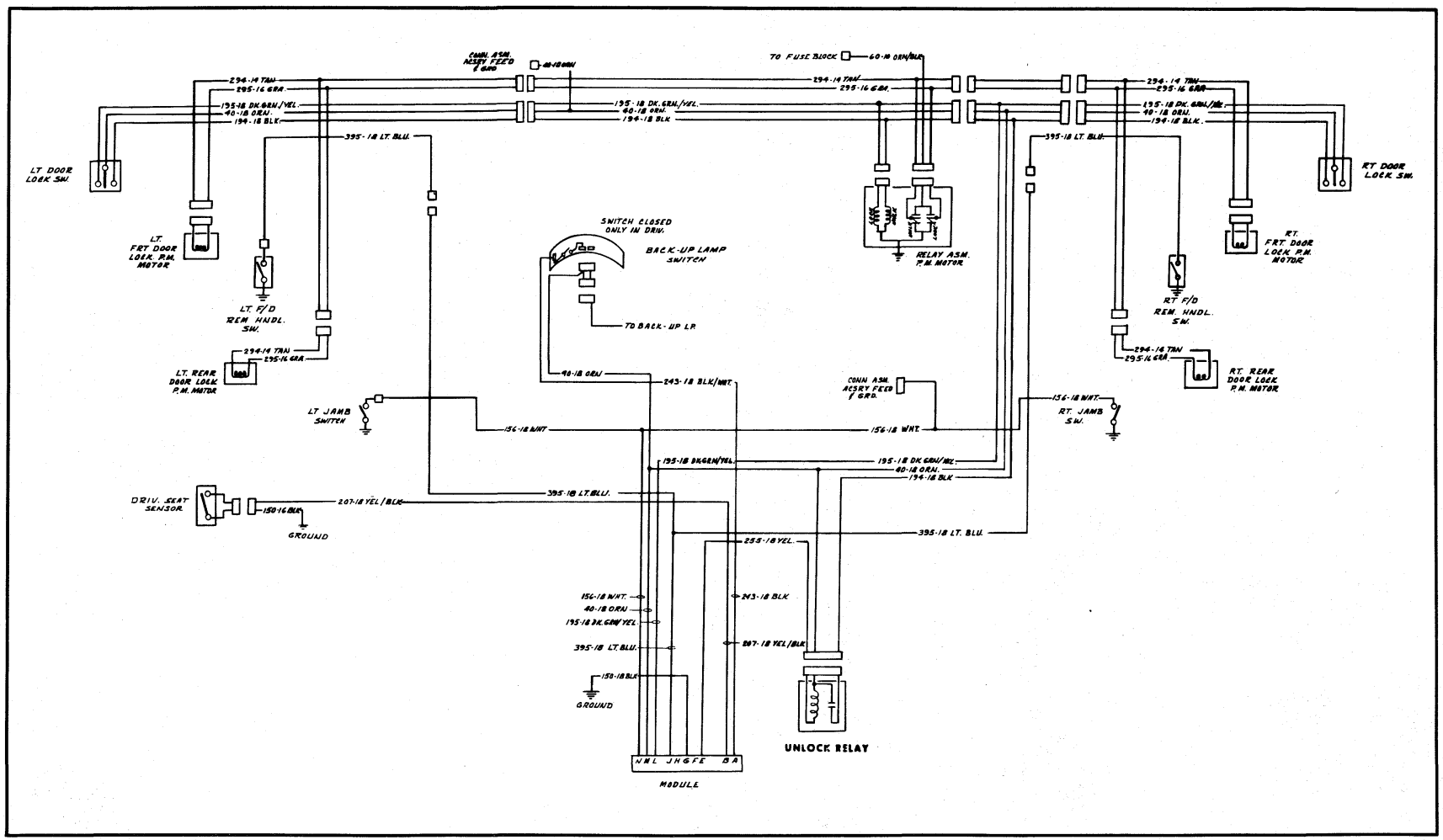
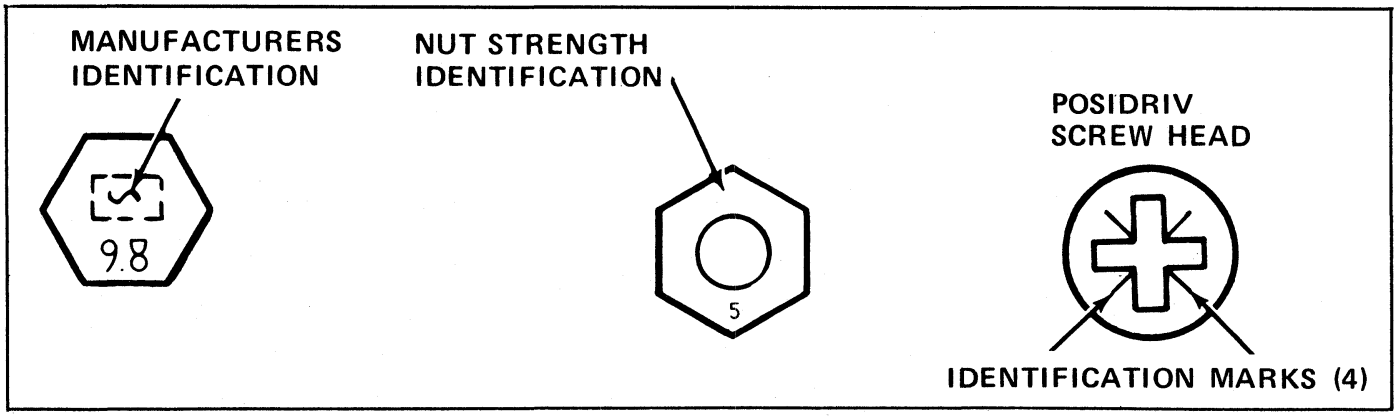


Fig. 9-93 Automatic Door Lock Circuit Diagram

BOLT AND NUT IDENTIFICATION

THREADED FASTENERS

All of the vehicles covered in this service manual have some metric threaded fasteners and some customary or inch-system fasteners. It is most important that replacement fasteners be of the correct nominal diameter, thread pitch and strength. Original equipment metric fasteners (except beauty bolts such as exposed bumper bolts and cross recess head screws) are identified by a number marking indicating the strength of the material in the fastener as shown below. Metric cross recess screws are identified by a Posidriv or type 1-A cross recess. Either Phillips-head or type 1-A cross recess screw drivers can be used in Posidriv recess screw heads, but type 1-A cross recess screw drivers will perform better.



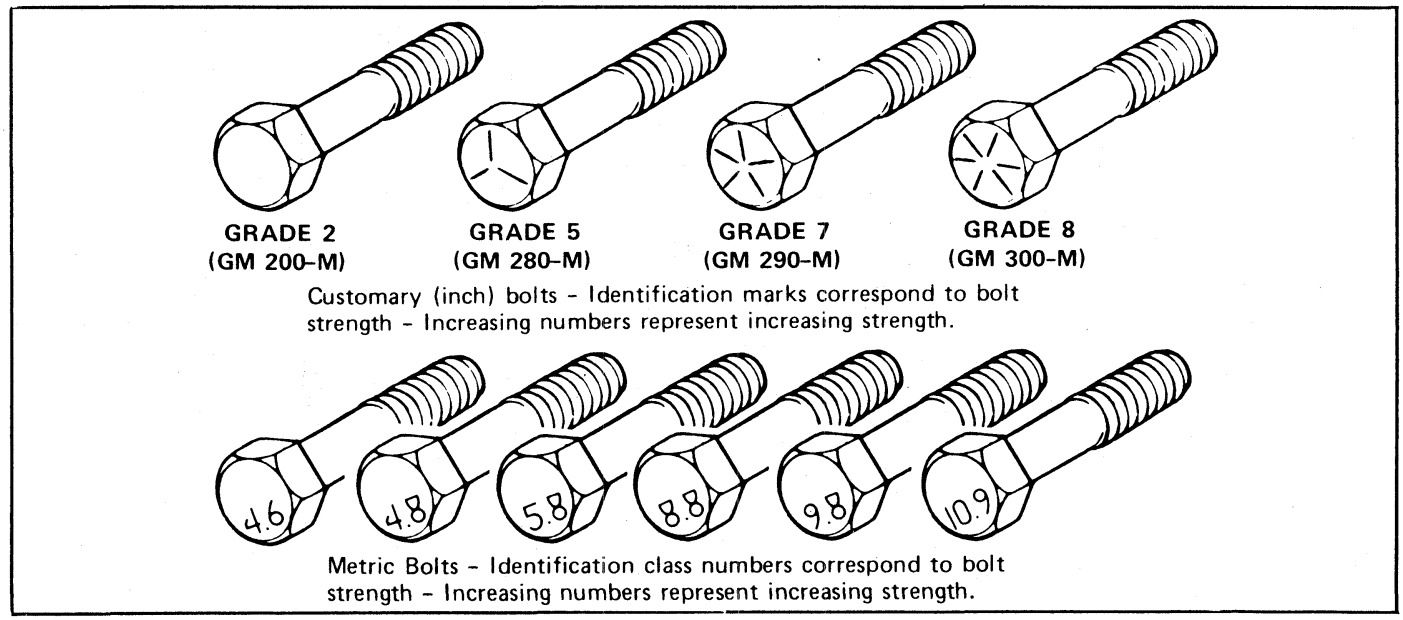
Metric Bolt and Nut Identification

FASTENER STRENGTH IDENTIFICATION

Common metric fastener strength property classes are 9.8 and 10.9 with the class identification embossed on the head of each bolt. Customary (inch) strength classes range from grade 2 to 8 with line identification embossed on each bolt head. Markings correspond to two lines less than the actual grade (i.e. grade 7 bolt will exhibit 5 embossed lines on the bolt head). Some metric nuts will be marked with single digit strength identification numbers on the nut face. The figure below illustrates the different strength markings.

When replacing metric fasteners, be careful to use bolts and nuts of the same strength or greater than the original fasteners (the same number marking or higher). It is likewise important to select replacement fasteners of the correct size. Correct replacement bolts and nuts are available from GMPD and other sources. However, many metric fasteners available in the after-market parts channels were designed to metric standards of countries other than the United States, and may be of lower strength, may not have the numbered head marking system, and may be of a different thread pitch. The metric fasteners used on Cadillac products are designed to new, international standards that may not yet be manufactured by some non-domestic bolt and nut suppliers. In general, except for special applications, the common sizes and pitches are:

M 6.3 X 1	M 12 X 1.75
M 8 X 1.25	M 14 X 2
M 10 X 1.5	

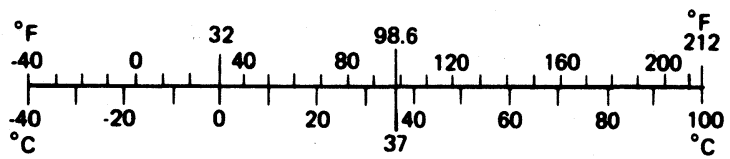


Bolt Strength Identification

DRILL SIZES

Letter Sizes	Drill Diam. Inches	Wire Gage Sizes	Drill Diam. Inches	Wire Gage Sizes	Drill Diam. Inches	Wire Gage Sizes	Drill Diam. Inches
Z	0.413	1	0.2280	28	0.1405	55	0.0520
Y	0.404	2	0.2210	29	0.1360	56	0.0465
X	0.397	3	0.2130	30	0.1285	57	0.0430
W	0.386	4	0.2090	31	0.1200	58	0.0420
V	0.377	5	0.2055	32	0.1160	59	0.0410
U	0.368	6	0.2040	33	0.1130	60	0.0400
T	0.358	7	0.2010	34	0.1110	61	0.0390
S	0.348	8	0.1990	35	0.1100	62	0.0380
R	0.339	9	0.1960	36	0.1065	63	0.0370
Q	0.332	10	0.1935	37	0.1040	64	0.0360
P	0.323	11	0.1910	38	0.1015	65	0.0350
O	0.316	12	0.1890	39	0.0995	66	0.0330
N	0.302	13	0.1850	40	0.0980	67	0.0320
M	0.295	14	0.1820	41	0.0960	68	0.0310
L	0.290	15	0.1800	42	0.0935	69	0.0292
K	0.281	16	0.1770	43	0.0890	70	0.0280
J	0.277	17	0.1730	44	0.0860	71	0.0260
I	0.272	18	0.1695	45	0.0820	72	0.0250
H	0.266	19	0.1660	46	0.0810	73	0.0240
G	0.261	20	0.1610	47	0.0785	74	0.0225
F	0.257	21	0.1590	48	0.0760	75	0.0210
E	0.250	22	0.1570	49	0.0730	76	0.0200
D	0.246	23	0.1540	50	0.0700	77	0.0180
C	0.242	24	0.1520	51	0.0670	78	0.0160
B	0.238	25	0.1495	52	0.0635	79	0.0145
A	0.234	26	0.1470	53	0.0595	80	0.0135
		27	0.1440	54	0.0550		

Multiply	by	to get equivalent number of:
LENGTH		
Inch	25.4	millimetres (mm)
Foot	0.304 8	metres (m)
Yard	0.914 4	metres
Mile	1.609	kilometres (km)
AREA		
$Inch^2$	645.2	$millimetres^2$ (mm^2)
	6.45	$centimetres^2$ (cm^2)
$Foot^2$	0.092 9	$metres^2$ (m^2)
$Yard^2$	0.836 1	$metres^2$
VOLUME		
$Inch^3$	16 387.	mm^3
	16.387	cm^3
	0.016 4	litres (l)
Quart	0.946 4	litres
Gallon	3.785 4	litres
$Yard^3$	0.764 6	$metres^3$ (m^3)
MASS		
Pound	0.453 6	kilograms (kg)
Ton	907.18	kilograms (kg)
Ton	0.907	tonne (t)
FORCE		
Kilogram	9.807	newtons (N)
Ounce	0.278 0	newtons
Pound	4.448	newtons
TEMPERATURE		
Degree Fahrenheit	(†°F-32) ÷ 1.8	degree Celsius (C)



Multiply	by	to get equivalent number of:
ACCELERATION		
$Foot/sec^2$	0.304 8	$metre/sec^2$ (m/s^2)
$Inch/sec^2$	0.025 4	$metre/sec^2$
TORQUE		
Pound-inch	0.112 98	newton-metres (N-m)
Pound-foot	1.355 8	newton-metres
POWER		
Horsepower	0.746	kilowatts (kW)
PRESSURE OR STRESS		
Inches of water	0.249 1	kilopascals (kPa)
Pounds/sq. in.	6.895	kilopascals
ENERGY OR WORK		
BTU	1 055.	joules (J)
Foot-pound	1.355 8	joules
Kilowatt-hour	3 600 000. or 3.6×10^6	joules (J = one W's)
LIGHT		
Foot candle	1.076 4	$lumens/metre^2$ (lm/m^2)
FUEL PERFORMANCE		
Miles/gal	0.425 1	kilometres/litre (km/l)
Gal/mile	2.352 7	litres/kilometre (l/km)
VELOCITY		
Miles/hour	1.609 3	kilometres/hr. (km/h)

METRIC-ENGLISH CONVERSION TABLE

DECIMAL AND METRIC EQUIVALENTS

Fractions	Decimal In.	Metric MM.	Fractions	Decimal In.	Metric MM.
1/64	.015625	.39688	33/64	.515625	13.09687
1/32	.03125	.79375	17/32	.53125	13.49375
3/64	.046875	1.19062	35/64	.546875	13.89062
1/16	.0625	1.58750	9/16	.5625	14.28750
5/64	.078125	1.98437	37/64	.578125	14.68437
3/32	.09375	2.38125	19/32	.59375	15.08125
7/64	.109375	2.77812	39/64	.609375	15.47812
1/8	.125	3.1750	5/8	.625	15.87500
9/64	.140625	3.57187	41/64	.640625	16.27187
5/32	.15625	3.96875	21/32	.65625	16.66875
11/64	.171875	4.36562	43/64	.671875	17.06562
3/16	.1875	4.76250	11/16	.6875	17.46250
13/64	.203125	5.15937	45/64	.703125	17.85937
7/32	.21875	5.55625	23/32	.71875	18.25625
15/64	.234375	5.95312	47/64	.734375	18.65312
1/4	.250	6.35000	3/4	.750	19.05000
17/64	.265625	6.74687	49/64	.765625	19.44687
9/32	.28125	7.14375	25/32	.78125	19.84375
19/64	.296875	7.54062	51/64	.796875	20.24062
5/16	.3125	7.93750	13/16	.8125	20.63750
21/64	.328125	8.33437	53/64	.828125	21.03437
11/32	.34375	8.73125	27/32	.84375	21.43125
23/64	.359375	9.12812	55/64	.859375	21.82812
3/8	.375	9.52500	7/8	.875	22.22500
25/64	.390625	9.92187	57/64	.890625	22.62187
13/32	.40625	10.31875	29/32	.90625	23.01875
27/64	.421875	10.71562	59/64	.921875	23.41562
7/16	.4375	11.11250	15/16	.9375	23.81250
29/64	.453125	11.50937	61/64	.953125	24.20937
15/32	.46875	11.90625	31/32	.96875	24.60625
31/64	.484375	12.30312	63/64	.984375	25.00312
1/2	.500	12.70000	1	1.00	25.40000

S. I. METRIC–CUSTOMARY CONVERSION TABLES

HOW TO USE CONVERSION CHARTS

Left Column is units of 10, (0, 10, 20, 30 etc.);
Top Row is in units of one (0, 1, 2, 3, etc).

EXAMPLE: Feet to Inches Conversion Chart

feet	0	1	2	3	4	5	6	7	8	9	feet
	inches	inches	inches	inches	inches	inches	inches	inches	inches	inches	
--		12	24	36	48	60	72	84	96	108	--
10	120	132	144	156	168	180	192	204	216	228	10
20	240	252	264	276	288	300	312	324	336	348	20
30	360	372	384	396	408	420	432	444	456	468	30
40	480	492	504	516	528	540	552	564	576	588	40
50	600	612	624	636	648	660	672	684	696	708	50

12 feet equals 144 inches. Read across from 10 and down from 2.
6 feet equals 72 inches. Read down from 6.

FEET TO METRES

ft	0	1	2	3	4	5	6	7	8	9	ft
	m	m	m	m	m	m	m	m	m	m	
--		0.305	0.610	0.914	1.219	1.524	1.829	2.134	2.438	2.743	--
10	3.048	3.353	3.658	3.962	4.267	4.572	4.877	5.182	5.486	5.791	10
20	6.096	6.401	6.706	7.010	7.315	7.620	7.925	8.230	8.534	8.839	20
30	9.144	9.449	9.754	10.058	10.363	10.668	10.973	11.278	11.582	11.887	30
40	12.192	12.497	12.802	13.106	13.411	13.716	14.021	14.326	14.630	14.935	40
50	15.240	15.545	15.850	16.154	16.459	16.764	17.069	17.374	17.678	17,983	50
60	18.288	18.593	18.898	19.202	19.507	19.812	20.117	20.422	20.726	21.031	60
70	21.336	21.641	21.946	22.250	22.555	22.860	23.165	23.470	23.774	24.079	70
80	24.384	24.689	24.994	25.298	25.603	25.908	26.213	26.518	26.822	27.127	80
90	27.432	27.737	28.042	28.346	28.651	28.956	29.261	29.566	29.870	30.175	90
100	30.480	30.785	31.090	31.394	31.699	32.004	32.309	32.614	32.918	33.223	100

METRES TO FEET

m	0	1	2	3	4	5	6	7	8	9	m
	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	
--		3.2808	6.5617	9.8425	13.1234	16.4042	19.6850	22.9659	26.2467	29.5276	--
10	32.8084	36.0892	39.3701	42.6509	45.9318	49.2126	52.4934	55.7743	59.0551	62.3360	10
20	65.6168	68.8976	72.1785	75.4593	78.7402	82.0210	85.3018	88.5827	91.8635	95.1444	20
30	98.4252	101.7060	104.9869	108.2677	111.5486	114.8294	118.1102	121.3911	124.6719	127.9528	30
40	131.2336	134.5144	137.7953	141.0761	144.3570	147.6378	150.9186	154.1995	157.4803	160.7612	40
50	164.0420	167.3228	170.6037	173.8845	177.1654	180.4462	183.7270	187.0079	190.2887	193.5696	50
60	196.8504	200.1312	203.4121	206.6929	209.9738	213.2546	216.5354	219.8163	223.0971	226.3780	60
70	229.6588	232.9396	236.2205	239.5013	242.7822	246.0630	249.3438	252.6247	255.9055	259.1864	70
80	262.4672	265.7480	269.0289	272.3097	275.5906	278.8714	282.1522	285.4331	288.7139	291.9948	80
90	295.2756	298.5564	301.8373	305.1181	308.3990	311.6798	314.9606	318.2415	321.5223	324.8032	90
100	328.0840	331.3648	334.6457	337.9265	341.2074	344.4882	347.7690	351.0499	354.3307	357.6116	100

S. I. METRIC–CUSTOMARY CONVERSION TABLES

MILES TO KILOMETRES

mile	0	1	2	3	4	5	6	7	8	9	mile
	km	km	km	km	km	km	km	km	km	km	
--		1.609	3.219	4.828	6.437	8.047	9.656	11.265	12.875	14.484	--
10	16.093	17.703	19.312	20.921	22.531	24.140	25.750	27.359	28.968	30.578	10
20	32.187	33.796	35.406	37.015	38.624	40.234	41.843	43.452	45.062	46.671	20
30	48.280	49.890	51.499	53.108	54.718	56.327	57.936	59.546	61.155	62.764	30
40	64.374	65.983	67.593	69.202	70.811	72.421	74.030	75.639	77.249	78.858	40
50	80.467	82.077	83.686	85.295	86.905	88.514	90.123	91.733	93.342	94.951	50
60	96.561	98.170	99.779	101.39	103.00	104.61	106.22	107.83	109.44	111.04	60
70	112.65	114.26	115.87	117.48	119.09	120.70	122.31	123.92	125.53	127.14	70
80	128.75	130.36	131.97	133.58	135.19	136.79	138.40	140.01	141.62	143.23	80
90	144.84	146.45	148.06	149.67	151.28	152.89	154.50	156.11	157.72	159.33	90
100	160.93	162.54	164.15	165.76	167.37	168.98	170.59	172.20	173.81	175.42	100

KILOMETRES TO MILES

km	0	1	2	3	4	5	6	7	8	9	km
	mil	mil	mil	mil	mil	mil	mil	mil	mil	mil	
--		0.621	1.243	1.864	2.486	3.107	3.728	4.350	4.971	5.592	--
10	6.214	6.835	7.457	8.078	8.699	9.321	9.942	10.562	11.185	11.805	10
20	12.427	13.049	13.670	14.292	14.913	15.534	16.156	16.776	17.399	18.019	20
30	18.641	19.263	19.884	20.506	21.127	21.748	22.370	22.990	23.613	24.233	30
40	24.855	25.477	26.098	26.720	27.341	27.962	28.584	29.204	29.827	30.447	40
50	31.069	31.690	32.311	32.933	33.554	34.175	34.797	35.417	36.040	36.660	50
60	37.282	37.904	38.525	39.147	39.768	40.389	41.011	41.631	42.254	42.874	60
70	43.497	44.118	44.739	45.361	45.982	46.603	47.225	47.845	48.468	49.088	70
80	49.711	50.332	50.953	51.575	52.196	52.817	53.439	54.059	54.682	55.302	80
90	55.924	56.545	57.166	57.788	58.409	59.030	59.652	60.272	60.895	61.515	90
100	62.138	62.759	63.380	64.002	64.623	65.244	65.866	66.486	67.109	67.729	100

GALLONS (U.S.) TO LITRES

U.S. gal	0	1	2	3	4	5	6	7	8	9	U.S. gal
	L	L	L	L	L	L	L	L	L	L	
--		3.7854	7.5709	11.3563	15.1417	18.9271	22.7126	26.4980	30.2834	34.0638	--
10	37.8543	41.6397	45.4251	49.2105	52.9960	56.7814	60.5668	64.3523	68.1377	71.9231	10
20	75.7085	79.4940	83.2794	87.0648	90.8502	94.6357	98.4211	102.2065	105.9920	109.7774	20
30	113.5528	117.3482	121.1337	124.9191	128.7045	132.4899	136.2754	140.0608	143.8462	147.6316	30
40	151.4171	155.2025	158.9879	162.7734	166.5588	170.3442	174.1296	177.9151	181.7005	185.4859	40
50	189.2713	193.0568	196.8422	200.6276	204.4131	208.1985	211.9839	215.7693	219.5548	223.3402	50
60	227.1256	230.9110	234.6965	238.4819	242.2673	246.0527	249.8382	253.6236	257.4090	261.1945	60
70	264.9799	268.7653	272.5507	276.3362	280.1216	283.9070	287.6924	291.4779	295.2633	299.0487	70
80	302.8342	306.6196	310.4050	314.1904	317.9759	321.7613	325.5467	329.3321	333.1176	336.9030	80
90	340.6884	344.4738	348.2593	352.0447	355.8301	359.6156	363.4010	367.1864	370.9718	374.7573	90
100	378.5427	382.3281	386.1135	389.8990	393.6844	397.4698	401.2553	405.0407	408.8261	412.6115	100

S. I. METRIC–CUSTOMARY CONVERSION TABLES

LITRES TO GALLONS (U.S.)

L	0	1	2	3	4	5	6	7	8	9	L
	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	
--		0.2642	0.5283	0.7925	1.0567	1.3209	1.5850	1.8492	2.1134	2.3775	--
10	2.6417	2.9059	3.1701	3.4342	3.6984	3.9626	4.2267	4.4909	4.7551	5.0192	10
20	5.2834	5.5476	5.8118	6.0759	6.3401	6.6043	6.8684	7.1326	7.3968	7.6610	20
30	7.9251	8.1893	8.4535	8.7176	8.9818	9.2460	9.5102	9.7743	10.0385	10.3027	30
40	10.5668	10.8310	11.0952	11.3594	11.6235	11.8877	12.1519	12.4160	12.6802	12.9444	40
50	13.2086	13.4727	13.7369	14.0011	14.2652	14.5294	14.7936	15.0577	15.3219	15.5861	50
60	15.8503	16.1144	16.3786	16.6428	16.9069	17.1711	17.4353	17.6995	17.9636	18.2278	60
70	18.4920	18.7561	19.0203	19.2845	19.5487	19.8128	20.0770	20.3412	20.6053	20.8695	70
80	21.1337	21.3979	21.6620	21.9262	22.1904	22.4545	22.7187	22.9829	23.2470	23.5112	80
90	23.7754	24.0396	24.3037	24.5679	24.8321	25.0962	25.3604	25.6246	25.8888	26.1529	90
100	26.4171	26.6813	26.9454	27.2096	27.4738	27.7380	28.0021	28.2663	28.5305	28.7946	100

GALLONS (IMP.) TO LITRES

IMP gal	0	1	2	3	4	5	6	7	8	9	IMP gal
	L	L	L	L	L	L	L	L	L	L	
--		4.5460	9.0919	13.6379	18.1838	22.7298	27.2758	31.8217	36.3677	40.9136	--
10	45.4596	50.0056	54.5515	59.0975	63.6434	68.1894	72.2354	77.2813	81.8275	86.3732	10
20	90.9192	95.4652	100.0111	104.5571	109.1030	113.6490	118.1950	122.7409	127.2869	131.8328	20
30	136.3788	140.9248	145.4707	150.0167	154.5626	159.1086	163.6546	168.0005	172.7465	177.2924	30
40	181.8384	186.3844	190.9303	195.4763	200.0222	204.5682	209.1142	213.6601	218.2061	222.7520	40
50	227.2980	231.8440	236.3899	240.9359	245.4818	250.0278	254.5738	259.1197	263.6657	268.2116	50
60	272.7576	277.3036	281.8495	286.3955	290.9414	295.4874	300.0334	304.5793	309.1253	313.6712	60
70	318.2172	322.7632	327.3091	331.8551	336.4010	340.9470	345.4930	350.0389	354.5849	359.1308	70
80	363.6768	368.2223	372.7687	377.3147	381.8606	386.4066	390.9526	395.4985	400.0445	404.5904	80
90	409.1364	413.6824	418.2283	422.7743	427.3202	431.8662	436.4122	440.9581	445.9041	450.0500	90
100	454.5960	459.1420	463.6879	468.2339	472.7798	477.3258	481.8718	486.4177	490.9637	495.5096	100

LITRES TO GALLONS (IMP.)

L	0	1	2	3	4	5	6	7	8	9	L
	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	
--		0.2200	0.4400	0.6599	0.8799	1.0999	1.3199	1.5398	1.7598	1.9798	--
10	2.1998	2.4197	2.6397	2.8597	3.0797	3.2996	3.5196	3.7396	3.9596	4.1795	10
20	4.3995	4.6195	4.8395	5.0594	5.2794	5.4994	5.7194	5.9394	6.1593	6.3793	20
30	6.5593	6.8193	7.0392	7.2592	7.4792	7.6992	7.9191	8.1391	8.3591	8.5791	30
40	8.7990	9.0190	9.2390	9.4590	9.6789	9.8989	10.9189	10.3389	10.5588	10.7788	40
50	10.9988	11.2188	11.4388	11.6587	11.8787	12.0987	12.3187	12.5386	12.7586	12.9786	50
60	13.1986	13.4185	13.6385	13.8585	14.0785	14.2984	14.5184	14.7384	14.9584	15.1783	60
70	15.3983	15.6183	15.8383	16.0582	16.2782	16.4982	16.7182	16.9382	17.1581	17.3781	70
80	17.5981	17.8181	18.0380	18.2580	18.4780	18.6980	18.9179	19.1379	19.3579	19.5779	80
90	19.7978	20.0178	20.2378	20.4578	20.6777	20.8977	21.1177	21.3377	21.5576	21.7776	90
100	21.9976	22.2176	22.4376	22.6575	22.8775	23.0975	23.3175	23.5374	23.7574	23.9774	100

S. I. METRIC–CUSTOMARY CONVERSION TABLES

POUNDS TO KILOGRAMS

lb	0	.1	2	3	4	5	6	7	8	9	lb
	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	
--		0.454	0.907	1.361	1.814	2.268	2.722	3.175	3.629	4.082	--
10	4.536	4.990	5.443	5.897	6.350	6.804	7.257	7.711	8.165	8.618	10
20	9.072	9.525	9.979	10.433	10.886	11.340	11.793	12.247	12.701	13.154	20
30	13.608	14.061	14.515	14.969	15.422	15.876	16.329	16.783	17.237	17.690	30
40	18.144	18.597	19.051	19.504	19.958	20.412	20.865	21.319	21.772	22.226	40
50	22.680	23.133	23.587	24.040	24.494	24.948	25.401	25.855	26.308	26.762	50
60	27.216	27.669	28.123	28.576	29.030	29.484	29.937	30.391	30.844	31.298	60
70	31.751	32.205	32.659	33.112	33.566	34.019	34.473	34.927	35.380	35.834	70
80	36.287	36.741	37.195	37.648	38.102	38.555	39.009	39.463	39.916	40.370	80
90	40.823	41.277	41.730	42.184	42.638	43.092	43.545	43.998	44.453	44.906	90
100	45.359	45.813	46.266	46.720	47.174	47.627	48.081	48.534	48.988	49.442	100

KILOGRAMS TO POUNDS

kg	0	1	2	3	4	5	6	7	8	9	kg
	lb	lb	lb	lb	lb	lb	lb	lb	lb	lb	
--		2.205	4.409	6.614	8.818	11.023	13.228	15.432	17.637	19.842	--
10	22.046	24.251	26.455	28.660	30.865	33.069	35.274	37.479	39.683	41.888	10
20	44.092	46.297	48.502	50.706	52.911	55.116	57.320	59.525	61.729	63.934	20
30	66.139	68.343	70.548	72.752	74.957	77.162	79.366	81.571	83.776	85.980	30
40	88.185	90.389	92.594	94.799	97.003	99.208	101.41	103.62	105.82	108.03	40
50	110.23	112.44	114.64	116.84	119.05	121.25	123.46	125.66	127.87	130.07	50
60	132.28	134.48	136.69	138.89	141.10	143.30	145.51	147.71	149.91	152.12	60
70	154.32	156.53	158.73	160.94	163.14	165.35	167.55	169.76	171.96	174.17	70
80	176.37	178.57	180.78	182.98	185.19	187.39	189.60	191.80	194.01	196.21	80
90	198.42	200.62	202.83	205.03	207.23	209.44	211.64	213.85	216.05	218.26	90
100	220.46	222.67	224.87	227.08	229.28	231.49	233.69	235.89	238.10	240.30	100

POUNDS PER SQUARE INCHES TO KILOPASCALS

lb/in^2	0	1	2	3	4	5	6	7	8	9	lb/in^2
	kPa	kPa	kPa	kPa	kPa	kPa	kPa	kPa	kPa	kPa	
--	0.0000	6.8948	13.7895	20.6843	27.5790	34.4738	41.3685	48.2663	55.1581	62.0528	--
10	68.9476	75.8423	82.7371	89.6318	96.5266	103.4214	110.3161	117.2109	124.1056	131.0004	10
20	137.8951	144.7899	151.6847	158.5794	165.4742	172.3689	179.2637	186.1584	193.0532	199.9480	20
30	206.8427	213.7375	220.6322	227.5270	234.4217	241.3165	248.2113	255.1060	262.0008	268.8955	30
40	275.7903	282.6850	289.5798	296.4746	303.3693	310.2641	317.1588	324.0536	330.9483	337.8431	40
50	344.7379	351.6326	358.5274	365.4221	372.3169	379.2116	386.1064	393.0012	399.8959	406.7907	50
60	412.6854	420.5802	427.4749	434.3697	441.2645	448.1592	455.0540	461.9487	468.8435	475.7382	60
70	482.6330	489.5278	496.4225	503.3173	510.2120	517.1068	524.0015	530.8963	537.7911	544.6858	70
80	551.5806	558.4753	565.3701	572.2648	579.1596	586.0544	592.9491	599.8439	606.7386	613.6334	80
90	620.5281	627.4229	634.3177	641.2124	648.1072	655.0019	661.8967	668.7914	675.6862	682.5810	90
100	689.4757	696.3705	703.2653	710.1601	717.0549	723.9497	730.8445	737.7393	744.6341	751.5289	100

S. I. METRIC–CUSTOMARY CONVERSION TABLES

KILOPASCALS TO POUNDS PER SQUARE INCHES

kPa	0	1	2	3	4	5	6	7	8	9	kPa
	lb/in^2	lb/in^2	lb/in^2	lb/in^2	lb/in^2	lb/in^2	lb/in^2	lb/in^2	lb/in^2	lb/in^2	
--		.1450	.2901	.4351	.5801	.7252	.8702	1.0153	1.1603	1.3053	--
10	1.4504	1.5954	1.7404	1.8855	2.0305	2.1556	2.3206	2.4656	2.6107	2.7557	10
20	2.9007	3.0458	3.1908	3.3359	3.4809	3.6259	3.7710	3.9160	4.0610	4.2061	20
30	4.3511	4.4961	4.6412	4.7862	4.9313	5.0763	5.2213	5.3664	5.5114	5.6564	30
40	5.8015	5.9465	6.0916	6.2366	6.3816	6.5267	6.6717	6.8167	6.9618	7.1068	40
50	7.2518	7.3969	7.5419	7.6870	7.8320	7.9770	8.1221	8.2671	8.4121	8.5572	50
60	8.7022	8.8473	8.9923	9.1373	9.1824	9.4274	9.5724	9.7175	9.8625	10.0076	60
70	10.1526	10.2976	10.4427	10.5877	10.7327	10.8778	11.0228	11.1678	11.3129	11.4579	70
80	11.6030	11.7480	11.8930	12.0381	12.1831	12.3281	12.4732	12.6182	12.7633	12.9083	80
90	13.0533	13.1984	13.3434	13.4884	13.6335	13.7785	13.9236	14.0686	14.2136	14.3587	90
100	14.5037	14.6487	14.7938	14.9388	15.0838	15.2289	15.3739	15.5190	15.6640	15.8090	100

POUND FEET TO NEWTON-METRES

ft-lb	0	1	2	3	4	5	6	7	8	9	ft-lb
	N·m	N·m	N·m	N·m	N·m	N·m	N·m	N·m	N·m	N·m	
--		1.3558	2.7116	4.0675	5.4233	6.7791	8.1349	9.4907	10.8465	12.2024	--
10	13.5582	14.9140	16.2698	17.6256	18.9815	20.3373	21.6931	23.0489	24.4047	25.7605	10
20	27.1164	28.4722	29.8280	31.1838	32.5396	33.8954	35.2513	36.6071	37.9629	39.3187	20
30	40.6745	42.0304	43.3862	44.7420	46.0978	47.4536	48.8094	50.1653	51.5211	52.8769	30
40	54.2327	55.5885	56.9444	58.3002	59.6560	61.0118	62.3676	63.7234	65.0793	66.4351	40
50	67.7909	69.1467	70.5025	71.8584	73.2142	74.5700	75.9258	77.2816	78.6374	79.9933	50
60	81.3491	82.7049	84.0607	85.4165	86.7724	88.1282	89.4840	90.3898	92.1956	93.5514	60
70	94.9073	96.2631	97.6189	98.9747	100.3305	101.6863	103.0422	104.3980	105.7538	107.1096	70
80	108.4654	109.8213	111.1771	112.5329	113.8887	115.2445	116.6003	117.9562	119.3120	120.6678	80
90	122.0236	123.3794	124.7353	126.0911	127.4469	128.8027	130.1585	131.5143	132.8702	134.2260	90
100	135.5818	136.9376	138.2934	139.6493	141.0051	142.3609	143.7167	145.0725	146.4283	147.7842	100

NEWTON-METRES TO POUND FEET

N·m	0	1	2	3	4	5	6	7	8	9	N·m
	ft-lb	ft-lb	ft-lb	ft-lb	ft-lb	ft-lb	ft-lb	ft-lb	ft-lb	ft-lb	
--		.7376	1.4751	2.2127	2.9502	3.6878	4.4254	5.1692	5.9005	6.6381	--
10	7.3756	8.1132	8.8507	9.5883	10.3258	11.0634	11.8010	12.5385	13.2761	14.0136	10
20	14.7512	15.4888	16.2264	16.9639	17.7015	18.4390	19.1766	19.9142	20.6517	21.3893	20
30	22.1269	22.8644	23.6020	24.3395	25.0771	25.8147	26.5522	27.2898	28.0274	28.7649	30
40	29.5025	30.2400	30.9776	31.7152	32.4527	33.1903	33.9279	34.6654	35.4030	36.1405	40
50	36.8781	37.6157	38.3532	39.0908	39.8283	40.5659	41.3035	42.0410	42.7786	43.5162	50
60	44.2537	44.9913	45.7288	46.4664	47.2040	47.9415	48.6791	49.4167	50.1542	50.8918	60
70	51.6293	52.3669	53.1045	53.8420	54.5796	55.3171	56.0547	56.7923	57.5298	58.2674	70
80	59.0050	59.7425	60.4801	61.2176	61.9552	62.6928	63.4303	64.1679	64.9055	65.6430	80
90	66.3806	67.1181	67.8557	68.5933	69.3308	70.0684	70.8060	71.5435	72.2811	73.0186	90
100	73.7562	74.4938	75.2313	75.9689	76.7064	77.4440	78.1816	78.9191	79.6567	80.3943	100

Subject	Page
A	
AIR CONDITIONING "C" CAR:	
Accumulator	1-58
Adding Oil	1-52
Adding Refrigerant	1-52
Air Delivery System	1-1
Airflow at Auto	1-22
Airflow at Bi-Level	1-28
Airflow at Def	1-31
Airflow at Economy	1-16
Airflow at Off	1-13
Airflow at Hi	1-25
Airflow at Lo	1-19
ATC Tester	1-44
Auxiliary Vacuum Circuit Test	1-43
Auxiliary Vacuum Problem Diagnosis	1-42
Blower Control Circuit Problem Diagnosis	1-40
Blower Circuit Test	1-48
Blower Motor	1-59
Blower Operation at Auto	1-24
Blower Operation at Bi-Level	1-30
Blower Operation at Def	1-33
Blower Operation at "Economy"	1-18
Blower Operation at Off	1-15
Blower Operation at Hi	1-27
Blower Operation at Lo	1-21
C.C.O.T.	1-9
Checking Refrigerant Charge	1-51
Component Adjustments	1-54
Compressor — Assembly Procedure	1-85
Compressor Clutch Coil and Housing Assembly	1-74
Compressor Clutch Plate and Hub Assembly	1-69
Compressor — Complete Removal and Installation	1-55
Compressor Internal Mechanism	1-77,87
Compressor Leak Testing — External and Internal — Bench Check Procedure	1-89
Compressor Low Pressure Switch	1-77
Compressor — Partial Removal and Installation	1-56
Compressor Pressure Relief Valve	1-77
Compressor Pulley and Bearing Assembly	1-71
Compressor Pulley Bearing	1-72
Compressor Service	1-67
Compressor Shaft Seal	1-75
Condenser	1-58
Control Head	1-59
Control Panel	1-67
Control System Functional Test	1-53
Diagnosis	1-36
Evacuating Refrigeration System	1-51
Evaporator	1-56
Expansion Tube	1-59
General Description	1-1
Handling Refrigerant and Refrigeration Components	1-49
Heater Core	1-57
How to Isolate the Problem	1-36
In-Car Sensor	1-59
Introduction	1-1
Leak Testing Refrigeration System	1-53
Low Pressure Switch	1-57
Major Compressor Repair Procedures	1-75
Minor Repair Procedures	1-67
On-Car-Service	1-49
Programmer	1-59,64
Programmer Functional Test	1-47
Purging Refrigeration System	1-51
Reference Drawings	1-59
Refrigeration Problem Diagnosis	1-43
Refrigeration System	1-8
Sensor String Test	1-47
System Operation at Various Lever Settings	1-13
System Response	1-34
Teflon Piston Ring Replacement	1-83
Temperature Control Problem Diagnosis	1-37
Temperature Control System	1-2
Temperature Control System Operation	1-5
Temperature Dial Calibration	1-47
Thermostatic — Cycling Switch	1-57
Unit Repair	1-64
Vacuum Circuit at Auto and Hi — A/C Mode	1-26
Vacuum Circuit at Auto and Hi-Heater Mode	1-23
Vacuum Circuit at Bi-Level and at Auto and Hi in Bi-Level Mode	1-29
Vacuum Circuit at Defrost-Heater Mode	1-32
Vacuum Circuit at Economy and Lo — A/C Mode	1-20
Vacuum Circuit at Economy and Lo-Heater Mode	1-17
Vacuum Circuit at Off	1-14
AIR CONDITIONING — "E" CAR:	
Accumulator	1-151
Air Conditioning Control Panel Disassembly and Assembly	1-154
Air Conditioning Outlets	1-154
Air Delivery System	1-105
Airflow at Various Lever Settings	1-121
Automatic Climate Control Panel	1-154
Auxiliary Vacuum Problem Diagnosis	1-147
Blower Control Circuit Problem Diagnosis	1-145
Blower Motor	1-152
Blower Operation at "Auto"	1-132
Blower Operation at "Bi-Level"	1-134
Blower Operation at "Def"	1-135
Blower Operation at "Economy"	1-130
Blower Operation at "Hi"	1-133
Blower Operation at "Lo"	1-130
Blower Operation at "Off"	1-129
Component Adjustments	1-149
Compressor (Complete Removal and Installation)	1-151
Complete Electrical Circuit Diagrams	1-121,136
Compressor (Partial Removal and Installation)	1-151
Complete Vacuum Circuit Diagram	1-121
Condenser	1-152

Subject	Page
Condenser Removal and Installation (Partial)	1-151
Control System Components	1-107
Control System Functional Test	1-149
Control System Operation	1-112
Defroster Bleed Vacuum Circuit	1-116
Defroster Vacuum Circuit	1-117
Diagnosis	1-137
Evaporator Case	1-151
Evaporator Core	1-152
General Description	1-105
Handling Refrigerant and Refrigeration Components	1-49
Heater Case	1-152
Heater Core	1-153
Heater Water Valve Vacuum Circuit	1-119
How to Isolate the Problem	1-137
In-Car Sensor	1-154
Lower Mode Door Vacuum Circuit	1-115
Programmer	1-152
Programmer Disassembly	1-155
Recirc Air Vacuum Circuit	1-118
Refrigeration System	1-114
Refrigeration Problem Diagnosis	1-149
System Operation at Various Lever Settings	1-128
Temperature Control Problem Diagnosis	1-139
Temperature Control System	1-107
Torque Specifications	1-157
Unit Repair	1-154
Upper Mode Door Vacuum Circuit	1-114
Water Control Valve	1-153
AIR CONDITIONING — LIMOUSINE:	
Air Delivery System	1-91
Blower Control System	1-92
Blower Operation at All Except Rear	1-100
Blower Operation at Rear	1-101
Diagnosis — Service Procedures	1-104
General Description	1-91
Refrigeration System	1-92
System Operation at Auto, Hi and Rear — A/C Mode	1-98
System Operation at Auto, Hi and Rear — Heater Mode	1-97
System Operation at Defrost	1-99
System Operation at Economy and Lo — A/C Mode	1-96
System Operation at Economy and Lo-Heater Mode	1-95
System Operation at Off	1-94
System Operation at Various Lever Settings	1-93
Torque Specifications	1-104
AIR CONDITIONING "K" CAR — SEVILLE	
Accumulator	1-201
Air Conditioning Outlets	1-202
Air Delivery System	1-158
Airflow at Auto	1-170
Airflow at Bi-Level	1-173
Airflow at Def	1-174
Airflow at Economy	1-169
Airflow at Lo	1-169
Aux. Vacuum Problems	1-196
Blower Circuits at Various Lever Settings	1-175
Blower Control Circuit Problem Diagnosis	1-194
Blower Motor	1-202
Blower Operation at Auto	1-178
Blower Operation at Bi-Level	1-180
Blower Operation at Def	1-180
Blower Operation at Economy	1-176
Blower Operation at Lo	1-177
Blower Operation at Off	1-175
Blower Operation at Hi	1-179
Compodent Adjustment	1-197
Compressor Removal & Installation	1-201
Compressor Overhaul	1-204
Complete Electrical Diagrams	1-167
Complete Vacuum Diagrams	1-167
Condensor Removal & Installation	1-200
Control System Functional Test	1-197
Control System Components	1-159
Diagnosis	1-188
Evaporator Case	1-201
Evaporator Core	1-201
Expansion Tube	1-202
General Description	1-158
In-Car Sensor	1-202
Low Pressure Switch	1-202
Programmer	1-201
Refrigeration System	1-167
Special Tools	1-211
System Operation at Various Lever Setting	1-165,168
Temperature Control Problem Diagnosis	1-188
Temperature Control Systems	1-159
Thermostatic Cycling Switch	1-202
Torque Specifications	1-210
Unit Repair	1-204
Vacuum Circuits	1-180
Vacuum Circuit at Auto & Hi (Heater Mode)	1-183
Vacuum Circuit at Auto & Hi (Air Mode)	1-184
Vacuum Circuit at Bi-Level (Air Mode)	1-186
Vacuum Circuit at Defrost	1-187
Vacuum Circuit at Economy & Lo	1-181
Vacuum Circuit at Off	1-180
Water Control Valve	1-202
ALIGNMENT — FRONT END:	
Camber	3A-1
Caster	3A-1
Checking Front Standing Spring Height — "C" and "K" Car	3A-2
Front Wheel Alignment — "C" and "K" Car	3A-2
Front Wheel Alignment — "E" Car	3A-12
General Description	3A-1
Standing Height Adjustment — "E" Car	3A-12
Toe-In	3A-1
ASTRO ROOF:	
Diagnosis	9-88

Subject	Page
General Description	9-88
Halo Molding	9-88
Sunshade	9-88
Water Leaks	9-88
AUTOMATIC DOOR LOCKS:	
General Description	9-90
Back-up Light Switch	9-90
Diagnosis and Service Information	9-91
Door Handle Switches	9-90
Driver's Seat Sensor	9-90
Lock Relay	9-91
Logic Module	9-90
Unlock Relay	9-91
AUTOMATIC LEVEL CONTROL:	
Assembling Compressor, Reservoir, and Regulator From Major Components	3D-26
Control Valve and Link	3D-16
Control Valve Test	3D-17
Compressor and Reservoir	3D-16
Compressor Output Test	3D-17
Compressor, Regulator, and Reservoir Assembly (Except Seville)	3D-20
Reservoir Assembly (Seville)	3D-21
Compressor, Reservoir, and Regulator: Disassembly, Inspection, and Assembly of Major Components	3D-22
Dealer Installation	3D-17
Diagnosis	3D-17
Diagnosis Chart	3D-18
Disassembling Compressor, Reservoir, and Regulator into Major Components	3D-21
General Description	3D-16
Height Control Valve	3D-20
Leak Tests	3D-19
Lines and Fittings	3D-17
Pressure Regulator	3D-16
Quick Check of Automatic Level Control System	3D-17
Regulator Test	3D-19
Superlift Rear Shock Absorber	3D-16
System	3D-16
Special Tools	3D-28
Trim Adjustment	3D-20
Tubing	3D-20
Torque Specifications	3D-27
AXLE — REAR:	
Axle Shaft	4B-9
Axle Shafts, Bearings and Oil Seals	4B-2
Bearing Diagnosis	4B-4
Bearing Noise	4B-4
Bearing Problem Conditions	4B-4
Diagnosis	4B-4
Gear Noise	4B-4
General Description	4B-1
Periodic Service Recommendations	4B-3
Rear Axle	4B-8
Rear Axle Assembly	4B-9
Rear Axle Backlash Measurement	4B-9
Rear Hub	4B-26
Rear Wheel Bearing Adjustment	4B-25
Rear Wheel Bearings and Grease Retainer	4B-26
Rear Wheel Spindle — On Car	4B-26

B

Subject	Page
BATTERY:	
Battery Cable Service	6D-3
Battery Removal and Installation	6D-3
Carrier and Hold Down	6D-1
Charging Procedures	6D-2
Cleaning	6D-1
Common Causes of Battery Trouble	6D-1
Diagnosis	6D-2
General Description	6D-1
Jump Starting	6D-3
Ratings	6D-1
Test Indicator	6D-2
BRAKES — DISC — DRUM SYSTEMS:	5-1
Bleeding Brakes	5-9
Booster	5-1
Brake Combination Valve	5-3,21
Brake Diagnosis Chart	5-8
Brake Fluid	5-4
Brakes	5-1
Brake Stoplight Switch	5-4
Break-In of New Linings	5-12
Diagnosis	5-5
Disc Brake Caliper Assembly — Front	5-12
Disc Brake Caliper Disassembly, Cleaning, Inspection and Assembly (Front)	5-13
Disc Brake Relining (Front)	5-10
Double Lap Flaring	5-23
Front Disc Brakes	5-1
General Description	5-1
Hub and Rotor Assembly (Front)	5-14
Hydraulic Brake Tubing	5-22
Hydraulic Lines	5-21
Machining Brake Drums	5-17
Master Cylinder & Combination Valve	5-2
Master Cylinder Disassembly, Cleaning, Inspection and Assembly	5-24
Parking Brake	5-1,4
Parking Brake Adjustment — Drum Brakes	5-10
Parking Brake Cable	5-20
Parking Brake Pedal Assembly	5-19
Parking Brake Preliminary Checks	5-7
Power Brake Unit	5-23
Parking Brake Vacuum Diaphragm	5-20
Rear Drum Brakes	5-4
Rear Drum Brake Shoe Adjustment	5-9
Relining Procedure	5-10
Relining Rear Drum Brakes	5-15
Servicing Front Rotors	5-14
Servicing Hydraulic Brake Hoses and Piping	5-21
Single Piston Sliding Caliper Front Disc Brakes	5-2
Stoplight Switch Adjustment	5-10
Substandard or Contaminated Brake Fluid	5-7
Tandem Diaphragm Vacuum Power Brake Unit	5-4
Testing Brake System	5-5

Subject	Page
Testing Brake Tell-Tale Light Operation	5-7
Torque Specifications	5-32
Unit Overhaul	5-24
Vacuum Power Head Assembly, Cleaning, Inspection, and Assembly	5-26
Wheel Cylinder Servicing	5-18
BRAKES — ELDORADO:	5-46
Brake Combination Valve	5-46
Brake Diagnosis Chart	5-47
Diagnosis	5-48
Front Disc Brakes	5-46
General Description	5-46
Hub and Rotor	5-46
Parking Brake	5-48,52
Parking Brake Adjustment	5-53
Rear Brake Caliper	5-48
Rear Brake Caliper Assembly	5-51
Rotor Assembly Removal and Installation	5-48
Servicing Steel Brake Lines and Flexible Hoses	5-53
Single Piston Sliding Caliper Rear Disc Brakes	5-46
Torque Specifications	5-57
BRAKES — FOUR WHEEL DISC SYSTEMS:	5-32
Brake Combination Valve	5-34
Brake Diagnosis Chart	5-35
Combination Valve	5-32
Diagnosis	5-34
General Description	5-32
Parking Brake Adjustment	5-36
Parking Brake Cables	5-36
Rear Brake Caliper	5-37
Rear Brake Caliper Assembly	5-41
Specifications	5-44
Unit Overhaul	5-41
BRAKES — HYDROBOOST:	5-56
Accumulator Leakdown Test	5-58
Bleeding Procedure	5-59
Booster Functional Test	5-58
Diagnosis	5-56
Diagnosis Chart	5-57
General Description	5-56
Hydraulic Brake Booster Overhaul	5-59
Hydraulic Power Brake Booster	5-59
Pneumatic Accumulator Overhaul	5-62
Seal Leak Diagnosis	5-57
Spring Accumulator Overhaul	5-60
Special Tools	5-68
Torque Specifications	5-67
Trouble Shooting & Testing	5-58,66
Unit Overhaul	5-59
BUMPERS — FRONT AND REAR — "C" CAR:	
Diagnosis	2B-4
Front Bumper	2B-5
Front Bumper Center Impact Strip	2B-6
Front Bumper Filler	2B-8
Front Bumper Guards and Bumper Guard Impact Strips	2B-7
Front Bumper Main Reinforcement	2B-6
Front Bumper Outer End	2B-7
Front Bumper Outer Impact Strip	2B-7
Front Energy Absorbing Unit	2B-5
Fuel Filler Door	2B-8
General Description	2B-1
Inspection After Collision	2B-5
License Guard	2B-8
Radiator Grille Lower Air Deflector	2B-3
Rear EA Unit	2B-9
Rear Bumper	2B-8
Rear Bumper Impact Strips	2B-8
Rear Bumper License Plate Filler	2B-8
Rear Bumper Main Reinforcement	2B-8
Rear Bumper Outer End and Impact Pad	2B-8
Rear Bumper Quarter Filler	2B-8
Testing Front or Rear Energy Absorber Operation	2B-4
BUMPERS — FRONT AND REAR — "E" CAR:	
Bumper Guard Impact Strips	2B-12
Front Bumper	2B-11
Front Bumper Center Impact Strip	2B-14
Front Bumper Outer End and Outer Cap	2B-12
Front Bumper Outer Impact Strip	2B-14
Front EA Unit and Mounting Brackets	2B-11
Front Fender Filler Panel	2B-12
Front License Plate Bracket	2B-12
Fuel Filler Door	2B-16
Lower Center Bar	2B-13
Lower Guard	2B-13
Rear Bumper	2B-15
Rear Bumper Impact Strip and License Plate Filler	2B-16
Rear Bumper Outer End and Impact Pad	2B-16
Rear EA Unit and Mounting Bracket	2B-15
Rear Quarter Filler Panel	2B-16
BUMPERS — FRONT AND REAR — "K" CAR:	
Front EA Unit	2B-17
Front and Rear Bumper Reinforcement and Strip	2B-18
Front Bumper	2B-17
Front Bumper Outer Guards and Impact Strips	2B-17
Front License Bracket	2B-17
Front License Plate Bumper Guards and Impact Strips	2B-17
Rear Bumper	2B-19
Rear EA Unit	2B-19
Rear Quarter Filler Panel	2B-19

C

Subject	Page
CARBURETION:	
Adjustment Specifications	6C-44
A/C Idle Speed-Up Solenoid Adjustment	6C-12
Air Horn	6C-13
Air Horn to Bowl	6C-23
Carburetor Application Chart	6C-44

Subject	Page
Carburetor Diagnosis Chart	6C-7
Carburetor Disassembly	6C-13
Carburetor Overhaul Adjustments	6C-12,25
Carburetor Removal and Installation	6C-12
Choke Disassembly	6C-18
Choke Housing to Float Bowl	6C-21
Cleaning and Inspection	6C-20
Completion of Float Bowl Assembly	6C-21
Diagnosis of Fuel System	6C-6
Electric Choke Assembly	6C-6
Fast Idle Speed Adjustment	6C-12
Float Bowl	6C-16,21
Float Level Adjustment	6C-22
Fuel Filter	6C-1
Fuel Pump (Mechanical)	6C-1
Fuel Tank & Lines	6C-1
Fuel Tank Filter	6C-24
General Description	6C-1
Idle Mixture Adjustment	6C-12
Remaining Float Bowl Parts	6C-19
Throttle Body	6C-19,21
CHARGING SYSTEM:	
Analyzing Charging System Trouble	6D-10
Bearing Replacement and Lubrication	6D-17
Diagnosis	6D-8
Charging System (With H.D. Generator)	6D-10
General Description	6D-5
Generator Inspection and Test	6D-13
Generator Inspection and Test (With H.D. Generator)	6D-20
Generator Overhaul	6D-13
Generator Overhaul (With H.D. Generator)	6D-18
Generator Removal and Installation	6D-11
Generator Removal and Installation (With H.D. Generator)	6D-17
Generator Testing	6D-16
Heavy Duty Generator	6D-6
Noisy Generator	6D-6
Slip Ring Servicing	6D-17
CRANKING SYSTEM:	
Checking Inoperative Starter Motor	6D-39
Checking Starter Motor Pinion Clearance	6D-40
Cranking Voltage Test	6D-37
Diagnosis	6D-37
Fusible Links	6D-45
General Description	6D-36
Special Tools	6D-47
Specifications	6D-46
Starter Motor Circuit Resistance Test	6D-39
Starter Motor Removal and Installation	6D-40
Starter Motor — Unit Overhaul	6D-42
Torque Specifications	6D-46
Unit Repair	6D-42
Visual Inspection	6D-43
CRUISE CONTROL:	
Brake Release Switches	9-32
Cruise Control Diagnosis	9-33
Cruise Control Diagnosis Chart	9-37
Cruise Control Road Test	9-33
Electronic Controller	9-32,43
Engagement Switch	9-33,43
General Description	9-32
Instrument Panel Switch	9-32
Power Unit	9-32,41
Solenoid Valve	9-35
Speed Sensor and Harness	9-36,43
Vacuum Control Valve	9-32
Vacuum Control Valve Functional Test	9-36

D

DEFOGGER — REAR WINDOW:	
De-Fogger Relay Removal and Installation	9-64
De-Fogger Switch Removal and Installation	9-64
De-Fogger Switch Test	9-64
De-Fogger Test	9-63
Diagnosis	9-60
General Description	9-60
DIFFERENTIAL:	
Checks and Adjustments	4B-23
Controlled Differential	4B-23
Differential Overhaul	4B-12
Drive Pinion	4B-15
Gear Tooth Contact Pattern Check	4B-22
Pinion Oil Seal Replacement	4B-11
Special Tools	4B-29
Specifications	4B-28
Torque Specifications	4B-28

E

ELDORADO CUSTOM BIARRITZ:	
General Description	9-89
Vinyl Top and Cap Assembly Removal and Installation	9-89
ELECTRICAL/VACUUM DIAGRAMS:	
To see the below Electrical Chassis Diagrams, please see Gatefolds on inside back cover.	
Body Vacuum Circuit Diagrams — Except Seville	
Body Wiring Diagram — Coupe De Ville	
Body Wiring Diagram — Eldorado	
Body Wiring Diagram — Sedan De Ville	
Body Wiring Diagram — Seville	
Chassis Wiring Diagram — Except Eldorado & Seville	
Chassis Wiring Diagram — Eldorado	
Chassis Wiring Diagram — Seville	
Engine Vacuum Circuit Diagrams — Except Seville	
Vacuum Circuit Diagram — Seville	
ELECTRICAL INSTRUMENTS:	
Back-Up Light Switch	8-110
Clock Resetting	8-108
Electrical Accessory Installation	8-90
Float Arm Check-Bent	8-91
Fuel Gauge Diagnosis	8-90
Horns — Removal and Installation	8-111
Ignition Switch	8-90

Subject	Page
Lamp Monitor System General Description	8-111
Monitor Inoperative	8-111
Turn Signal Switch Replacement — Standard Column	8-108
Turn Signal Switch Replacement — Tilt & Telescope Column	8-109
ELECTRONIC FUEL INJECTION:	
Adjustments	6C-97
Air Induction Subsystem	6C-49
Chassis — Mounted Fuel Pump	6C-108
Diagnosis	6C-53
ECU	6C-100
Electronic Control Unit	6C-52,97
Engine Sensors	6C-51
Fast Idle Valve	6C-100
Fuel Delivery Subsystem	6C-48
Fuel Filter	6C-104
Fuel Filter Assembly	6C-104
Fuel Line Gaskets	6C-97
Fuel Pressure Regulator	6C-103
Fuel System Hoses	6C-109
General Description	6C-46
Idle Speed	6C-100
Injection Valve	6C-101
In-Tank Fuel Pump	6C-107
Reference Drawings	6C-109
Relieving Fuel Pressure	6C-97
System Description	6C-47
Special Tools	6C-119
Temperature Sensors	6C-107
Testing EFI — "K" Car	6C-53
Testing EFI — "C" and "E" Car	6C-53
Throttle Body Assembly	6C-99
Throttle Position Switch	6C-97,100
Torque Specifications	6C-121
EMISSIONS:	
A.I.R. General Description (Except Seville)	6E-6
A.I.R. General Description (Seville)	6E-8
A.I.R. Pump Centrifugal Filter	6E-12
A.I.R. Pump — Except Seville	6E-6
A.I.R. Pump — Seville Only	6E-12
Air Injector Reactor System	6E-6
A.I.R. System Check Valve	6E-11
A.I.R. System Diverter Valve	6E-11
Back Pressure EGR Valve	6E-16
Carburetor Calibration	6E-1
Catalytic Converter	6E-1
Diagnosis	6E-2
Diagnosis — A.I.R. Pump	6E-11
Diagnosis — Crankcase Ventilator Valve	6E-6
Distributor Calibration	6E-1
Distributor EFI Vacuum Solenoid	6E-24
Distributor Vacuum Solenoid	6E-24
EFE Valve — Eldorado Only	6E-3
EFE Valve — Except Seville	6E-1
E.G.R. General Description	6E-16
E.G.R. Operation	6E-16
E.G.R. Port Cleaning	6E-22
E.G.R. Thermal Delay Valve	6E-24

Subject	Page
E.G.R. Vacuum Solenoid	6E-24
E.G.R. Valve Cleaning	6E-22
E.G.R. Valve Diagnosis & Chart	6E-20
Exhaust Gas Recirculation	6E-16
Exhaust Pressure Transducer	6E-18
General Description	6E-1
P.C.V. General Description	6E-4
Positive Crankcase Ventilation System	6E-4
Positive Crankcase Ventilator Valve Replacement	6E-6
Testing Thermostatic Air Cleaner	6E-15
Thermal Vacuum Switch	6E-23
Thermostatic Air Cleaner — General Description	6E-12
Thermostatic Air Cleaner — Temperature Sensor — Seville	6E-15
Thermostatic Air Cleaner Vacuum Motor	6E-16
Vacuum Controls	6E-23
ENGINE — MECHANICAL — "C and E" CAR:	
Arrangement of Valves and Valve Lifters	6A-14
Camshaft	6A-23
Camshaft Bearing Replacement	6A-24
Connecting Rod Alignment	6A-29
Connecting Rod and Piston	6A-25
Connecting Rod Bearing Clearance Checking and Replacement	6A-26
Crankshaft	6A-25
Crankshaft Pulley and Hub	6A-21
Cylinder Head	6A-16
Dipstick Tube Installation	6A-31
Engine and Transmission Mounts — Eldorado Only	6A-8
Engine and Transmission Mounts — Except Eldorado	6A-8
Engine and Transmission Support Mounts	6A-8
Engine Front Cover	6A-22
Engine Lubricating System	6A-1
Engine Oil Pan	6A-19
Engine Removal and Installation	6A-5
Exhaust Manifold	6A-2,11
Front Cover Oil Seal Replacement	6A-23
General Description	6A-1
Intake Manifold — EFI Only	6A-11
Intake Manifold — Except E.F.I.	6A-10
Main Bearing Replacement and Clearance Checking	6A-29
Oil Pump Servicing	6A-20
Operation of Valve Lifter Mechanism	6A-13
Piston Clearance	6A-28
Piston Pin	6A-27
Piston Ring Replacement	6A-26
Rear Main Bearing Oil Seal Replacement	6A-20
Rocker Arm Covers	6A-12
Service Procedures	6A-5
Special Tools	6A-34
Specifications	6A-31

Subject	Page
Torque Specifications	6A-33
Torque Specifications (Carb.)	6C-45
Valve and Seat Reconditioning	6A-18
Valve (Intake or Exhaust)	6A-18
Valve Lifter	6A-13
Valve Lifter Disassembly and Assembly	6A-15
Valve Lifter Leak — Down Rate Checking	6A-12
Valve Spring or Oil Shedder Replacement	6A-15
Valve Train Diagnosis	6A-12
ENGINE — MECHANICAL — "K" CAR:	
Camshaft	6A-56
Camshaft Bearings	6A-56
Checking Cylinder Bore	6A-50
Checking Valve Timing Without Removing Front Cover	6A-55
Cleaning Piston	6A-50
Connecting Rod and Piston Assembly	6A-49
Connecting Rod Bearings	6A-49
Crankshaft	6A-57
Crankshaft Pulley	6A-53
Crankshaft Timing Gear	6A-55
Cylinder Head	6A-45
Design Features	6A-36
Engine Lubricating System	6A-37
Engine Mount	6A-40
Engine — Removal and Installation	6A-38
Engine Specifications	6A-62
Flywheel	6A-61
Front Cover	6A-53
Front Cover Oil Seal	6A-54
General Description	6A-35
Harmonic Balancer	6A-53
Intake Manifold	6A-41
Main Bearings	6A-58
Measuring Piston	6-50
Oil Pan	6A-48
Oil Pump	6A-48
Piston Pins	6A-51
Rear Main Bearing Upper Oil Seal	6A-60
Rear Main Lower Oil Seal	6A-60
Reconditioning Rods	6A-50
Reconditioning Valves	6A-46
Replacing Valve Spring (Head on Engine)	6A-47
Rings	6A-50
Rocker Arm Assemblies	6A-42
Rod and Piston Assembly — Installation	6A-50
Service Procedures	6A-38
Special Tools	6A-65
Torque Specifications	6A-64
Torque Specifications (Carb.)	6C-45
Transmission Mount	6A-40
Valves and Springs with Head Removed	6A-46
Valve Cover	6A-42
Valve Lifters	6A-42
Valve Lifter Diagnosis	6A-44
Valve Lifter Leak — Down Rate Checking	6A-45
ENGINE COOLING — "C and E" CAR:	
Belt Adjustments	6B-12
Clutch Fan Assembly	6B-8
Cooling System Flushing Procedure	6B-7
Cooling System Preventative Maintenance	6B-7
Diagnosis	6B-5
Fan Assembly	6B-8
Fan Clutch Diagnosis	6B-6
Fan Shroud	6B-9
General Description	6B-1
Radiator	6B-9
Specifications	6B-20
System Leak Test	6B-3
Testing Coolant Solutions	6B-6
Thermostat	6B-3,8
Thermostat Test	6B-6
Unit Repair	6B-10
Water Pump	6B-9,10
ENGINE COOLING — "K" CAR:	
Belt Adjustments	6B-18
Cooling System Flushing Procedure	6B-16
Cooling System Preventative Maintenance	6B-16
Engine Accessory Drive Belts	6B-21
Fan and Clutch Assembly	6B-17
Fan Clutch Diagnosis	6B-16
General Description	6B-14
Special Tools	6B-22
System Leak Test	6B-16
Testing Coolant Solutions	6B-16
Thermostat	6B-15
Thermostat Test	6B-16
Torque Specifications	6B-21
Water Pump	6B-17
EVAPORATIVE EMISSION CONTROL SYSTEM:	
Adjustment Specifications	6C-44
Carburetor Application Chart	6C-44
EEC Hoses Service Applications	63-39
Fuel Pump Specifications	6C-39
General Description	6C-36
Throttle Linkage Adjustment	6C-40
Torque Specifications	6C-45
Vapor Canister	6C-36
Vapor Canister Filter	6C-39
EXHAUST SYSTEM:	
Catalyst Replacement	6F-9
Catalytic Converter	6F-1
Catalytic Converter Bottom Cover Replacement	6F-12
Exhaust System Alignment	6F-1
General Description	6F-1
On-Car Service	6F-1
Special Tools	6F-13
Torque Specifications	6F-13

Subject	Page
F	
FRONT WHEEL DRIVE:	
Diagnosis	4C-1
Final Drive	4C-11
General Description	4C-1
Inner Joint	4C-6
Left Output Shaft and Drive Axle	4C-4
Outer Constant Velocity Joint	4C-5
Output Shaft Seal Replacement	4C-9
Pinion Bearing Oil Seal Replacement	4C-12
Right Output Shaft and Drive Axle	4C-3
Right Output Shaft Bearing	4C-9
Service Procedures	4C-3
Special Tools	4C-14
Torque Specifications	4C-13
FUEL ECONOMY INDICATOR SYSTEM:	
Diagnosis — Functional Test	9-78
General Description	9-77
FUEL MONITOR SYSTEM AND LOW FUEL LEVEL WARNING INDICATOR:	
Diagnosis	9-76
Diode Test	9-76
General Description	9-75
FUEL PUMP:	
Fuel Pump	6C-24
Fuel Pump Inspection	6C-30
Fuel Pump Pressure Test	6C-30
Fuel Pump Flow Test	6C-30
Fuel Pump Specifications	6C-45
FUEL TANK:	
Draining Fuel Tank	6C-35
Fuel Line	6C-35
Fuel Line and Tank Cleaning	6C-34
Fuel Line Repair	6C-36
Fuel Tank	6C-34
Fuel Tank Float Unit	6C-35
Fuel Tank Strap	6C-34
General Description	6C-31
Storage Precautions	6C-34
G	
GENERAL INFORMATION, MAINTENANCE, AND LUBRICATION:	
Body Identification Plate	0A-4
Body Lubrication	0B-1
Car Storage Preparation	0A-12
Emission Control Maintenance	0B-5
Engine Oil Change Interval and Viscosity Chart	0B-8
Fluid Capacities	0B-9
Hoist Recommendations	0A-6
Identification Numbers	0A-4
Jump Starting with Auxiliary (Booster) Battery	0A-5
Jump Start Procedure	0A-6
Keys	0A-5
Lube and General Maintenance	0B-1
Maintenance Schedules I and II	0B-1
Pushing or Pulling Car to Start Engine	0A-5
Recommenden Fluids & Lubricats Chart	0B-6
Safety Maintenance	0B-4
Tire Pressure	0A-4
Towing Instructions	0A-5
Vehicle Identification Number	0A-1
Vibration Complaints and Correction	0A-9
GUIDEMATIC:	
Diagnosis	9-48
Foot Switch	9-52
Guidematic Diagnosis Chart	9-50
Guidematic General Description	9-45
Photo — Amplifier — Vertical Aiming Adjustment	9-51
Operation — Automatic	9-45
Operation — Low Beam	9-45
Operation — Manual	9-45
Photo — Amplifier Unit	9-51
Power Relay Unit	9-52
Sensitivity Control Switch	9-51
I	
IGNITION SYSTEM:	
Analyzing H.E.I. System Condtion	6D-29
Centrifugal Advance	6D-24
Diagnosis	6D-28
Distributor	6D-23,31
Distributor Disassembly and Assembly	6D-31
Distributor Removal and Installation	6D-31
Distributor Service Precautions	6D-31
Distributor Useage Chart	6D-24
Electronic Module	6D-24,31
General Description	6D-23
Ignition Coil	6D-23,35
Ignition Switch	6D-25,35
Ignition Timing	6D-25
Ignition Timing Adjustment	6D-32,34
Operation	6D-24
Pick-Up Coil Assembly	6D-24
Spark Plugs	6D-25,30
Speed Sensor	6C-120
Tachometer Connections	6D-31
Vacuum Advance	6D-24
Vacuum Advance Systems	6D-24
INSTRUMENT PANEL — "C" CAR:	
A/C Adapter — Left	8-14
A/C Adapter — Right	8-14
A/C Center Outlet	8-16
A/C Control Head	8-8
A/C Distributor	8-16
A/C Flexible Hose Duct — Right	8-16
A/C In-Car Sensor	8-4
A/C Outlet	8-2
A/C Outlet — Left	8-16
A/C Outlet — Left Duct Extension	8-16
Accessory Switch	8-8
Ash Tray Guide — Housing	8-9
Cruise Control Switch	8-8

Subject	Page
Digital Clock	8-4
Electronic Control Unit	8-13
Fuel Gage	8-3
General Description	8-1
Glove Box Lock Case	8-13
Glove Box Lock Cylinder	8-12
Glove Box Door	8-12
Glove Box Liner	8-11
Headlamp Switch	8-7
Hood Lock Primary Release	8-13
Instrument Panel Assembly	8-13
Instrument Panel Center Insert	8-8
Instrument Panel Insert and Applique — Right	8-10
Instrument Panel Top Cover	8-2
Instrument Panel Torque Specifications	8-20
Lighting and Chassis Electrical Torque Specifications	8-20
Map Lamps — Left & Right	8-8
Rear View Mirror — Right	8-8
Speedo Cable and Cable Housing	8-7
Speedo Cluster	8-6
Speedo Cluster — Left Insert and Applique	8-5
Speedo Cluster Printed Circuit	8-6
Steering Column Cover — Lower	8-4
Speedo Driven Gear	8-7
Speedo Gear Application Chart	8-8
Speedo Head	8-6
Speedo Head Component Service	8-6
Telltale Assembly — Left	8-4
Telltale Assembly — Right	8-4
Telltale Cluster Printed Circuit	8-4
Theft Deterrent Controller	8-8
Trunk Release Switch	8-13
Twilight Sentinel Amplifier	8-4
Twilight Sentinel Photocell	8-4
Windshield Wiper Switch	8-8
INSTRUMENT PANEL — "E" CAR:	
A/C Control Head	8-27
Accessory Switch Bulb	8-31
Accessory Switches and Housing	8-31
Ash Tray	8-28
Ash Tray Door and Cigar Lighter Base Assembly	8-28
Climate Control Air Outlet Grilles	8-21
Climate Control Duct — Left	8-27
Climate Control Duct — Right	8-28
Climate Control In-Car Sensor	8-27
Climate Control Outlet Doors and Bezels	8-27
Cruise Control Switch	8-30
Digital Clock	8-32
Electronic Control Unit	8-33
Fuel Gage	8-32
Glove Box Door	8-32
Glove Box Liner	8-32
Glove Box Lock Case	8-33
Glove Box Lock Cylinder	8-32
Headlamp Switch	8-30
Hood Lock Primary Release	8-32
Instrument Panel — General Description	8-21
Instrument Panel Insert and Applique	8-30
Instrument Panel Insert — Left	8-29
Instrument Panel Pad	8-21
Instrument Panel Top Cover	8-22
Instrument Panel Torque Specifications	8-39
Lighting and Chassis Electrical Torque Specifications	8-38
Power Antenna Relay	8-31
Rear View Mirror — Right	8-33
Rear Window Defogger Timer Relay and Circuit Breaker	8-32
Seat Belt Timer and Buzzer Assembly	8-33
Speedo Cable and Cable Housing	8-25
Speedo Cluster	8-22
Speedo Cluster Bezel Assembly	8-22
Speedo Cluster Printed Circuit	8-24
Steering Column Cover — Lower	8-21
Speedo Driven Gear	8-25
Speedo Gear Application Chart	8-26
Speedo Head	8-24
Speedo Head Component Service	8-25
Tell-Tale Housing	8-27
Tell-Tale Printed Circuit	8-26
Theft Deterrent Controller	8-31
Trunk Release Switch	8-31
Twilight Sentinel Amplifier	8-26
Twilight Sentinel Photocell	8-26
Windshield Wiper Switch	8-28
INSTRUMENT PANEL — "K" CAR:	
Accessory and/or Antenna Switch Housing	8-47
Climate Control Air Outlet Grilles	8-41
Climate Control Cross Car Duct	8-50
Climate Control In-Car Sensor	8-47
Climate Control Head	8-51
Climate Control Outlet Assemblies	8-41
Cruise Control Switch	8-51
Defroster Grilles	8-46
Electronic Control Unit	8-52
Fuel Gage	8-46
Glove Box Lock Case	8-49
Glove Box Lock Cylinder	8-49
Glove Box Door	8-49
Glove Box Liner	8-49
Headlamp Switch	8-50
Insert and Applique — Right	8-47
Instrument Panel General Description	8-40
Instrument Panel — Lower Left	8-50
Instrument Panel — Lower Right	8-50
Instrument Panel Top Cover	8-44
Instrument Panel Top Cover Inserts	8-47
Instrument Panel Torque Specifications	8-55
Lighting and Chassis Electrical Torque Specifications	8-54
Remote Control Mirror — Right	8-47
Rear Window Defogger Circuit Breaker	8-42
Seat Belt Warning Chime	8-49
Speedo Cable and Cable Housing	8-44
Speedo Cluster	8-42

Subject	Page
Speedo Cluster Bezel Assembly	8-42
Speedo Cluster Printed Circuit	8-42
Steering Column — Lower Cover and Reinforcement	8-41
Speedo Driven Gear	8-44
Speedo Gear Application Chart	8-45
Speedo Head	8-42
Speedo Head Component Service	8-43
Telltale and Fuel Gage Assembly	8-46
Telltale and Fuel Gage Printed Circuit	8-46
Theft Deterrent Controller	8-49
Theft Deterrent Fuses	8-49
Trunk Release Switch	8-49
Twilight Sentinel Amplifier	8-52
Twilight Sentinel Photocell	8-52
Windshield Wiper Switch	8-42

L

LAMPS — "C" CAR:	
Back-Up Lamps	8-69
Bulb Data Chart	8-70
Bulb Replacement	8-69
Cornering Side Marker Lamp and Bezel	8-67
Front Lamp Monitor Harness	8-68
Front Lamp Monitor Read-Out	8-68
Headlamp Housing Assembly	8-67
Headlamp Replacement	8-66
License Plate Lamp	8-69
Parking Lamp Replacement	8-67
Tail, Stop-Signal Lamp, Back-Up Lamp Assembly	8-69
Tail, Stop-Signal Lamps, Rear Side Marker Lamps	8-68
LAMPS — "E" CAR:	
Back-Up Lamp Assembly	8-73
Bulb Data Chart	8-74
Bulb Replacement	8-73
Front Monitor Harness	8-71
Front Monitor Read-Out	8-72
Front Parking Lamp Bulb, Lens, Bezel and Gasket Replacement	8-71
Headlamp Housing Assembly	8-69
Headlamp Replacement	8-69
License Plate Lamp — Rear	8-73
Parking Lamp Assembly	8-69
Side Marker and Cornering Lamp Assembly and Bezel	8-71
Side Marker Lamp Assembly — Rear	8-73
Tail, Stop, and Turn Signal Lamps	8-72
LAMPS — "K" CAR:	
Back-Up Lamps	8-77
Bulb Data Chart	8-79
Cornering and Front Side Marker Lamp	8-77
Exterior Lamp Bulb Replacement	8-77
Front Monitor Harness and Readout	8-76
Front Parking and Turn Signal Lamp	8-75
Headlamp Bezel	8-75
Headlamp Housing Assembly	8-73
Headlamp Replacement	8-75
Interior Bulb Replacement	8-77
License Lamps	8-77
Tail, Stop, and Rear Side Marker Lamp	8-77
Lamp Monitor System Diagnosis	8-111
General Description	8-111
Monitor Inoperative	8-111
On-Car-Service	8-112
LIGHTING SYSTEMS — (GENERAL):	
Back-Up Lamps Diagnosis	8-66
Cornering Lamps Diagnosis	8-62
Headlamps — General Description	8-60
Headlamp Aiming	8-66
Headlights Diagnosis	8-60
Side Marker Lamps Diagnosis	8-63
Special Tools	8-80
Stop Lamps Diagnosis	8-65
Tail, Park, and License Lamps — Diagnosis	8-64
Turn Signal and Hazard Warning Lamps Diagnosis	8-61

M

MOUNTS — FRAME AND BODY:	
Body Cross Rod Installation	2A-3
Body Mounts	2A-3
Frame Repair	2A-3
General Description	2A-1
Torque Specifications	2A-12

P

PROPELLER SHAFT:	
Ball Seat Assembly	4A-9
Center Bearing	4A-11
Diagnosis	4A-3
Front Section	4A-10
General Description	4A-1
Link Yoke	4A-8
Propeller Shaft Assembly	4A-5
Propeller Shaft Centering Ball	4A-8
Propeller Shaft Rebalancing	4A-2
Special Tools	4A-14
Torque Specifications	4A-13
Universal Joint — Constant Velocity	4A-7
Universal Joint — Front	4A-12

R

RADIO — ANTENNA:	
AM/FM and AM/FM Stereo Radios	9-1
AM/FM Pushbutton Stereo Digital Frequency, Time and Date Display Radio	9-3
AM/FM Stereo 23 or 40 Channel CB Receiver — Transmitter	9-4

Subject	Page
AM/FM Stereo Radio with 8-Track Tape Player	9-2
Antenna Cap and Automatic Switch Assembly Replacement	9-30
Antenna DOG Assembly Replacement	9-29
Antenna Mast and Support Tube Assembly Replacement	9-31
Antenna Motor and Drive Assembly Replacement	9-30
Antenna Switch	9-29
Antenna Unit Repair	9-29
CB Transceiver Location	9-4
CB Transceiver — Removal	9-26
CB Microphone	9-26
CB Antenna	9-27
Electric Antenna Removal	9-28
Electric Antenna Unit	9-27
Power Antenna	9-8
Power Antenna Overhaul Procedure	9-28
Power Antenna Unit	9-28
Procedure for Setting Date and Time	9-3
Rear Seat Remote Control Unit	9-24
Radio	9-1
Radio and Antenna — General Description	9-1
Radio Controls, Operation	9-5
Radio Diagnosis	9-12
Radio Front Speakers	9-25
Radio Front Speakers and Grilles	9-26
Radio Minor Adjustments	9-23
Radio Noise Suppressors	9-7
Radio Rear Seat Speakers	9-24
Radio Receiver	9-24
Radio Removal and Installation	9-23
Radio Speaker	9-23
Radio Special Tools	9-31
Scanning Signal Seeking Tuner	9-2
Stereo Tape	9-23

S

Subject	Page
SHEET METAL — CHASSIS — "C" CAR:	
Aluminum Hood Repair (Information)	2C-5
Battery Canister Tray	2C-2
Durastrut	2C-2
Fiberglass Repair	2C-7
Front End Panel	2C-2
Front End Panel Fillers	2C-6
Front Fender	2C-11
Front Fender Wheelhousing	2C-12
General Description	2C-1
Grille	2C-2
Hairline Cracks	2C-8
Hood Panel	2C-4
Hood Panel Adjustment	2C-5
Hood Latch Mechanism Adjustment	2C-4
Lower Grille	2C-6
Plastic Solder Kit	2C-7
Radiator Support Mounts	2C-2
Resin Repair Kit	2C-7
Scratches and Gouges	2C-7
Upper Grille	2C-5
SHEET METAL — CHASSIS — "E" CAR:	
Fender Extension	2C-15
Front Fender	2C-13
Front Fender Wheelhousing	2C-13
Lower Grille	2C-13
Upper Grille	2C-12
SHEET METAL — CHASSIS — "K" CAR:	
Adjusting Sheet Metal Tolerances	2C-18
Cowl Panel	2C-18
Front Fender	2C-16
Front Fender Wheelhousing	2C-16
Lower Grille	2C-16
Upper Grille	2C-15
STEERING LINKAGE — "C" AND "K" CAR:	
Diagnosis Chart	3B-2
General Description	3B-1
Idler Arm	3B-6
Intermediate Rod	3B-5
Pitman Arm	3B-7
Steering Linkage Removal, Disassembly, Assembly and Installation	3B-3
Tie Rod Adjuster Tube	3B-6
Tie Rod Pivot Seal Replacement	3B-7
Tie Rods	3B-4
STEERING LINKAGE — "E" CAR:	
Idler Arm	3B-9
Intermediate Rod Height Adjustment	3B-9
Pitman Arm	3B-9
Steering Linkage Joint Lub.	3B 9
Steering Linkage Removal, Disassembly, Assembly, and Installation	3B-8
STEERING PUMP AND GEAR:	
Alternate Thrust Bearing Adjustment Procedure	3B-41
Checking Fluid Level	3B-20
Component Replacement Recommendations	3B-14
External Leakage Check	3B-14
External Leakage Diagnosis	3B-13
Fluid Level	3B-20
General Description	3B-11
Individual Leakage Breakdown	3B-15
Intermediate Shaft	3B-21
Intermediate Shaft and/or Stone Shield Replacement	3B-27
Lower Steering Shaft — "E" Car	3B-21
Pitman Shaft "Over-Center" Sector Adjustment	3B-42
Pitman Shaft Seals — Removal and Installation	3B-43
Pump	3B-15
Pump Pressure	3B-20
Quick Fixes	3B-14
Removal of Major Components	3B-33
Steering Gear	3B-13
Steering Gear — Eldorado	3B-25
Steering Gear and Pump Diagnosis Chart	3B-16
Steering Gear Disassembly	3B-34
Steering Gear, Disassembly, Inspection, and Assembly of Major Components	3B-34

Subject	Page
Steering Gear, Installation of Major Components	3B-39
Steering Gear Line Connector Seats and Poppet Check Valve Replacement	3B-43
Steering Gear Removal	3B-25
Steering Leakage Diagnosis	3B-13
Steering Pump	3B-13,24
Steering Pump — "C" and "E" Car	3B-23
Steering Pump — "K" Car	3B-24
Steering Pump Disassembly, Cleaning, Inspection, and Assembly	3B-28
Steering Pump Fluid Cooler Tube	3B-21
Steering Pump Shaft Seal Replacement	3B-32
Thrust Bearing Adjustment	3B-41
Unit Repair	3B-27
STEERING WHEELS AND COLUMNS:	
Checking Steering Column For Accident Damage	3B-76
Energy Absorbing Steering Column	3B-49
General Description	3B-46
Ignition Switch	3B-47
Key Buzzer Diagnosis Chart	3B-60
Mechanical Neutral Start System	3B-46
Method to Determine Column Collapse	3B-51,56
Standard Column Diagnosis Chart	3B-50
Standard Steering Column Disassembly, Inspection, and Assembly	3B-66
Steering Column	3B-63
Steering Column Alignment — "K" and "E" Car	3B-64
Steering Column Lower Bearing Removal	3B-71
Steering Shaft	3B-71
Steering Wheel	3B-62
Special Tools	3B-80
Tilt and Telescope Steering Column	3B-49
Tilt and Telescoping Column Diagnosis Chart	3B-53
Tilt and Telescope Column Disassembly, Inspection, and Assembly	3B-71
Torque Specifications	3B-78
Turn Signal Switch Diagnosis Chart	3B-57
SUN ROOF:	
Design and Construction Features	9-78
Diagnosis	9-80
Drain Hose Replacement	9-84
Electrical System	9-79
General Description	9-78
Headlining Panel	9-80
Headlining Panel Adjustments and Related Repairs	9-80
Manual Operation	9-78
Motor and Gear Box Assembly	9-82
Operation	9-78
Periodic Maintenance	9-84
Sunroof Panel, Rear Slide, and Cable	9-83
Sunroof Switch Removal and Installation	9-82
Weatherstrip Replacement	9-84
SUSPENSION — FRONT — "C" and "K" CAR:	
Bearing Problem Conditions	3C-4
Checking Front Shock Absorbers	3C-8
Diagnosis	3C-4
Front Bushing	3C-15
Front Shock Absorbers	3C-8
Front Lower Suspension Arm	3C-14
Front Lower Suspension Arm Bushings	3C-14
Front Spring	3C-9
Front Suspension Diagnosis Chart	3C-2
Front Suspension System	3C-1
Front Suspension Upper Arm Shaft and Bushings	3C-13
Front Upper Suspension Arm	3C-13
Front Wheel Bearings	3C-6
General Description	3C-1
Lower Spherical Joint	3C-11
Special Tools	3C-32
Stabilizer Bar	3C-9
Steering Knuckle	3C-15
Torque Specifications	3C-31
Upper Spherical Joint	3C-10
SUSPENSION — FRONT — "E" CAR:	
Front Shock Absorber	3C-18
Front Wheel Stud Replacement	3C-29
General Description	3C-18
Hub Bearing and Knuckle Assembly	3C-25
Suspension Arm	3C-24
Suspension Arm Bushings	3C-24
Suspension Arm Spherical Joint	3C-25
Suspension Arm Spherical Joint Seal	3C-23
Special Tools	3C-32
Spherical Joint Checking Procedure	3C-18
Stabilizer Bar	3C-18
Steering Knuckle and Inner Seal	3C-21
Torsion Bar	3C-20
Torque Specifications	3C-31
Upper Suspension Arm	3C-19
Upper Suspension Arm Bushing	3C-19
Upper Suspension Arm Spherical Joint	3C-20
SUSPENSION — REAR — "C" and "K" CAR:	
Checking Rear Shock Absorbers	34-4
Checking Rear Standing Height	3D-2
General Description	3D-2
Rear Lower Control Arm	3D-5
Rear Leaf Springs	3D-12
Rear Shock Absorbers	3D-3
Rear Springs	3D-4
Rear Spring Damper	3D-13
Rear Spring Front Bushing	3D-13
Rear Spring Tip Liners	3D-15
Rear Stabilizer Bar	3D-15
Rear Stabilizer Bar — ALC Only	3D-6
Rear Upper Control Arm	3D-5
Rear Wheel Stud Replacement	3D-6

Subject	Page
SUSPENSION — REAR — "E" CAR:	
Lower Control Arm	3D-9
Rear Springs	3D-10
Rear Upper Control Arm	3D-8
Rear Upper Control Arm Bushing	3D-9
Rear Wheel Stud Replacement	3D-10

T

TELLTALE LAMP DIAGNOSIS — "C & E CAR":	
Brake Combination Valve and Park Brake Lamp	8-102
Electrical Instruments General Description	8-90
Engine Metal Temperature Indicator Circuit	8-95
High Beam Indicator Circuit	8-92
Oil Pressure Indicator Circuit	8-94
Seat Belt Warning Light and Buzzer	8-94
Speedometer Printed Circuit Legend	8-101
Telltale Lamp Diagnosis	8-91
Telltale Cluster Printed Circuit Legend	8-98,100
Trunk Lid Warning Lamp	8-92
Water Temperature Indicator Circuit	8-94
TELLTALE LAMP DIAGNOSIS — "K" CAR:	
Brake Combination Valve and Park Brake	8-102
Engine Metal Temperature Indicator Circuit	8-104
High Beam Indicator Circuit	8-92
Horn Operation and Testing	8-104
Oil Pressure Indicator Circuit	8-102
Seat Belt Warning Light and Chime	8-103
Speedometer Printed Circuit Legend	8-107
Telltale Lamp Diagnosis	8-100
Telltale Warning Cluster Printed Circuit Legend	8-106
Trunk Lid Warning Lamp	8-100
Water Temperature Indicator Circuit	8-103
THEFT DETERRENT SYSTEM:	
Alarm Description	9-65
Arming	9-66
Automatic Shut Down	9-66
Controller	9-65
Disarming	9-66
Door and Trunk Locks	9-65
Fuses	9-65
Hood Sensing Switch	9-75
Hood Switch	9-65
Location of Parts	9-65
Theft Deterrent Diagnosis Chart	9-71
Theft Deterrent System General Description	9-65
TRANSMISSION — "C" AND "K" CAR:	
Band Apply Pin Selection Check	7A-35
Bushing Service	7A-72
Center Support and Intermediate Clutch Piston	7A-53
Center Support Bushing	7A-73
Check Balls, Control Valve, Spacer Plate and Gaskets, Detent Solenoid, Front Servo Assembly and Electrical Connector	7A-67
Checking and Adding Fluid	7A-25
Control Valve Assembly	7A-43
Control Valve Assembly, Governor Pipes and Governor Screen Assembly	7A-68
Control Valve Assembly, Governor Pipes, Detent Spring, Roller Assembly	7A-27
Converter	7A-69
Detent Lever, Manual Shaft, and Parking Linkage	7A-27
Detent Solenoid, Solenoid Connector, Control Valve Spacer, Gaskets, Check Balls, and Front Servo Assembly	7A-67
Diagnosis	7A-2
Direct Clutch and Intermediate Roller Assembly	7A-52
Downshift Solenoid Circuit Check	7A-27
E.G.R. System	7A-3
Extension Housing	7A-20
Extension Housing Bushing	7A-74
Extension Housing Oil Seal Replacement	7A-27
Extension Housing Removal and Installation	7A-28
Front Band and Remaining Clutch Assemblies	7A-64
Forward Clutch Assembly — Disassembly	7A-49
Front Servo Assembly	7A-67
Front Unit End Play Checking Procedure	7A-36
Gear Unit	7A-54
General Description	7A-1
Governor Assembly	7A-27
Governor Driven Gear	7A-42
Governor Removal and Installation	7A-32
Inspection of Detent Lever, Manual Shaft, and Parking Linkage	7A-41
Inspection of Extension Housing	7A-40
Inspection of Torque Converter	7A-40
Inspection of Transmission Case	7A-69
Inspection & Assembly of Individual Units	7A-40
Inspection of Vacuum Modulator Valve	7A-40
Intake Pipe and Filter Assembly and Bottom Pan	7A-27
Lateral Strut Rod	7A-32
Manual Linkage Adjustments	7A-27
Modulator Valve and Vacuum Modulator	7A-40
Oil Leaks	7A-20
Oil Pump, Remove	7A-37
Oil Pump Dissassembly	7A-46
Output Shaft or Output Flange Bushing	7A-73
Parking Linkage, Detent Lever and Manual Shaft	7A-66
Parking Pawl	7A-37
Pressure Regulator Valve Removal and Installation	7A-29
Pump Body Bushing	7A-72

Subject	Page
Pump Oil Seal Replacement	7A-33
Rear Oil Seal and Extension Housing	7A-33
Rear Servo Assembly	7A-27
Rear Unit End Play Checking Procedure	7A-37
Remaining Components	7A-38
Special Tools	7A-71
Speedometer Driven Gear	7A-27
Speedometer Driven Gear Assembly and Transmission Speed Sensor	7A-43
Stator Shaft — Front Bushing	7A-76
Stator Shaft — Rear Bushing	7A-75
Sun Gear Shaft Bushing — Front and Rear	7A-73
Support to Case Spacer Rear Band and Complete Gear Unit Assembly	7A-60
Torque Specifications	7A-70
Towing Instructions	7A-27
Transmission Case Bushing	7A-74
Transmission Case Repairs	7A-69
Transmission Downshift Switch	7A-25
Transmission Removal and Installation	7A-30
Turbine Shaft, Forward Clutch Housing, Direct Clutch Assembly, Sun Gear Shaft, and Front Band	7A-37
Units That Can Be Removed with Transmission in Car	7A-27
Unit Overhaul	7A-33
Vacuum Modulator and Valve	7A-27
TRANSMISSION — "E" CAR:	
Band Apply Pin Selection Check	7B-15
Center Support and Gear Unit	7B-23
Checking and Adding Fluid	7B-8
Control Valve Assembly	7B-38
Control Valve Assembly Governor Pipes, Detent Spring, Roller Assembly and Check Balls	7B-15
Converter	7B-46
Detent Lever, Manual Shaft, and Parking Linkage	7B-16
Detent Lever, Manual Shaft, Parking Linkage, Rear Servo, Front Servo, Check Balls, and Control Valve Spacer	7B-36
Diagnosis	7B-3
Direct Clutch and Intermediate Sprag Assembly	7B-30
Downshift Solenoid Circuit Check	7B-3
Fluid Leakage Precautions	7B-3
Forward Clutch Assembly	7B-32
Forward Clutch Assembly, Direct Clutch Assembly, Sun Gear Shaft, and Front Band	7B-20
Front Servo Piston and Rear Servo Piston	7B-15
Front Unit End Play Check	7B-19
General Description	7B-1
Governor Assembly	7B-13,45
Inspect Driven Sprocket and Input Shaft	7B-17
Inspect Drive Sprocket and Turbine Shaft and Link Assembly	7B-17
Inspection of Transmission Case	7B-23
Installing Transmission On Holding Fixture	7B-13
Intake Pipe and Filter Assembly and Bottom Pan	7B-14
Manual Linkage Adjustment	7B-8
Oil Pump	7B-19,35
Points of Possible Oil Leaks	7B-3
Pressure Control	7B-2
Pressure Regulator Valve	7B-14
Pressure Regulator Valve, Intake Pipe and Filter Assembly, Bottom Pan, Modulator Valve and Modulator	7B-43
Pump Cover Plate	7B-34
Pump Cover Plate, Converter Out Check Valve and Drive and Driven Support Housing Assemblies	7B-20
Rear Unit End Play Checking Procedure	7B-21
Remaining Components	7B-21
Special Tools	7B-48
Speedometer Driven Gear	7B-13
Sprocket Bearings	7B-18
Sprocket Cover, Link Assembly, Drive and Driven Sprockets	7B-16
Sprockets, Link Assembly, and Sprocket Cover	7B-35
Stator Shaft Bushing	7A-77
Theory of Operation	7B-1
Torque Chart	7B-47
Towing Instructions	7B-9
Transmission Downshift Switch Adjustment	7B-8
Transmission Removal and Installation	7B-10
Units That Can Be Removed With Transmission in Car	7B-9
Vacuum Modulator and Valve	7B-13
TWILIGHT SENTINEL:	
Amplifier Unit	9-60
Control Switch	9-60
Operation and Correction	9-59
Operation — Automatic	9-52
Operation — Manual	9-52
Photocell Unit	9-60
Sensitivity Adjustment	9-60
Twilight Sentinel Diagnosis Chart	9-54
Twilight Sentinel General Description	9-52

V

VACUUM DIAGRAMS:	
To see below Vacuum Diagrams, please see Gatefolds on inside back cover.	
Body Vacuum Circuit Diagrams — Except Seville	
Engine Vacuum Circuit Diagrams — Except Seville	
Vacuum Circuit Diagrams — Seville	

Subject	Page
W	
WHEELS AND TIRES:	
Balancing Wheels	3E-4
Correcting Non-Uniform Tires	3E-7
Demounting and Mounting of Tubeless Tire	3E-3
Diagnosis	3E-6
Diagnosis Charts	3E-9
Eldorado Front Wheel Balance	3E-6
Factory Balance Method and Specification	3E-4
Factory Tire to Wheel Matching	3E-4
General Description	3E-1
General Balance Precautions	3E-4
Inflation of Tires	3E-2
Irregular and/or Premature Tire Wear	3E-6
Lateral Force Variation (Radial Tire Wobble)	3E-7
Maintenance and Minor Adjustments	3E-2
Off-Car Balancing	3E-5
On-Car Balancing	3E-5
Radial Force Variation	3E-6
Recommended Balance Method	3E-4
Replacement Tires	3E-1
Replacement Wheels	3E-2
Special Tools	3E-10
Stowaway Spare	3E-4
Substitution Method	3E-7
Tire Repair	3E-3
Tire Rotation	3E-3
Tires	3E-1
Tire Size and Load Rating	3E-1
Tire Wear Indicators	3E-6
Use of Tire Chains	3E-2
Vibration	3E-6
Wheel Maintenance	3E-2
Wheel Removal	3E-3
Wheels	3E-1
WINDSHIELD WIPER SYSTEM — "C & E CAR":	
Controlled Cycle Wiper System	8-113
Washer Circuit	8-112
Washer Fluid Low Level Indicator — General Description	8-112
Washer Fluid Low Level Indicator Inoperative	8-117
Windshield Wiper Electrical Operation	8-112
Wiper Switch	8-113
WINDSHIELD WIPER SYSTEM — "K" CAR:	
Washer Fluid Low Level Indicator — General Description	8-118
Washer Fluid Low Level Indicator Inoperative	8-119
Washer Solution Bottle	8-116
Windshield Washer Height Adjustment	8-116
Windshield Wiper Motor	8-116
Windshield Wiper Switch	8-116
WIRING AND CIRCUIT PROTECTION:	
Circuit Breakers	8-81
Circuit Protection	8-80
Fuses	8-80
Fusible Links	8-81
Fusible Link Replacement	8-85
Relay Center	8-81
Specifications — Fuses, Relays, Circuit Breakers, Flashers, Fusible Links	8-87
Splicing Procedure For Aluminum Solid Core Wires	8-85
Wiring	8-80
Wiring & Circuit Protection General Description	8-80
Wiring Diagnosis	8-85
WIRING DIAGRAMS — BODY:	
To see below Wiring Diagrams, please see Gatefolds on inside back cover.	
Coupe De Ville	
Sedan De Ville	
Eldorado	
Seville	
WIRING DIAGRAMS — CHASSIS:	
To see below Wiring Diagrams, please see Gatefolds on inside back cover.	
Eldorado	
Except Eldorado & Seville	
Seville	

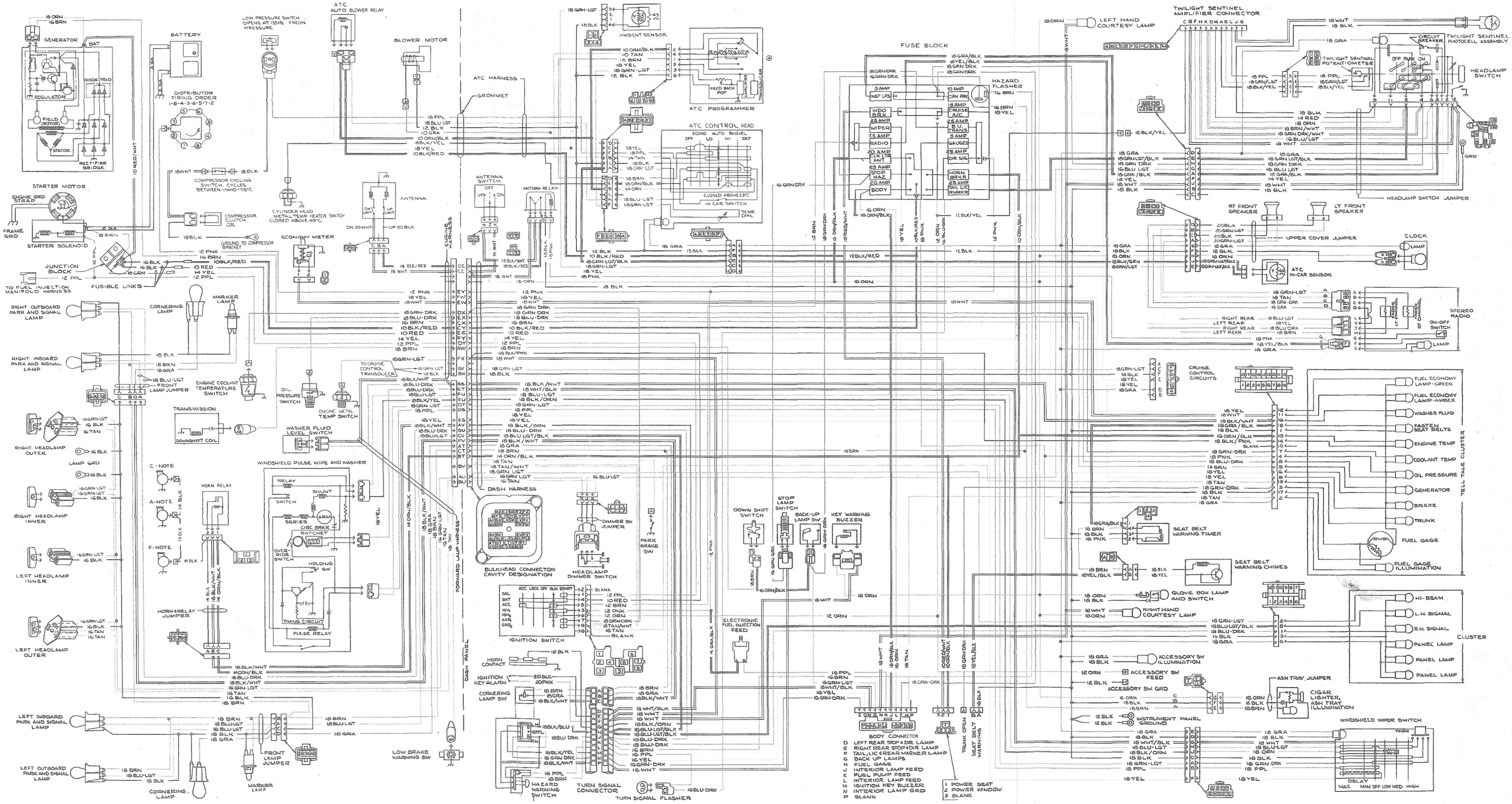


Fig. 1 1977 Seville Chassis Wiring Diagram

Fig. 2 1977 Cadillac Chassis Wiring Diagram (Except Eldorado and Seville)

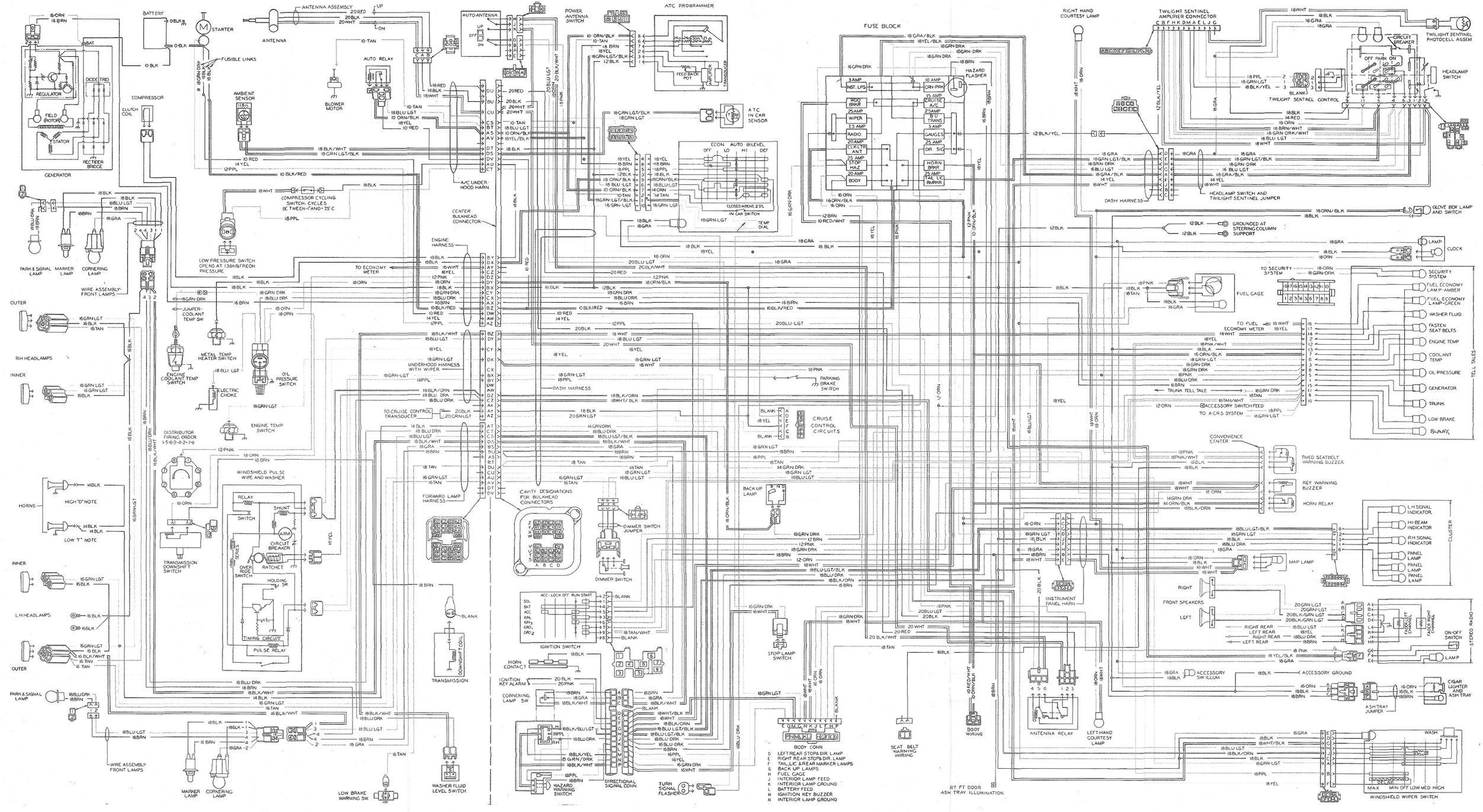


Fig. 3 1977 Cadillac Chassis Wiring Diagram (Eldorado)

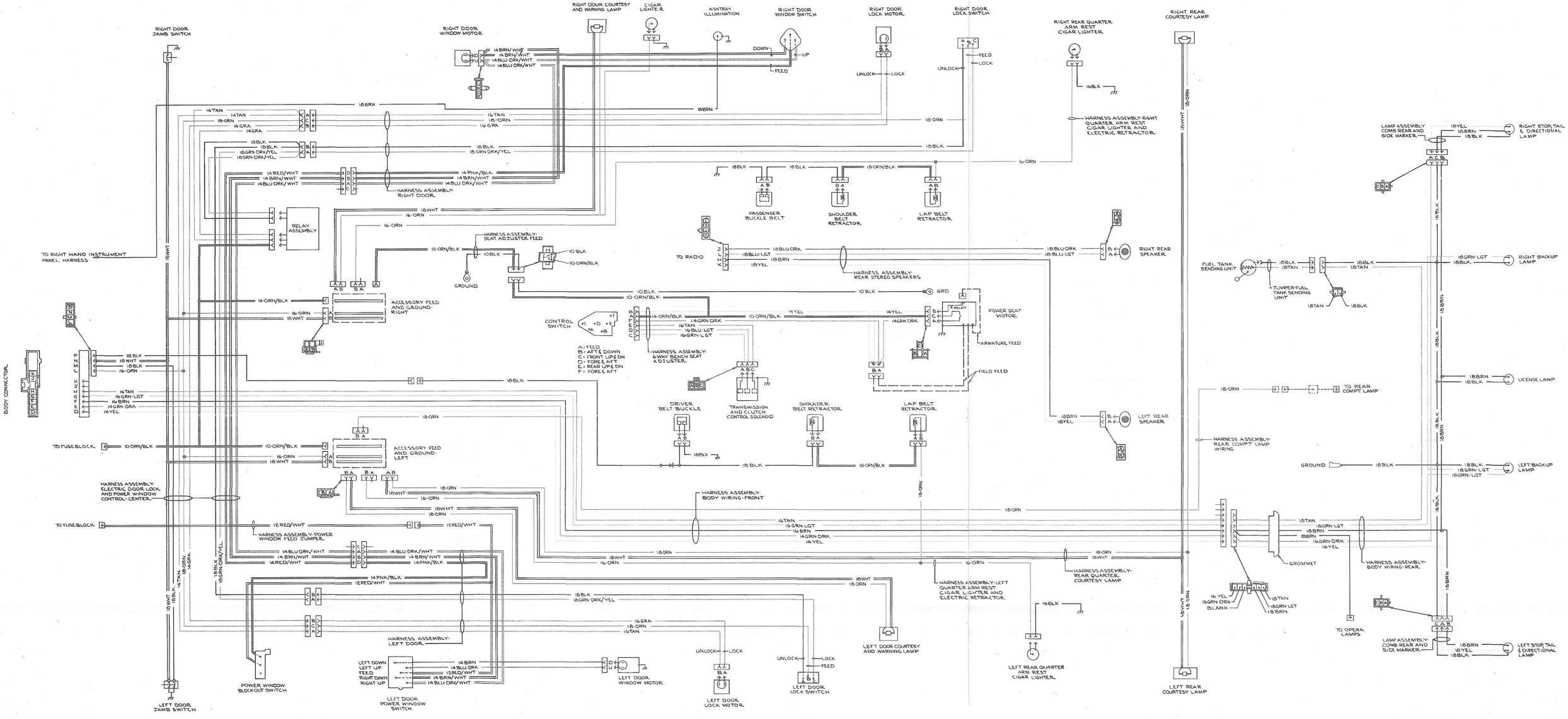


Fig. 4 1977 Cadillac Body Wiring Circuit Diagram (DeVille Coupe)

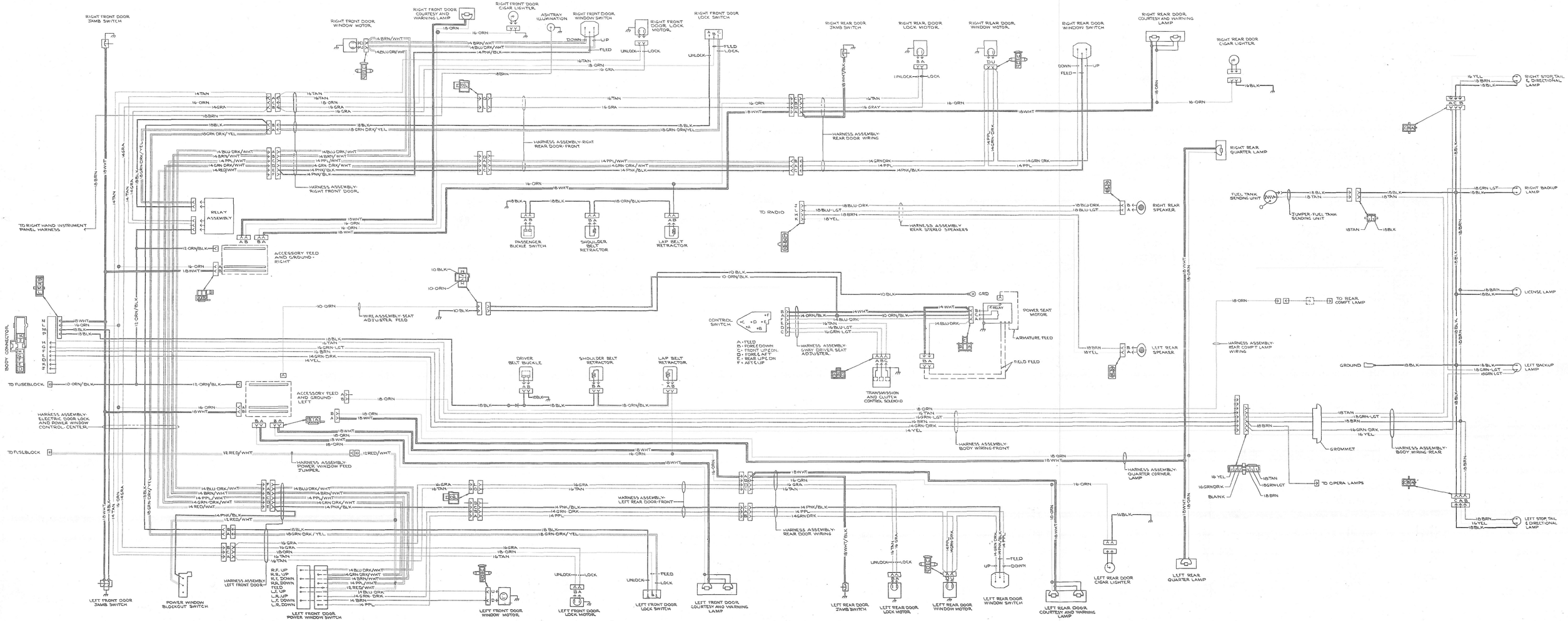


Fig. 5 1977 Cadillac Body Wiring Circuit Diagram (DeVille Sedan)

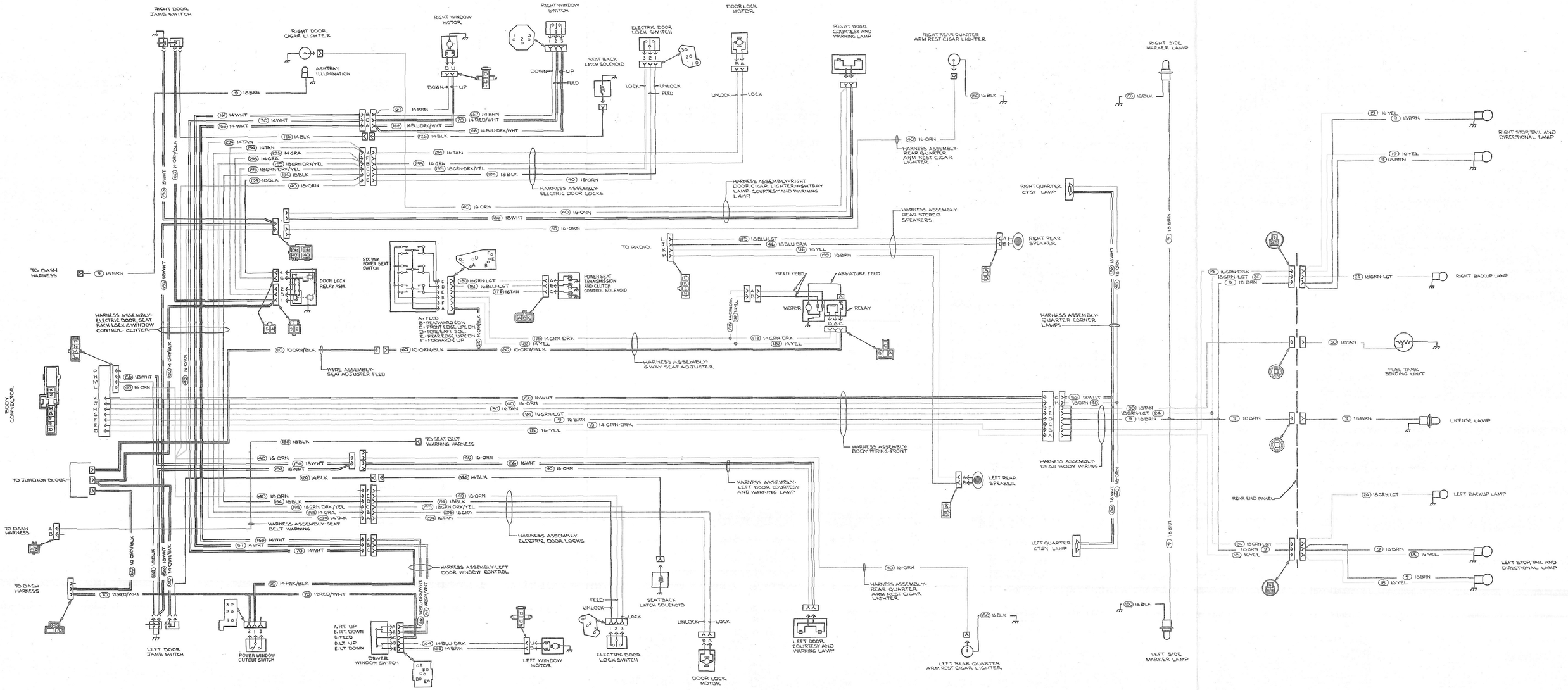


Fig. 6 1977 Cadillac Body Wiring Circuit Diagram (Eldorado)

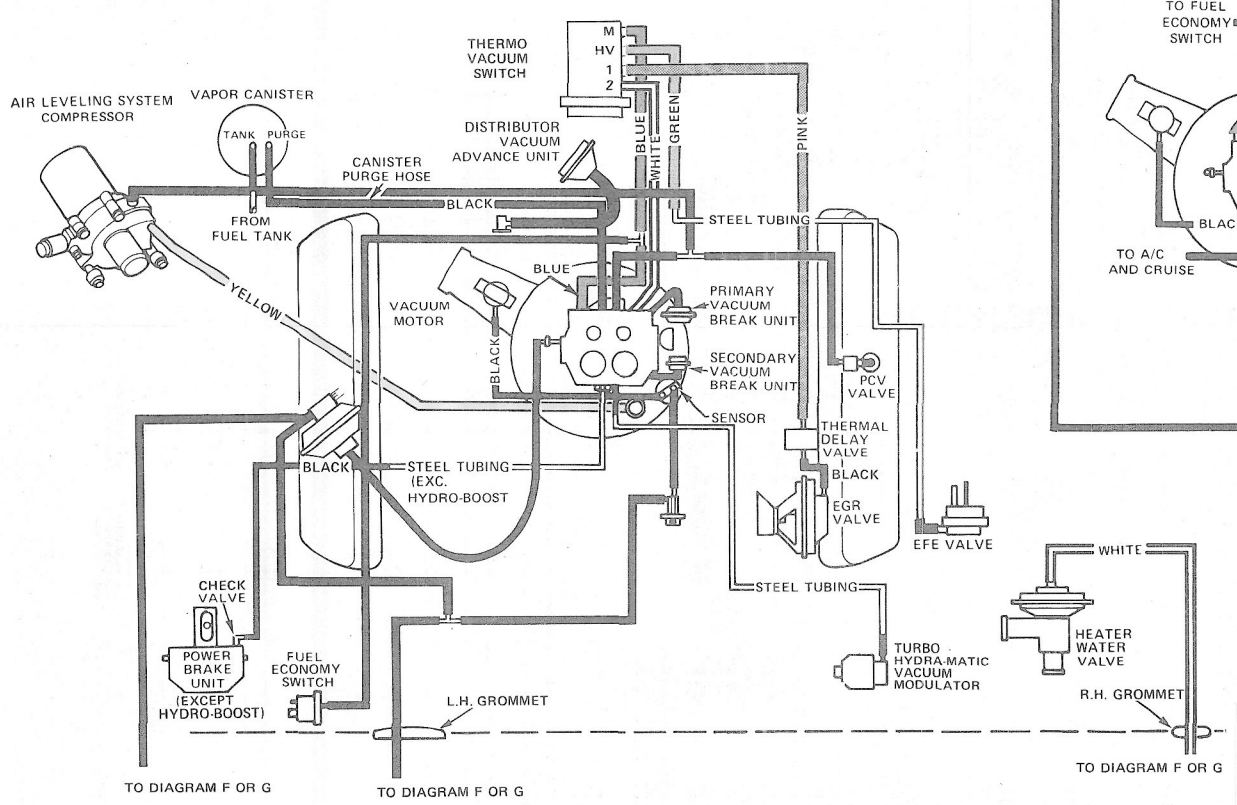
Fig. 7 1977 Cadillac Body Wiring Circuit Diagram (Seville)

1977 CADILLAC ENGINE VACUUM

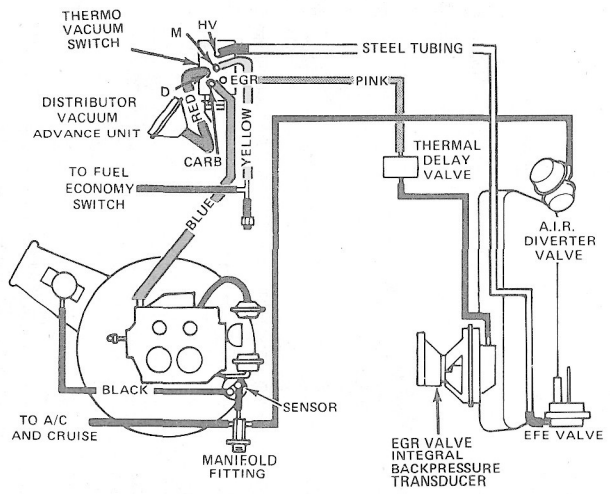
CIRCUIT DIAGRAMS
(ALL EXCEPT SEVILLE)

MATCH ENGINE DIAGRAM A, B, C, D OR E WITH BODY DIAGRAM (F OR G)

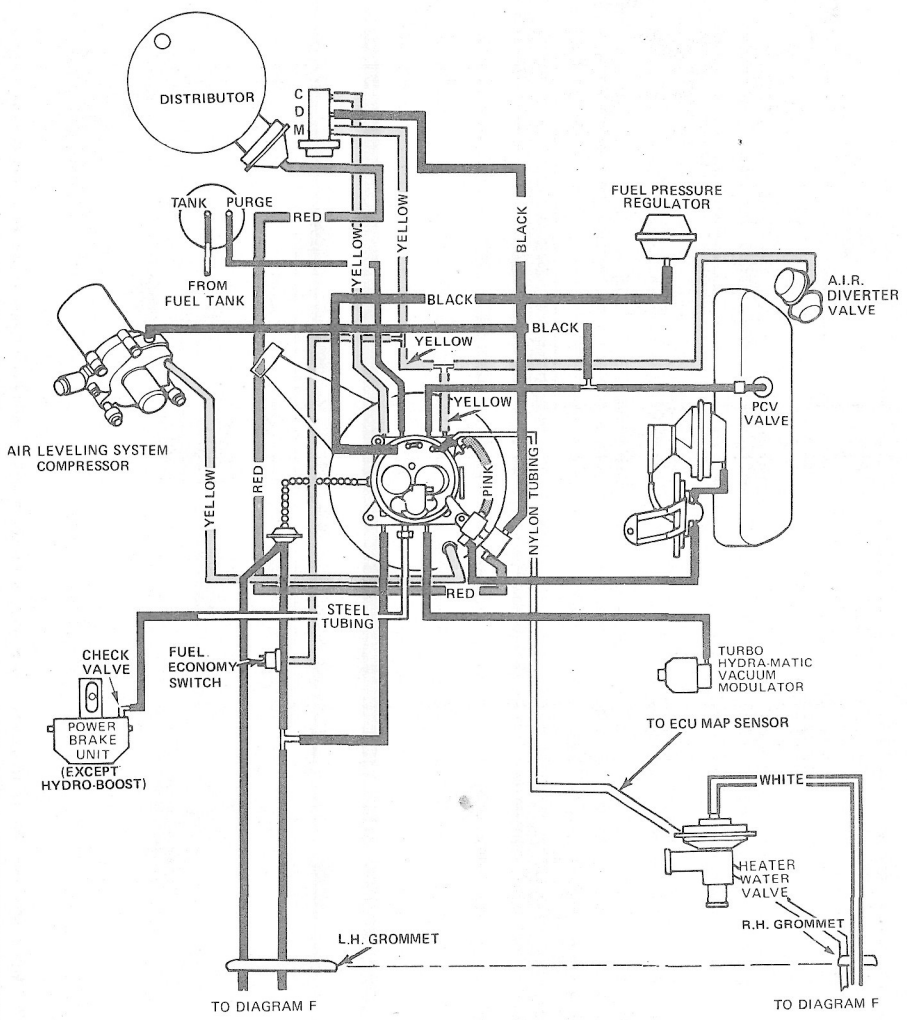
ALL EXCEPT SEVILLE, EXCEPT CALIFORNIA, WITH CARBURETOR DIAGRAM A



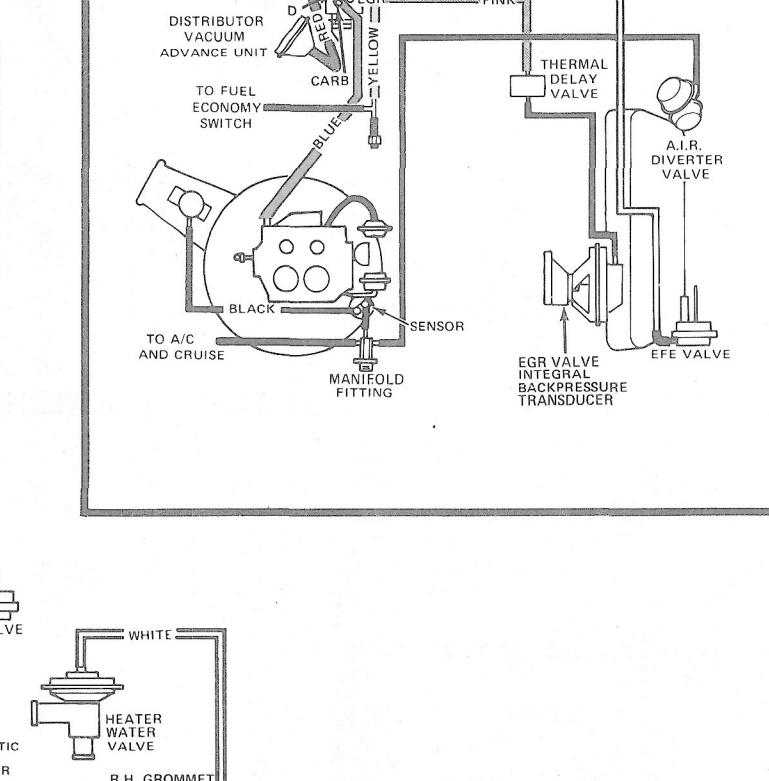
ALL EXCEPT SEVILLE, CALIFORNIA WITH CARBURETOR DIAGRAM B



ALL EXCEPT ELDORADO AND SEVILLE CALIFORNIA WITH FUEL INJECTION DIAGRAM C



ALL EXCEPT SEVILLE EXCEPT CALIFORNIA WITH FUEL INJECTION DIAGRAM D



ELDORADO CALIFORNIA WITH FUEL INJECTION DIAGRAM E

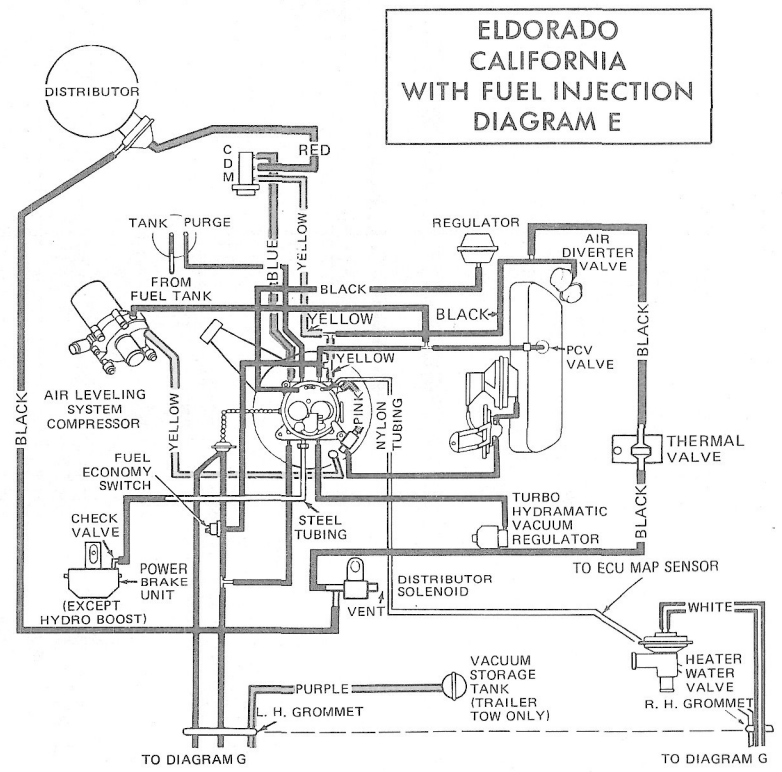
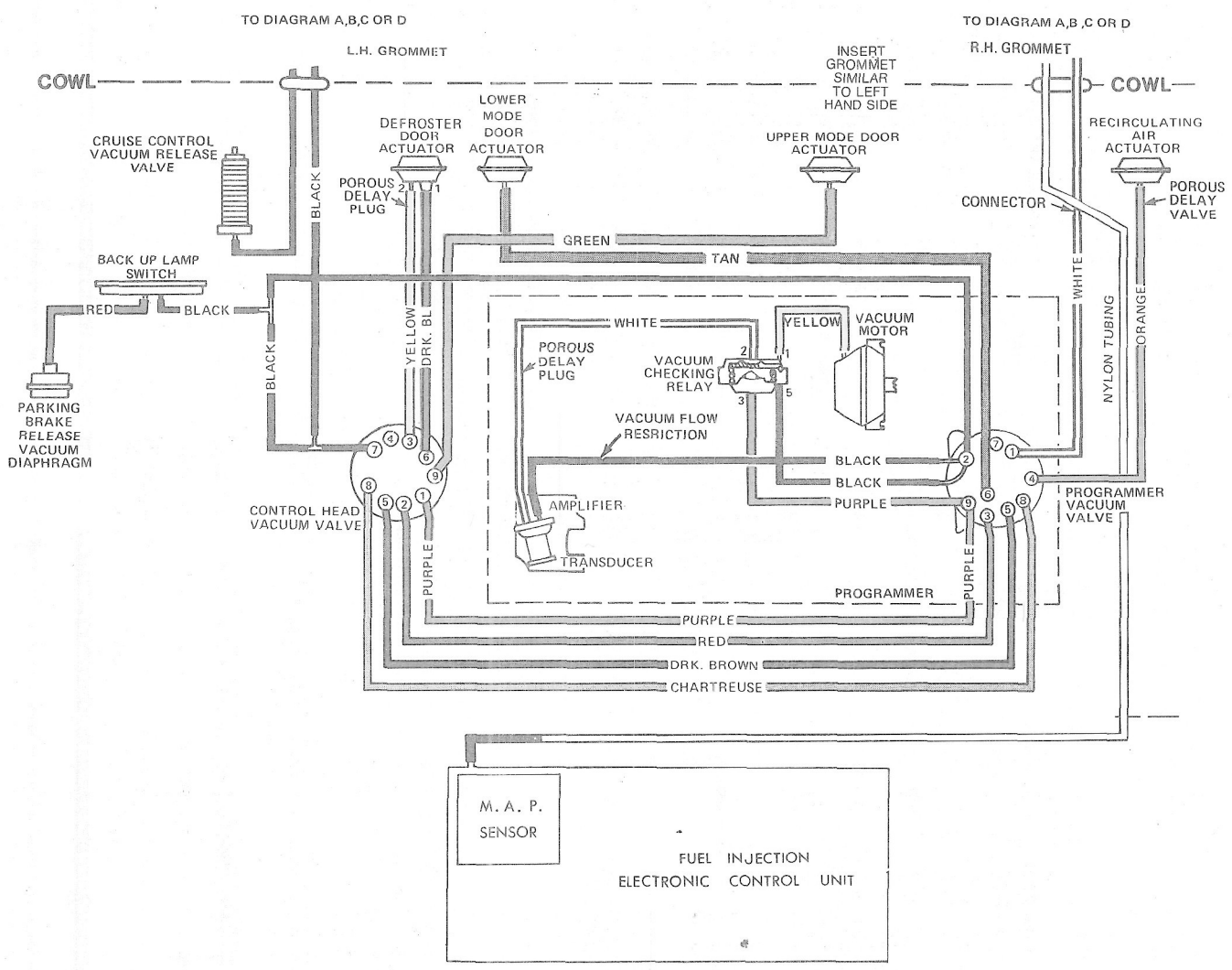
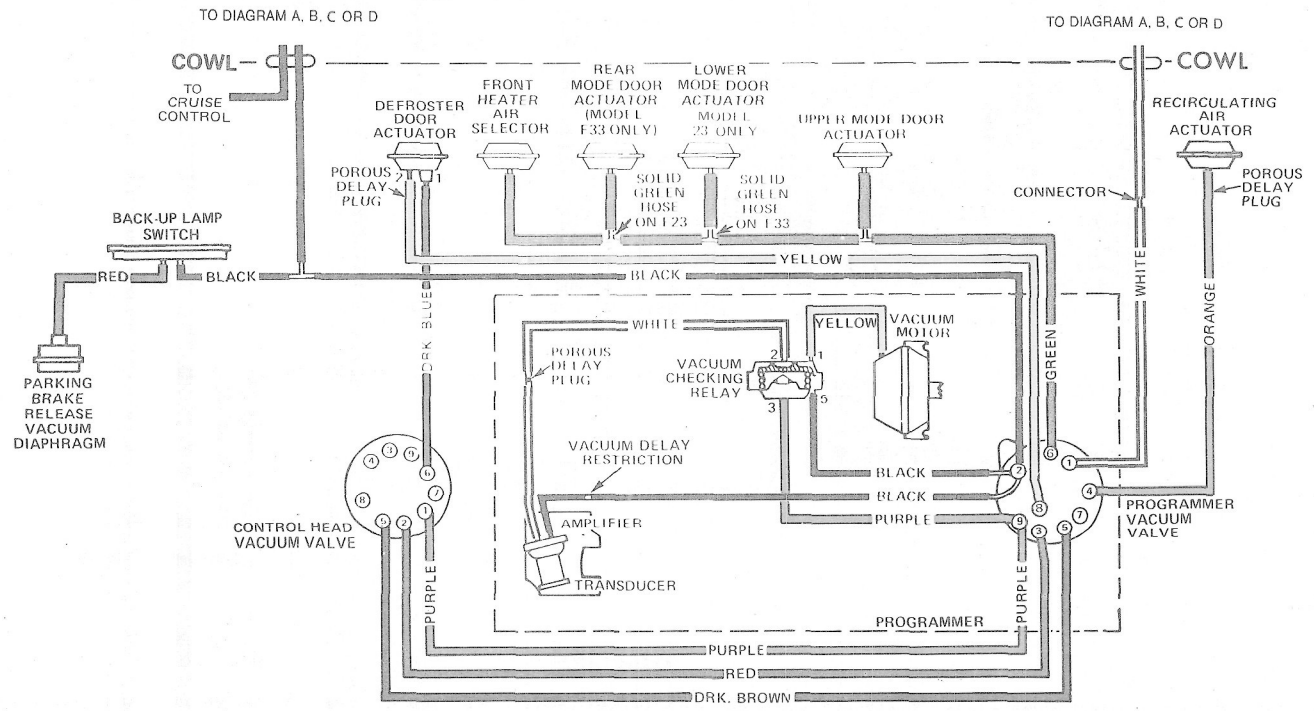


Fig. 8 1977 Cadillac Engine Vacuum Circuit Diagrams(All except Seville)

1977 BODY VACUUM CIRCUIT DIAGRAM
DEVILLE
DIAGRAM F



1977 BODY VACUUM CIRCUIT DIAGRAM
FLEETWOOD LIMOUSINE (F-23) AND FORMAL LIMOUSINE (F-33) DIAGRAM F



1977 BODY VACUUM CIRCUIT
DIAGRAM — ELDORADO
DIAGRAM G

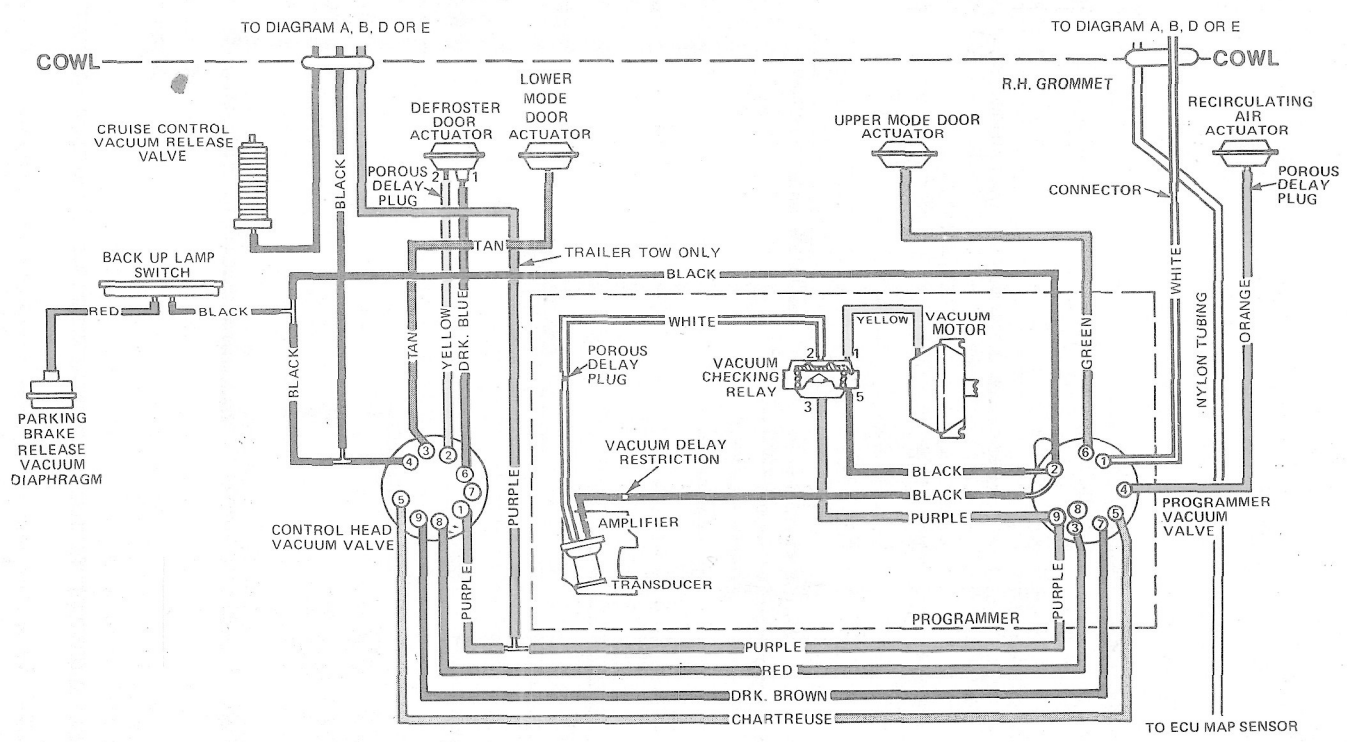
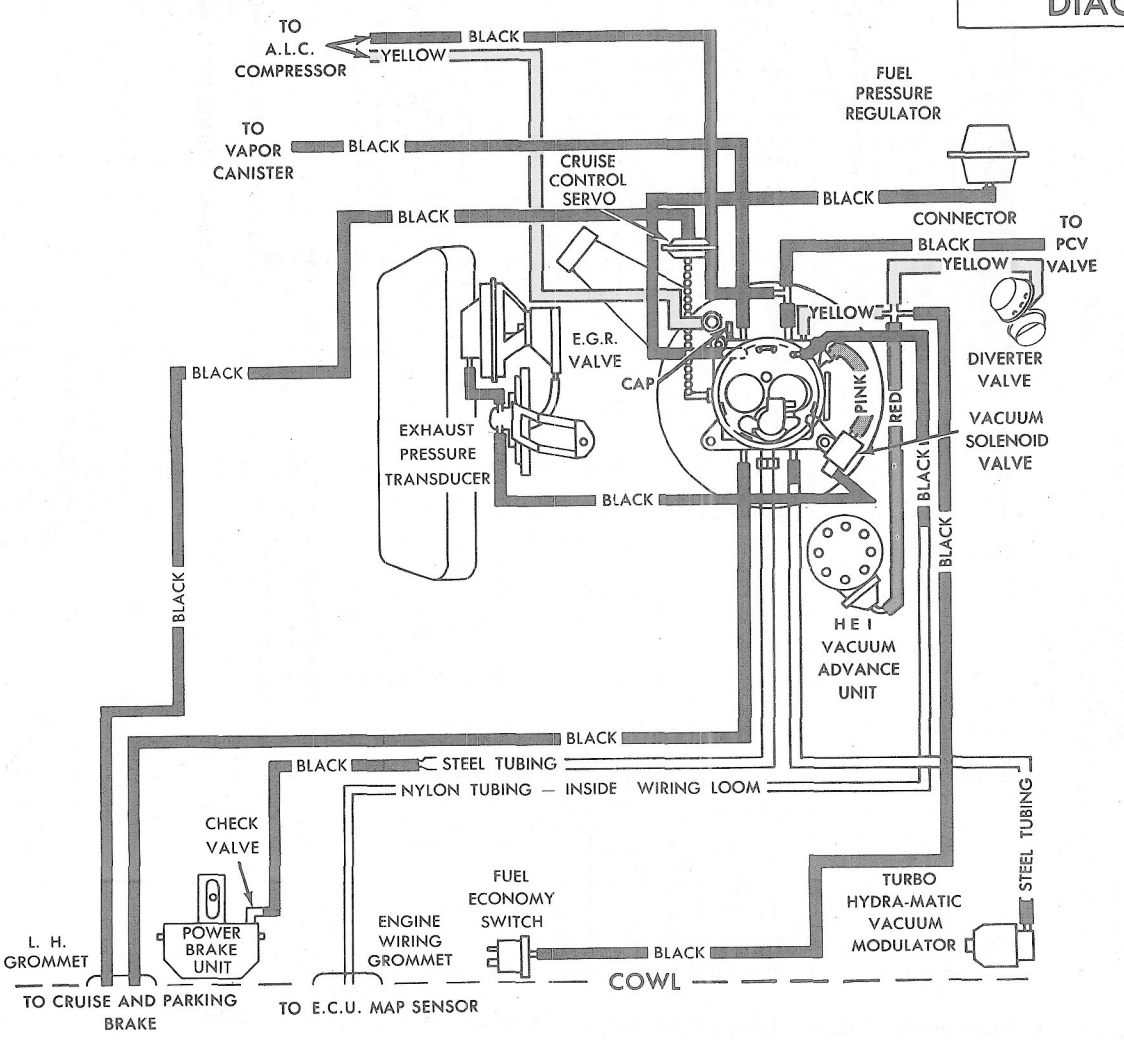


Fig. 9 1977 Cadillac Body Vacuum Circuit Diagrams (All except Seville)

1977 SEVILLE VACUUM CIRCUIT DIAGRAM

EXCEPT CALIFORNIA



CALIFORNIA

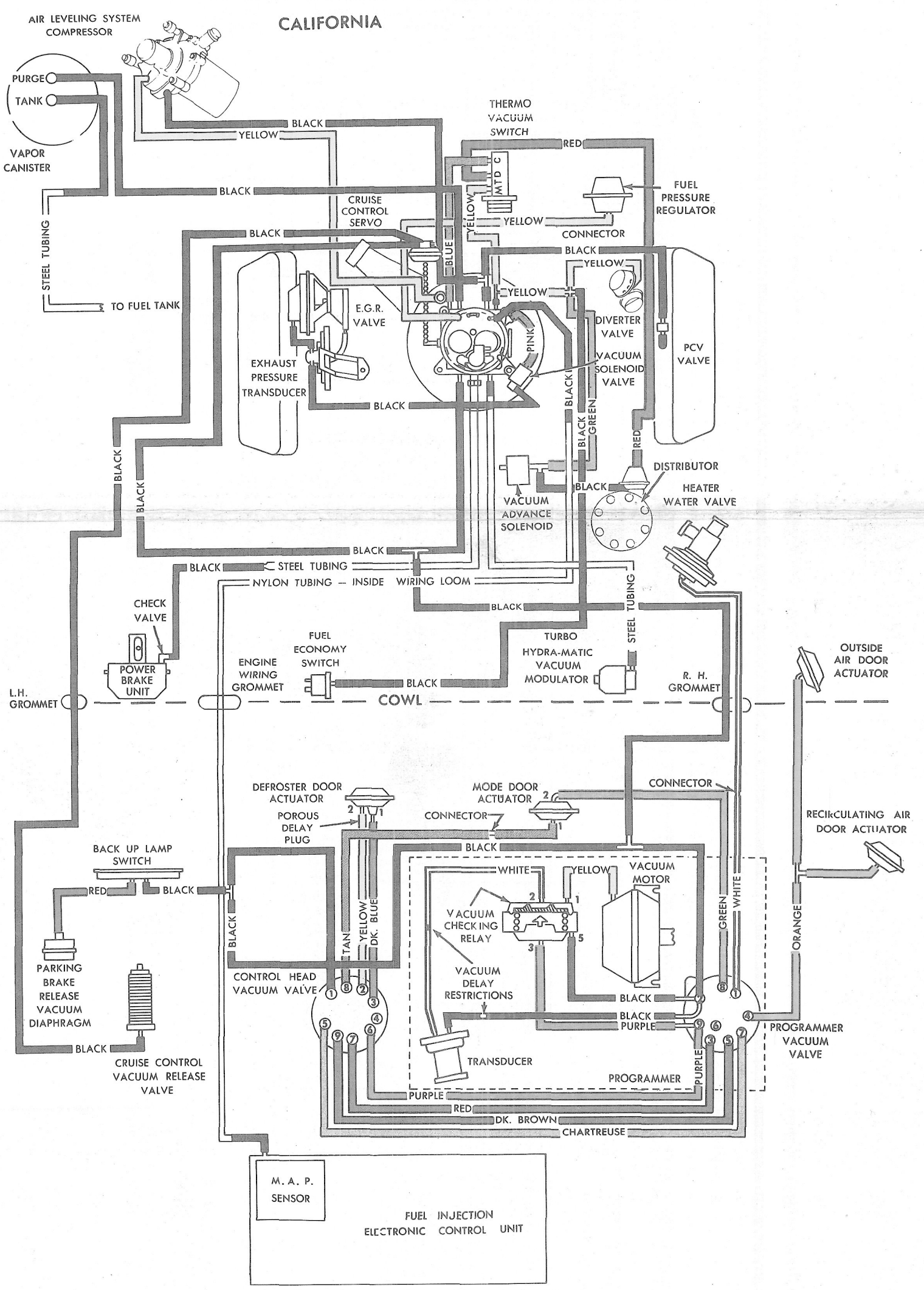


Fig. 10 1977 Cadillac Vacuum Circuit Diagram (Seville)